ANNALS

OF THE

CARNEGIE MUSEUM

Volume IV

1906–1908

W. J. HOLLAND, *Editor*

Published by the Authority of the
Board of Trustees of the Carnegie Institute

PRESS OF
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TABLE OF CONTENTS.

LIST OF PLATES.

Publications of the Carnegie Museum Serial No. 46

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Vol. IV. No. 1

December, 1906

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Editorial Notes.

The task of completing the great edifice of the new Carnegie Library and Institute at the entrance of Schenley Park is gradually nearing the end. The building is the largest structure devoted to similar uses in North America and covers a larger area than any other building of like character which has as yet been erected in the new world. The decoration of the walls and the permanent installation of apparatus for lighting and heating are rapidly going forward. In August it began to be possible for the management of the Museum to begin to transfer its contents to the various rooms which they are hereafter to occupy. A great deal had been in storage. The moving of the cases, their renovation, the cleaning and rearrangement of their contents, the orderly arrangement and classification of collections which had long been inaccessible, the mounting by the taxidermists of specimens which hitherto it had been impossible to mount for lack of room, all of these things involve an expenditure of effort which is taxing the time and strength of the working force of the Museum to the uttermost. It has been determined to formally dedicate the building upon the 11th of April, 1907. To bring the great halls and the accumulated treasures of the Museum into something like the shape which it is intended they shall ultimately have, is a task which in the limited time at the command of the working force is little less than herculean. The director of one of the leading Museums of America, upon the occasion of a recent visit to the institution expressed astonishment that such an undertaking should even be contemplated in view of the shortness of the time at command. "In order to do the work before you, it seems to me," he said, "that you ought to take at least two years." But of course that is impossible. It no doubt will be two or three years before the Museum will have assumed something like that appearance which it is designed to ultimately have. Nevertheless it is anticipated that when the formal opening occurs a very attractive and interesting beginning will have been made. The Director, whose plans are being faithfully executed by his colleagues, cannot refrain at this time from uttering a premonitory note of warning, so that the expectations of the public may not be unduly raised. When it is recalled that there are already in the custody of the Museum no less than a million and a quarter of objects each one of which has its significance, each one of which requires to be accurately determined and labeled and catalogued, and each one of which has to be assigned to a place where it may be readily found and referred to by those who may desire to consult the collections, it will be seen that the mere clerical labor involved in the undertaking is huge. In addition to this is the work of installation and display in the case of large portions of the collections, which calls for the exercise both of scientific knowledge and of artistic sense. When these facts are borne in mind it will be understood that the work assigned to the comparatively small force in the employment of the museum is such as to tax their ability to the last degree. However, as the dropping of water wears away the stone, so the persistent and faithful efforts of the gentlemen of the staff of the Museum will result in overcoming the great undertaking which is before them.

DURING the past summer it was not deemed expedient, in view of the necessities existing at the Museum, to send many members of the staff into the field for the purpose of adding to our collections. The only exception which was made was in the case of the section of paleontology, for the maintenance of which and for the special carrying on of explorations by which Mr. Carnegie himself makes an annual appropriation. Dr. Percy E. Raymond made a visit to northern New York and to Canada in quest of invertebrate fossils, in which he was entirely successful. Mr. W. H. Utterback during the greater part of the summer continued the work of uncovering and digging up fossils at the Agate Spring quarry, permission to explore which has been so kindly accorded to us by Mr. James H. Cook. He was very successful in his efforts, and one of the results has been the acquisition of a large amount of most excellent material illustrating the osteology of the genus *Moropus* and its allies. A great deal of material belonging to various genera of the extinct Rhinocerotidæ was recovered. During the month of September Mr. Utterback undertook to explore a locality known to him in the Laramie beds, which yielded some very fine material illustrative of the osteology of the Ceratopsia. He was unable to complete his work owing to the advent of winter at the high altitude at which he was laboring, but found enough to show that it is highly probable that we shall succeed in recovering an almost entire skeleton, including the skull, of *Torosaurus*, one of the huge horned reptiles of the Laramie. Messrs. Roy L. Moodie and J. W. Bartholow, acting under the instructions of Dr. S. W. Williston, succeeded in recovering for the Museum from the Hailey Shales of Wyoming a large quantity of interesting material, all of which is believed to be new to science. Upon the whole the work of the paleontological section of the Museum has been as successful as that of any previous year and will be found in the end to have resulted in a very considerable enlargement of our knowledge of the life of the past.

MR. W. E. C. TODD during the month of July made a brief excursion to Canada to the country south of Lake Abitibi, and succeeded in making some interesting observations upon the avifauna of that region and in collecting a number of desirable specimens.

THE editor of the ANNALS with sincere sorrow recalls that on July 19, 1906, Sir Walter L. Buller, the distinguished ornithologist, whose works on the birds of New Zealand are classic, ended his earthly labors. The great collection upon which he based his "Supplement to the Birds of New Zealand," which is in fact a revision of his earlier work on "The Birds of New Zealand," is the permanent property of the Carnegie Museum. A letter from his son states that on several occasions before his death Sir Walter expressed great pleasure at the thought that the collection was lodged in the Carnegie Museum, which he declared to be in his opinion "one of the finest institutions of its kind in existence."

THE skeleton of *Diplodocus carnegiei* has been mounted in the Hall of Paleontology upon bases resembling those upon which the replica was mounted at the British Museum in the spring of 1905. The attitude given the skeleton is in most respects identical with that given the replica on the other side of the Atlantic, with this difference, that the neck has been curved upward and is raised considerably higher than is the case with the facsimile in the British Museum. The mounting of the bones, which are many of them immensely heavy, involved far more mechanical difficulties than the mounting of the replica. Through the ingenuity of Mr. Arthur S. Coggeshall, the chief preparator in the Section of Paleontology, a system of cast steel supports was devised which reduces the amount of metal work exposed to view to a minimum and gives the skeleton so far as possible a very graceful appearance, while yet securing absolute rigidity and safety. The editor thinks that the mounting of this skeleton represents the most successful attempt which has yet been made anywhere in setting up so large and cumbrous as well as fragile a specimen.

MR. REMI H. SANTENS, who for eighteen years was connected with Ward's Natural Science Establishment at Rochester, New York, as a taxidermist, has entered into the service of the Carnegie Museum and is doing excellent work, for which his long experience and great ability abundantly prepare him.

MR. FREDERIC WEBSTER has mounted in very lifelike attitude a grizzly bear, two mountain sheep (*Ovis canadensis*), and a magnificent Rocky Mountain goat, recently presented to the Museum by Mr. John M. Phillips of Pittsburgh, whose adventures, in company with Mr. William T. Hornaday, are delightfully described in a volume coming from the pen of the latter gentleman and entitled "Camp Fires in the Canadian Rockies," which has just been issued by the Scribners. It is to be regretted that more of the hunters of big game in this country do not realize how much they might do to interest and instruct the general public if they would take the pains which has been taken by Mr. Phillips to preserve specimens obtained in the chase. Mr. Phillips' great kindness to the Museum is deeply appreciated, and we hope that his public-spirited example may be followed by many others of the sportsmen of the "Iron City."

THE paper upon "Early Chinese Writing" by Mr. Frank H. Chalfant, which has been published as Memoir No. 1 of Volume IV. of the memoirs, has been distributed and has elicited from those who are able to judge of its merits comments of a most favorable character. Dr. Friedrich Hirth, of the Department of Chinese in Columbia University, says in a letter to the editor: "It fills a long felt gap in literature on Chinese philological subjects, and I congratulate you for having brought out a book which will be much appreciated by the scientific world both in America and in Europe." A request has been preferred to the authorities of the Museum to supply copies of the work to a number of colleges in China. This request comes from one of the leading scholars of New York City. The editor cannot refrain from expressing some satisfaction in view of the fact that he was able in the city of Pittsburgh to make the Chinese types which were required in the composition of the work. In this task he was diligently aided by the author, who, no doubt, will in coming years, recall the long days he spent in the office of the Director of the Museum, engaged in finishing with a file the bits of metal which were used. A few years ago the production of such a work as this in Pittsburgh would have been impossible.

AN extensive and well-illustrated Memoir upon his researches on the Pacific coast of Costa Rica, by Mr. C. V. Hartman, is going through the press and will shortly appear as Memoir No. 1 of the third volume of the Memoirs. A number of plates illustrating objects of jade from Costa Rica and Mexico will be included in this work, the objects figured having been obtained by Mr. Hartman himself or having been acquired as parts of the Velasco collections purchased several years ago by the Carnegie Museum.

I. PLASTRON OF THE PROTOSTEGINÆ.

By G. R. Wieland.

In all the earlier discovered skeletons of the huge Cretaceous turtles included in the Protosteginæ, the hyoplastra were found in normal position in contact with the peculiar T-shaped entoplastron characterizing this subfamily; while elements definitely referable to the epiplastra were singularly absent. This condition having repeated itself at widely separated localities, and in two genera as represented by fully six specimens approaching completeness, I was led to suppose after the discovery of a median nuchal-like bone in *Archelon* that the T-shaped entoplastron might represent a fusion of the epiplastra with the entoplastron. This idea of fusion was beset by certain doubts at the time it was discussed in my description of the plastron of the type specimen of *Archelon*, and has proven incorrect. Dr. E. C. Case and Dr. O. P. Hay also held unpublished odinions on the subject, the one being inclined to accept, the other disagreeing with the idea of a supposable fusion of the anterior plastral elements; although both had mistakenly identified the T-shaped entoplastron as the nuchal of *Protostega*. However, as presenting one more example of the exigencies attending the uncovering of the fossil record, in spite of the various specimens known and the fact that the question of plastral structure in the Protosteginæ had thus become an open one, no direct evidence was obtained until two years ago. Then I secured on the west bank of the Cheyenne River where it breaks through the Oligocene Bad Lands of South Dakota, the greater part of a large *Archelon* skeleton including along with the hyo-, hypo-, and xiphiplastra a single epiplastron. This proves of quite unexpected interest, because it is of the out-turned type seen in the Trionychids and

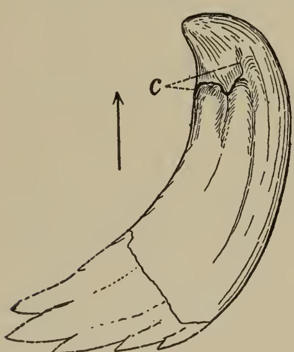


Fig. 1. *Achelon ischyror* Wieland. Left epiplastron. Inner (superior) view. × $\frac{1}{6}$. *c*, anterior limit of entoplastral overlap. Compare with epiplastra of *Aspidonectes*, etc., in figures 2 and 3.

Dermochelys amongst existing, and amongst extinct forms, only in the several genera of the Thalassemydidæ of the European Jurassic and Cretaceous, together with *Protosphargis* of the scaly clays of Italy.

The epiplastron of *Archelon* as represented in superior view in Fig. 1 is of subcrescentic outline with the anterior limb heavy, and the posterior broadened, flattened, and digitate. The thickness of the heavy anterior end is 4.5 centimeters, and an accompanying humerus is exactly 2 feet in length.

As in the Trionychydæ there is no true sutural union with the entoplastron, the contour showing that the superior face of the epiplastron was overlain by the antero-external border of the entoplastron. Beyond this border the anterior limb of the epiplastron projected about 7 cm. like a broad, short, heavy horn, with its convex side ental. Four

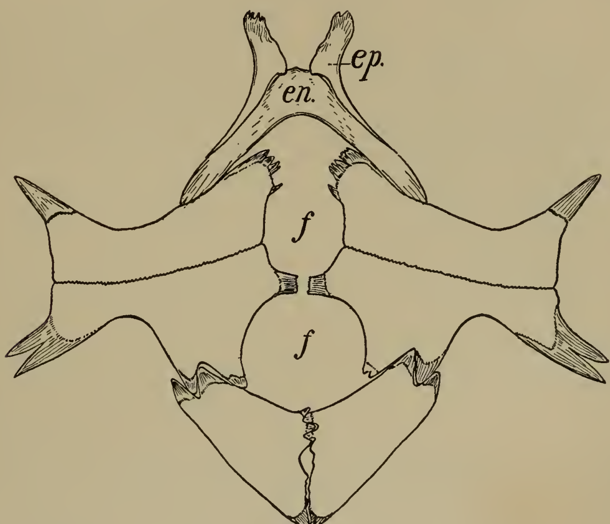


FIG. 2. *Aspidonectes spinifer*. Nether (ectal) view of plastron. × $\frac{1}{3}$. *ep*, epiplastron; *en*, entoplastron; *f*, *f*, anterior and mesial foramina. (*Cf.* epiplastron of *Archelon* and *Dermochelys*, also of Thalassemydidæ.)

broad, shallow furrows increasing in depth from the inner to the outer side, mark the contact of as many overlying digitations or ridges which may all have been entoplastral, rather than in part hyoplastral. This lack of sutural union and the boomerang-like shape of the epiplastron show how it must have been the very first bone to be torn out by predaceous fishes and sharks, or by wave action, after the turtle went down, and thus explain the rarity of its recovery and why the explorations of thirty years have hitherto failed to reveal so interesting a skeletal part.

Inasmuch as the adequate mounting and preparation for description of the original type of *Archelon ischyros* has now been begun at the Yale Museum, there is no present need to attempt further plastral restoration of this largest of sea turtles. Meanwhile, however, a very good idea of the plastral form may be had by comparison, in combination, of the writer's figure of the ento-, hyo-, hypo-, and xiphiplastra of *Archelon* with the figure of the Jurassic Thalassemyd *Hydropelta Meyeri* given on page 530 of Vol. III. of Zittel's Handbuch. The manner in which the epiplastra of *Archelon* projected anteriorly is quite closely paralleled in *Hydropelta*, except that in the former it appears that there was no epiplastral abutting on the median line, and that the entoplastron is relatively larger.

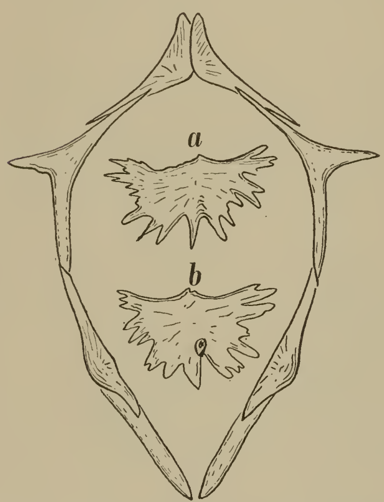


FIG. 3. *Dermochelys coriacea.* Plastron with (*a*) ectal and (*b*) ental view of nuchal. After Gervais (*cf.* out-turned epiplastra with those of *Archelon*, etc., in subjoined figures).

The present determination for the first time of the true type of plastron in the Protosteginæ is of far more than casual interest because of the obvious bearing on the most vexed of zoöpaleontological problems, the origin of *Dermochelys*, as well as on the highly interesting question of the mono- and polyphyly of the other existing and the various extinct genera of marine turtles.

The testudinate plastron while undergoing characteristic variations of form within closed groups is fully as conservative a structure as the carapace. Also, since in *Dermochelys* the plastron and nuchal are the only parts left for comparison with the normally developed carapace and plastron of other Testudinates, the paleontologic record has been scanned year after year for true marine turtles with a more or less reduced carapace and similar plastral type, which might stand in an ancestral or approximately ancestral relationship. Nevertheless, *Dermochelys* has retained its isolated position ; fossil evidence bearing directly on its origin has been singularly lacking, in fact going scarcely further than to indicate that *Psephophorus* of the Belgian Pliocene may have marked the culmination in size of the Dermochelydidæ. For a time, however, after Cope's description of *Protostega* in 1875 this genus, as very imperfectly known, was supposed to largely bridge the gap between *Dermochelys* and the other marine turtles, mainly on the ground of its considerable carapacial and its doubtless complete horn-shield reduction. The discovery, in much better preservation, of the closely related *Archelon*, as well as the study of better specimens of *Protostega*, however, developed the presence of far closer relationship to the Cheloniidæ than was at first suspected, the writer finally being led to include these forms in a Chelonidan subfamily, this doubtless being their correct morphologic rather than their exact phyletic position.

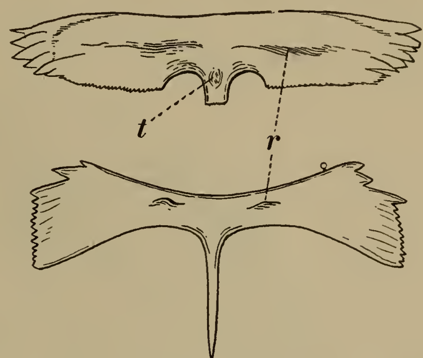


FIG. 4. Ental view of nuchal, of (*a*) *Aspidonectes spinifer* ($\times \frac{1}{2}$), and (*b*) the entoplastron of *Archelon ischyros* ($\times \frac{1}{20}$). *t*, small nether tubercular process articulating with neural arch of cervical vertebra; *r*, a lateral ridge for muscular attachment. Entoplastral and nuchal similarity are correlated in these forms.

Nevertheless it now becomes possible to coördinate several hitherto isolated facts. If we regard *Dermochelys* as the most specialized Testudinate, and the *osteodermal* mosaic as a secondary structure, the plastron has been more persistent than the carapace, only the entoplastron having been lost by reduction, whereas the nuchal is the sole remaining carapacial element. The Protosteginæ also, though structurally speaking members of the Cheloniidæ, are now seen to have with their much reduced carapace the same highly characteristic epiplastral type as *Dermochelys*, as well as other minor resemblances which need not now be enumerated. The same is true of the Thalassemydidæ of the European Jurassic and Cretaceous, as represented by various genera, for the greater part but imperfectly known. Moreover these Thalassemyds compose the group, which has been considered to stand most nearly in an ancestral relationship to the existing marine turtles, previous to my demonstration of the structure of the Propleurinæ of the New Jersey Cretaceous, and proof that this primitive littoral subfamily includes the forms which virtually bridge the gap between primitive land tortoises and the existing genera of the Cheloninæ. On the other hand it is to be emphasized that several other

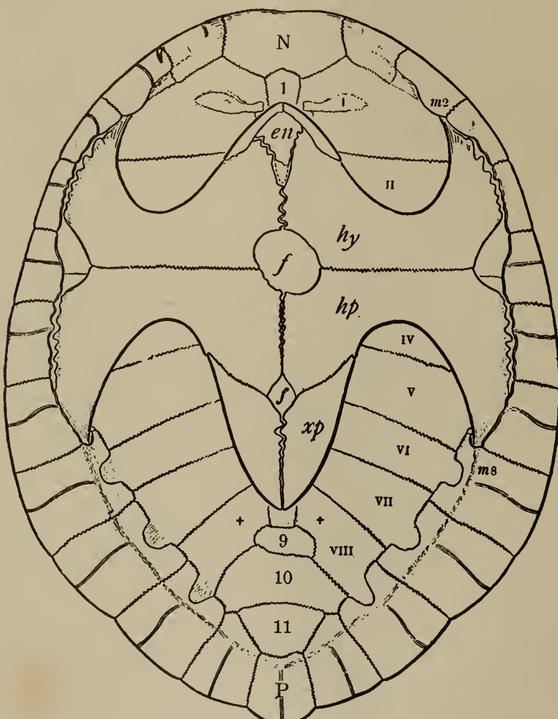


FIG. 5. *Osteopygis gibbi* Wieland, × ⅛. Plastral view. Primitive semi-marine turtle from the New Jersey Cretaceous, showing the elongate and in-turned epiplastra characteristic of the Cheloniidæ. The horn shields are not indicated, but are in approximate agreement with *Thalassochelys*.

Cretaceous subfamilies besides the Protosteginæ are so different from the New Jersey forms, that their ancestry must still be sought for amongst the Thalassemyds. Such are in particular the Desmatochelydinæ. It is hence more and more strongly suggested, as the

facts accumulate, that the flippered turtles represent a great complex of forms which have arisen through repeated invasion of the sea in Mesozoic time, it being indeed not improbable that most of the groups most conveniently grouped as marine subfamilies have thus independently arisen from more or less nearly related genera of land tortoises. The tracing of such independent lines is, however, doubtless rendered difficult, as much by subsequent homoplastic adaptations, as by the imperfections of the record as known. But while we are not yet in a position to absolutely prove such a polyphyly of the Cheloniidæ, the general facts in the case of the Protosteginæ, their various ear marks suggesting a certain relationship to *Dermochelys* by way of the Thalassemyds, together with culmination in the Cretaceous, assuredly suggest independent origin from forms other than the New Jersey Propleurinæ as so closely related to the Cheloninæ.

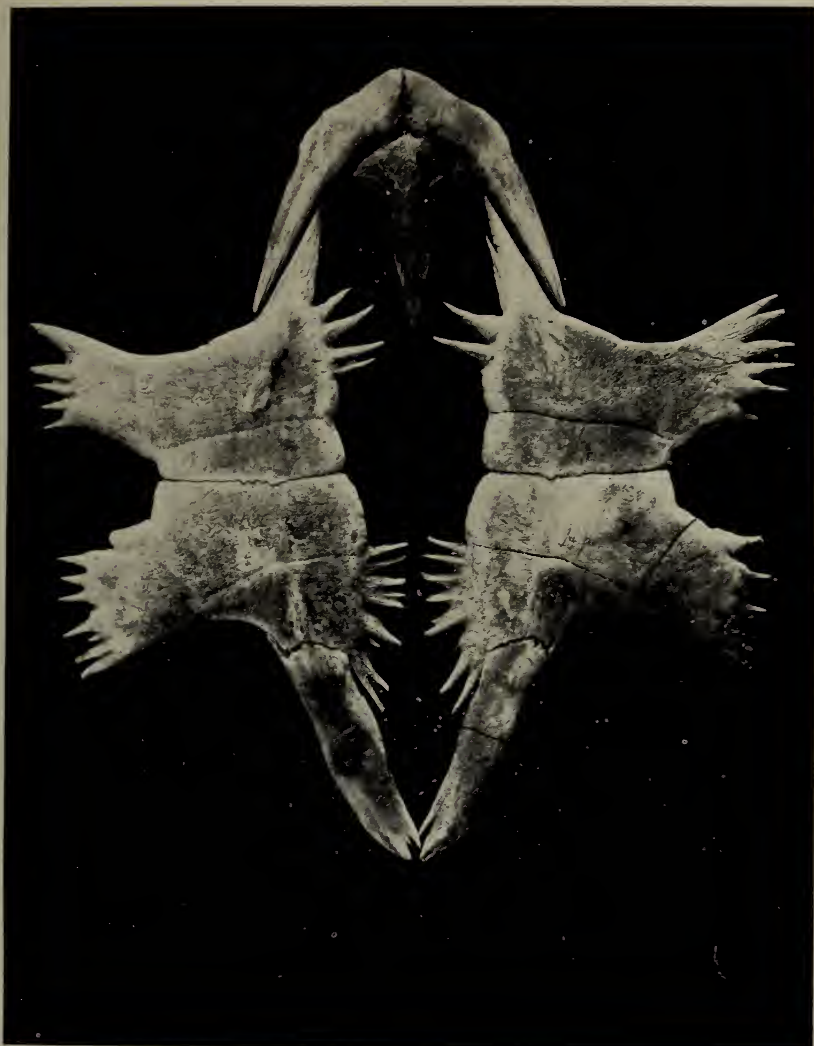
The hypothesis is therefore advanced, in conclusion, that: (*a*) The marine turtles are distinctly polyphyletic; that is, various more or less distantly related tortoises have from the Jurassic on repeatedly assumed littoral habits, and developed flippers. (*b*) Five of these distinct lines of marine turtles are exemplified by (1) *Dermochelys*, (2) the Protosteginæ, (3) the Desmatochelydinæ, (4) the Cheloninæ, (5) *Carettochelys insculpta*, the Fly River Turtle of New Guinea, a flippered pleurodiran with complete reduction of the horn shields. (*c*) The Ancestry of *Dermochelys* and the Protosteginæ falls within the Thalassemyds, or Acichelydidæ, and the plastron and nuchal also suggest certain affinities between the latter and some ancient form near to the original Trionychid line.

As correlative to this hypothesis I may add, though somewhat in repetition, that however one may split hairs about the meager evidence as to the nature of the mutations which have resulted in the osteodermal mosaic of *Dermochelys*, the safe and simple working view is to my mind that his plastron is a turtle plastron, his nuchal a true nuchal, all his other organization likewise testudinate and impossible of homoplastic origin, and that his ancestors were simply more ancient than those of the Cheloninæ, but withal typical tortoises, quite probably falling, as above suggested, within the Thalassemydidæ, and probably without an osteodermal mosaic. The epineural ossicles of *Toxochelys*, and the epimarginals of *Lytoloma*, show well that an osteodermal series corresponding to the hornshield system was once far more conspicuous in the turtles than now; and the keels of *Dermochelys* are in exact correspondence to such a series.

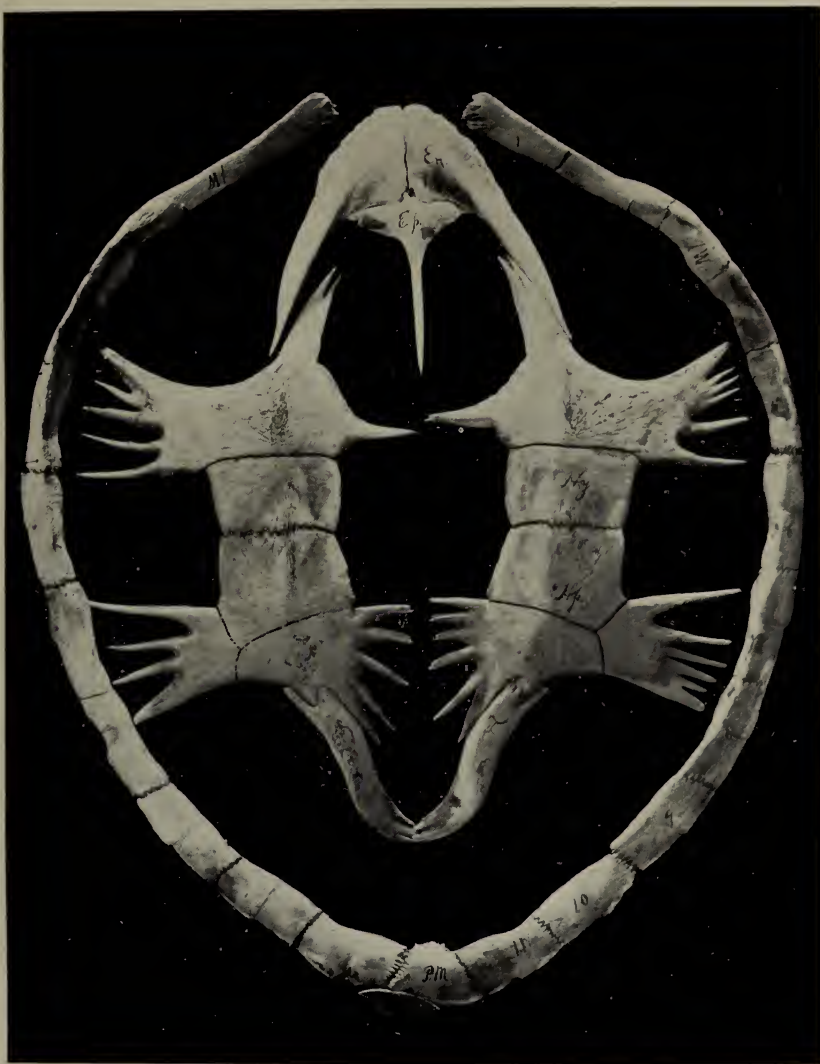
EXPLANATION OF PLATES.

Plate I. *Thalassochelys caretta*, Delaware Bay. Ectal view of plastron. $\times \frac{1}{2}$. Plastral type of the Cheloniidæ, except the Protosteginæ, with narrow in-turned epiplastra. The ventral horn-shield, or that imbricating over the hyo-hypoplastral junction, is the only one likely to be clearly indicated in fossil plastra of this type.

Plate II. *Chelone mydas* (var. or sp. nov.). Southern Atlantic coast of the United States. Plastron with marginals (less nuchal) placed in natural position very nearly. More reduced than the preceding.



Ectal View of Plastron of *Thalassochelys caretta*, $\frac{1}{2}$.



Chelone Mydas, less than ½.

II. DESCRIPTIONS OF NEW SPECIES OF TURTLES OF THE GENUS TESTUDO, COLLECTED FROM THE MIOCENE BY THE CARNEGIE MUSEUM; TOGETHER WITH A DESCRIPTION OF THE SKULL OF STYLEMYS NEBRASCENSIS.

By Oliver P. Hay.

(Plates III–VIII.)

Through the kindness of the Director of the Carnegie Museum, Dr. W. J. Holland, the writer has been permitted to study and describe in these pages six turtles, which have been collected by parties sent out from the Museum in recent years. The drawings and the photographs illustrating these species have been furnished by the Museum.

Testudo peragrans, sp. nov.

This species has as its type No. 1101 of the Carnegie Museum. It was collected in 1903, by Mr. Earl Douglass, at a point south of McCarty's mountain and Big Hole River, and north of Dillon, Montana. The deposits are supposed to belong to the Lower Miocene, but they may be a part of the Upper Oligocene.

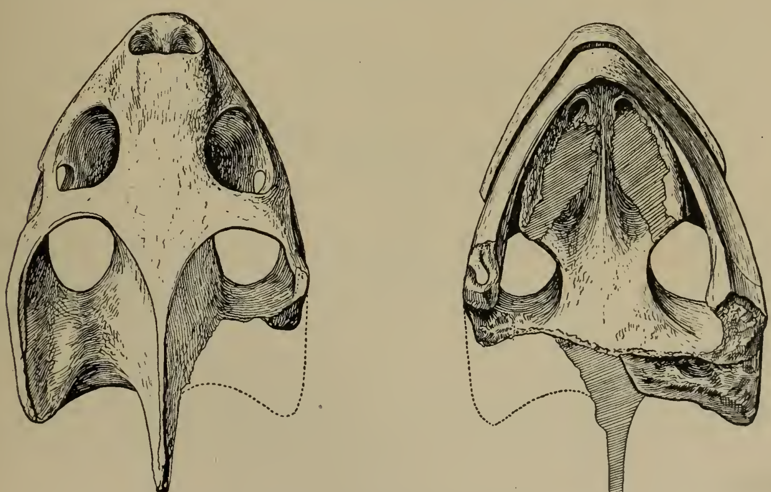


Fig. 1. Superior view of skull of *Testudo peragrans*. $\frac{1}{1}$.
Fig. 2. Inferior view of the skull of *Testudo peragrans*. $\frac{1}{1}$.

The specimen furnishes the carapace and plastron, both somewhat damaged, and the nearly complete skull. On account of the close application of the lower jaw to the skull, the character of the triturating surfaces of the upper jaw cannot be determined. There is, however, no reason for supposing that the species is not a *Testudo.*

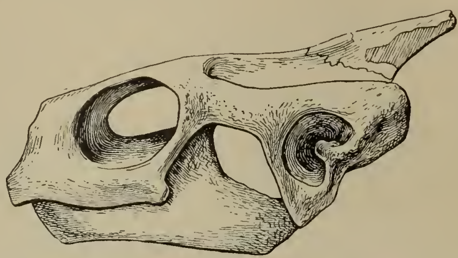


FIG. 3. View of the left side of the skull of *Testudo peragrans.* $\frac{1}{1}$.

The length of the skull (Figs. 1–3) from the snout to the occipital condyle, was very close to 53 mm. The width across the auditory chambers is 40 mm. The width of the interorbital space is 12 mm. The orbits are nearly circular, with a diameter of 15 mm.

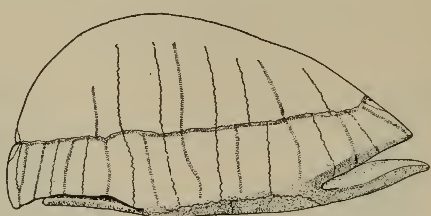


FIG. 4. Lateral view of shell of *Testudo peragrans.* $\frac{1}{6}$.

The shell (Figs. 4, 5) is damaged so that little can be determined regarding the neurals and the vertebral scutes. The general form of the shell is well preserved. The carapace is 320 mm. long and 280 mm. wide.

The plastron has a prominent epiplastral lip. This projects 30 mm. in front of the gulo-humeral sulci. It greatest thickness is 26 mm.

TESTUDO ARENIVAGA, sp. nov.

This species is based on fragments of a large turtle which has the catalogue number 1509 of the Carnegie Museum. The remains were found by a collecting party from the Museum in 1905, about two miles north of Agate Springs quarry, in Sioux county, Nebraska. The deposits belong to the Lower Miocene. The pygal and the eleventh peripheral are selected for description.

The pygal (Figs. 6, 7) has an extreme height of 112 mm. The width of the upper border is 102 mm; that of the free border, 58 mm. The upper border is notched for the supra-pygal. The thickness of the border which articulated with the eleventh peripheral is 30 mm. The upper, or hinder, surface of the bone is convex in all directions. The free border is acute.

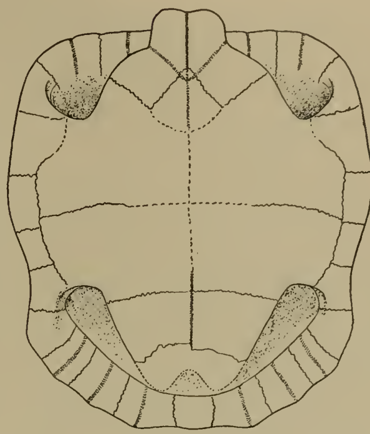


FIG. 5. Inferior view of shell of *Testudo peragrans*. $\frac{1}{6}$.

The eleventh peripheral (Figs. 6, 8) is 45 mm. wide above; 87 mm. wide below. The height is 98 mm. The outer surface is nearly plane next the pygal, strongly concave next the tenth peripheral. The greatest thickness is 31 mm.

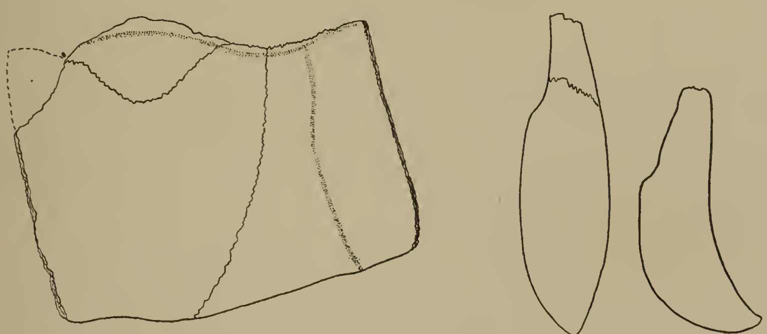


FIG. 6. FIG. 7. FIG. 8.

FIG. 6. Upper side of pygal and eleventh peripheral of *Testudo arenivaga*. $\frac{1}{3}$.
FIG. 7. Section along midline of pygal of *Testudo arenivaga*.
FIG. 8. Section of anterior end of eleventh peripheral of *Testudo arenivaga*.

TESTUDO INUSITATA, sp. nov.

(PLATES III–IV.)

This name is applied to a specimen which was collected by Mr. Earl Douglass, near Canyon Ferry, Broadwater County, Montana. The horizon is regarded as being that of the Deep River, a portion of the Middle Miocene. The number of the type is 311 of the Carnegie Museum.

The length of the carapace is 265 mm.; the width, 200 mm. A peculiarity of the species is found in the forms of the neurals. The first is, as usual in *Testudo*, four-sided. Usually in species of this genus one or more of the neurals behind the first is four-sided and one or more eight-sided. In the present species all behind the first are six-sided.

The vertebral scutes are about one half wider than long. Their sides are not strongly angulated.

The epiplastral lip is 25 mm. long and 58 mm. wide at the base. The hinder lobe is notched, as usual in the genus. The gular scutes extend backward on the entoplastron. The pectoral scutes meet along the midline a distance of 15 mm. Their outer ends are greatly expanded.

TESTUDO HOLLANDI, sp. nov.

(PLATES V–VI.)

The catalogue number of the type of this fine species is 1561 of the Carnegie Museum. The specimen was discovered by Mr. O. A. Peterson in the upper beds of the Loup Fork, near Running Water, Sioux county, Nebraska. The shell alone is preserved, and this is considerably crushed downward.

The carapace has a length of 305 mm. and a width of 280 mm.

The first neural is oval; the second and the fourth, octagonal; the third and the fifth, tetragonal. The proximal ends of the second and the fourth costals are narrow, the distal ends very wide; while the proximal ends of the third and the fifth are wide, the distal ends narrow.

The plastron is 325 mm. long, being thus longer than the carapace. The epiplastral lip projects 28 mm. beyond the gulo-humeral sulci and is 70 mm. wide at its base. Its greatest thickness is at a point 45 mm. behind the anterior border. The entoplastron is 61 mm. ong and 58 mm. wide.

The first vertebral scute is considerably narrower than the others. The lateral borders of the second and the third are angulated. The pectoral scutes occupy 24 mm. of the midline.

No. 1570 of the Carnegie Museum is likewise referred to this species. It was collected by Mr. Douglass at Cold Spring, Montana, in what are regarded as Loup Fork beds.

This species is dedicated to Dr. W. J. Holland, Director of the Carnegie Museum.

TESTUDO EDÆ, sp. nov.

(PLATES VII–VIII.)

The single specimen which forms the type of this species was collected by Mr. O. A. Peterson, in Loup Fork deposits, at Running Water, Sioux county, Nebraska. The specimen consists of the carapace and the plastron, from both of which a portion of the right side is missing. The catalogue number of the specimen is 1535.

The shell appears to have been originally somewhat depressed, but this depression has been exaggerated during fossilization. The length of the carapace is 450 mm. The width was 380 mm. The areas of the second and the third vertebral scutes are somewhat concave. On the area of the first there is a low and elongated boss. The lower border of the pygal is somewhat drawn in. There are in this individual only seven neurals. The first and the third are four-sided; the second and the fourth, eight-sided; the others, six-sided. Most of the costal plates behind the first are wedge-shaped, the narrow ends of the second, fourth, and sixth being directed upward; the narrow ends of the third and the fifth, downward.

The first and the fourth vertebral scutes are narrower than the others.

The plastron lacks but 5 mm. of being as long as the carapace. The epiplastral lip is 55 mm. long and 90 mm. wide at the base. Its inferior surface curves upward like a sleighrunner. The pectoral scutes occupy 25 mm. of the midline.

This species is named in honor of Mrs. Eda Peterson, of Pittsburgh.

STYLEMYS NEBRASCENSIS Leidy.

Notwithstanding the fact that hundreds, perhaps thousands, of shells of *Stylemys nebrascensis* have been collected in the badlands of South Dakota, Nebraska, and Colorado, no skull of the species has hitherto been found in connection with parts of the shell. In Princeton University there is a portion of a skull, and there is said to be a skull in the collection made by Dr. Baur for the University of Chicago; but with neither of these skulls was there any of the shell. The importance of the presence of the shell will be realized when it is remembered that the species was based on the shell and that there are a few species of the closely related genus *Testudo* in the same formation.

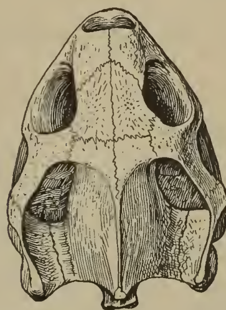


FIG. 9. Superior view of skull of *Stylemys nebrascensis* Leidy. $\frac{1}{1}$.
FIG. 10. Inferior view of skull *Stylemys nebrascensis* Leidy. $\frac{1}{1}$.

From the parts of the shell and limb bones the writer has been convinced that *Stylemys* belonged, without doubt, near *Testudo* and that it was at the same time a distinct genus. What is now known about the skull confirms these conclusions.

The length of the skull discovered by Mr. Douglass is 38 mm.; the width at the quadrates, 30 mm. The interorbital space is 10.5 mm. wide. The antero-posterior diameter of the orbit is 11 mm.; the vertical, 9 mm. The pterygoid region where narrowest is 10 mm. wide. The palate is deeply excavated and a low ridge runs along its middle line. The lower jaw remains in its natural position and hides the crushing surfaces of the upper jaw. The symphysis is short.

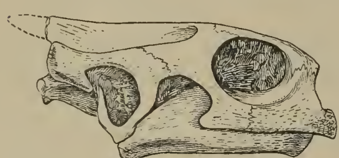


FIG. 11. View of right side of skull of *Stylemys nebrascensis* Leidy. $\frac{1}{1}$.

As seen from the figures (Figs. 9–11), this skull corresponds in all essentials with that of *Testudo*. It is identical, too, with the skull preserved at Princeton, which displays the crushing surfaces of the upper jaws. These present the same arrangement that we find in the living genus *Gopherus* (*Xerobates*, Agass.), there being especially a longitudinal ridge at the symphysis of the premaxillæ. On examining closely the Pittsburgh specimen this ridge is seen to be present.

Superior View of Shell of *Testudo inusitata* Hay, $\frac{45}{100}$.

Inferior View of Shell of *Testudo inusitata* Hay, $\frac{45}{100}$.

Superior View of Shell of *Testudo hollandi* Hay, $\frac{2}{5}$.

Inferior View of Shell of *Testudo hollandi* Hay, $\frac{2}{5}$

Superior View of Shell of *Testudo Edæ* Hay, $\frac{3}{10}$.

Inferior View of Shell of *Testudo Edæ* Hay, $\frac{3}{10}$.

III. THE MIOCENE BEDS OF WESTERN NEBRASKA AND EASTERN WYOMING AND THEIR VERTEBRATE FAUNÆ.[1]

By O. A. Peterson.

During the summers of the years 1900–1906 expeditions from the Carnegie Museum have been regularly employed each year in collecting fossils in the Tertiary deposits of northwestern Nebraska and eastern Wyoming. Much material has been accumulated, and the collections made contain many species new to science. In view of the general interest at the present time in regard to the geological position of the sediments which overlie the Oligocene of this region it has occurred to the writer that an illustration representing an ideal section showing the formations in proper succession, accompanied by a list of the vertebrates obtained in each, would be of assistance to the student of paleontology. A short preliminary description of new species and additional notes on some forms hitherto little known will follow each list. Statements and observations made in this paper are based almost exclusively upon the collections belonging to the Carnegie Museum, as they were made either directly by the writer or with complete knowledge by him of the geological horizons in which the individual specimens were found. A much more extended list might have been given by adding genera and species which have been collected and described by others from time to time, but as the correct geological position of these might, in some cases, be somewhat in doubt, it has been thought best in the present paper to mainly employ data which have been obtained at first hand.

Since the early Government surveys under Dr. F. V. Hayden, different writers have, from time to time, written upon the lithological and geological characters of this region, and they will in the present

[1] I take this opportunity to thank Dr. W. J. Holland, the Director of the Carnegie Museum and Curator of Paleontology, for his revision of the manuscript of this article, and for granting me the privilege of describing the splendid material with which it deals. To Mr. Earl Douglass I am indebted for many kind criticisms and suggestions. The drawings for the illustrations were made by Mr. Sidney Prentice. O. A. Peterson.

paper be alluded to only when necessary to do so in the interests of perspicuity.

In 1902 Mr. J. B. Hatcher[2] subdivided these beds and mentioned a number of species belonging to their faunæ. While the subdivisions which Hatcher proposed are here followed in the main, it may be stated that the horizons determined by him are difficult to distinguish on account of their lithological similarity. This is especially true of the Gering and Monroe Creek beds. In Fig. 1 each horizon is defined far more clearly than in nature in order to make the subject plain to the reader. The species given by Hatcher (*l. c.*, p. 117) in one or two cases are incorrectly identified.[3]

Referring to Fig. 1 attention should be called to the fact that the upper fifty or sixty feet of Squaw Butte appear to represent the Harrison beds. The Monroe Creek beds, however, run insensibly into the latter and the dividing line is difficult to determine except for the fact that *Dæmonelix*, which is characteristic of the Harrison beds, occurs in the upper strata. Along the line of the section Niobrara River (locally known as the "Running-water") does not cut through the Harrison beds, and the thickness of the Monroe Creek beds and the Gering horizons are here only conjectural. The sedimentary mass apparently decreases in thickness southward and eastward, so that if the lower horizons (Monroe Creek beds and Gering beds) are present at this point they are probably quite thin.

The sandhill region, south of the Niobrara River, represented in the illustration is a narrow strip extending east and west. The deposit is of late origin and has the usual æolian character met with in the more extensive sandhill areas further east in the State of Nebrasba. This deposit rests unconformably on the Harrison and the Upper Harrison (Nebraska[3a]) beds.

Spoon Butte is located in the southwestern part of Sioux County, Nebraska. It is a long and narrow elevation with deeply eroded sides and a flat top. The long axis of the butte is directed nearly east and

[2] *Proc. Am. Phil. Society*, Vol. XLI., pp. 113–131, 1902.

[3] Hatcher wrongly identified *Protolabis* for *Oxydactylus*, and *Cyclopidius* for *Merychyus*. No *Cyclopidius* has as yet been found in the Upper Harrison beds.

[3a] From a verbal statement made recently by Professor H. F. Osborn it now appears that the beds which Professor W. B. Scott referred to the Nebraska beds are of later origin than those, which, in former papers, I have referred to that horizon. This horizon, therefore, may be called the Upper Harrison beds and in this paper will be referred to under that name.

west, the western extremity lying within the State of Wyoming, in Laramie County. The summit of Spoon Butte, which is represented at the top of the section (Fig. 1) is capped by a hard pinkish-gray sandstone, thirty-five to fifty feet in thickness. In this hard cap of sandstone, which is regarded as the top of the Upper Harrison beds, our party found no fossils. The base of this elevation is composed of the Lower Harrison beds.

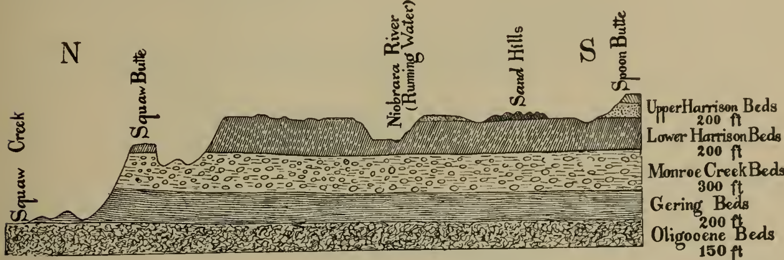


FIG. 1. A section of the Lower Miocene of western Nebraska and eastern Wyoming.

THE GERING BEDS.

The Gering horizon forms the contact between the Oligocene and the lower Miocene formations over extensive areas in eastern Wyoming and western Nebraska, and perhaps also parts of eastern Colorado. At Squaw Butte, the northern limit of the lower Miocene, where the section represented in Fig. 1 was obtained, the Gering sandstones rest directly on the Leptauchenia clays, which compose the uppermost horizon of the Oligocene formation. No fossils were found in this horizon in the neighborhood of Squaw Butte, but farther east, near Sand Creek and near Chadron, Nebraska, a few remains were found.

LIST OF THE FAUNA.

? *Mesoreodon.*
Leptauchenia.[4]

THE MONROE CREEK BEDS.

In the vicinity of Squaw Butte it is quite difficult to separate this horizon from the underlying Gering beds by lithological characters alone. While remains of *Leptauchenia* were found in the lower part

[4] The material referred to *Lepiauchenia* differs but slightly from that referred to *L. decora* Leidy, from the Oligocene, and should not in my judgment be regarded as belonging to the genus *Cyclopidius.*

of this horizon, none were found at the top by the parties from the Carnegie Museum, but it is quite probable that true *Cyclopidius* may occur in the upper levels. Other changes of the fauna occur which help to identify the horizon.

List of the Fauna.

? *Diceratherium.* *Mesoreodon.* *Leptauchenia.* *Cameloid fragments* (Genus?).	These genera are found in the lower levels of the beds and may with equal propriety in part be regarded as belonging to the fauna of the Gering horizon.
Canid fragments (Genus?). *Euhapsis platyceps* Peterson. *Promerycochœrus carrikeri*, n. sp. *Phenacocœlus typus*, gen. et sp. nov. *Protomeryx cederensis* Mathew. *Nothocyon lemur* Cope.	These genera and species are from the upper Monroe Creek horizon.

Description of New Material.

Diceratherium sp. indet.

A few fragments of jaws and teeth were found in the lower level of the Monroe Creek beds which evidently belong to the genus Diceratherium. The incisor is large and apparently occupied the usual procumbent position which is characteristic of the family. The specimen is probably that of an earlier type of the genus.

Mesoreodon melagodon sp. nov.

In the collection of the Carnegie Museum are five or six individuals upon which this species is founded. The material was found in the middle and lower Monroe Creek beds near Squaw Butte, Sioux County, Nebraska. All the specimens are crushed and the true contour of the skulls is consequently lost.

The front of the skull and lower jaws (No. 1325) of a young individual, but with all the permanent teeth in position (see Fig. 2) are selected as the type. A second specimen of a fully adult animal (No. 1323) is chosen as the paratype, and consists of the back part of the skull, the lower jaws very nearly complete (see Fig. 3), fragments of lumbar vertebræ, fore and hind limbs, and feet.

The principal differences between *Mesoreodon chelonyx*, the best known species described by Professor Scott,[5] and *Mesoreodon megalodon*

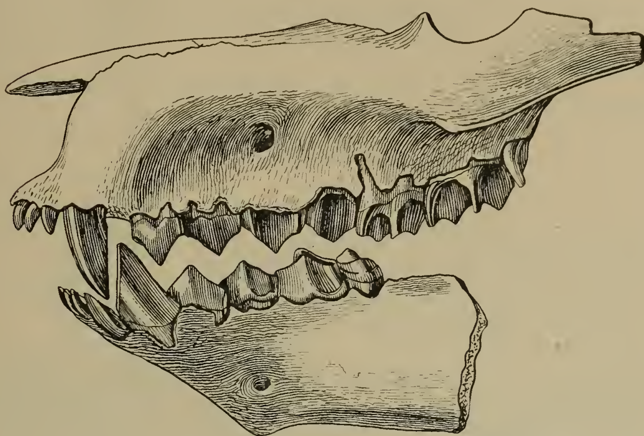


FIG. 2. Side view of upper and lower jaws of *Mesoreodon megalodon*. ½ nat. size. Type. No. 1325.

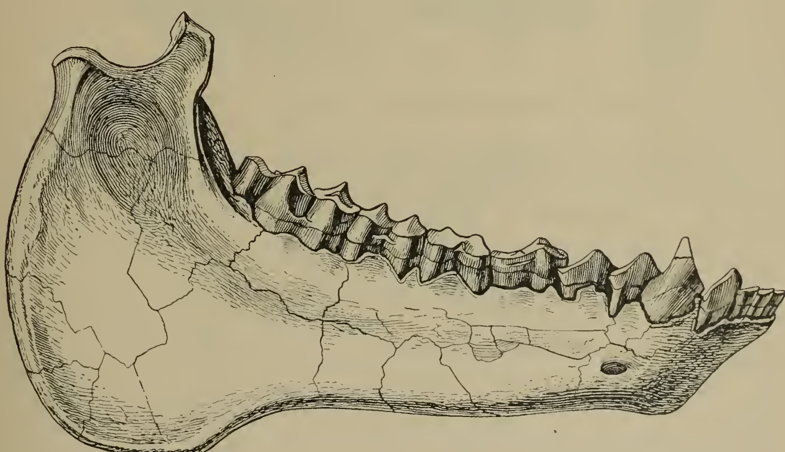


FIG. 3. External view of left mandible of *Mesoreodon megalodon*. ½ nat. size. Paratype, No. 1323.

may be stated by saying that in the present specimens the teeth are relatively heavier, the molars having a slightly greater antero-posterior diameter, the dentition being more crowded; the occiput probably

[5] *Am. Nat.*, Vol. XXVII., p. 661 (1893); *Trans. Amer. Philos. Society*, Vol. XXVIII., pp. 125–145 (1894).

lower; the muzzle heavier; the nasals longer; the infraorbital foramen placed further forward; the mandible deeper, with the angle more strongly produced downward and not so strongly produced behind the condyle. The limbs are also shorter and comparatively lighter than those in *Mesoreodon chelonyx*, as is indicated by the fragments of the limbs found with the paratype (No. 1323).

MEASUREMENTS.

	Type. (No. 1325.) mm.	Paratype. (No. 1323.) mm.
Distance from anterior border of orbit to the incisors	123	
Transverse diameter of muzzle at base of canine	60	
Antero-posterior diameter of premolars	60	
Antero-posterior diameter of molars $\underline{1}$ and $\underline{2}$	44	
Antero-posterior diameter of $M^{\underline{3}}$		30
Vertical diameter of mandible at $P_{\overline{4}}$	34	32
Vertical diameter of mandible at anterior part of $M_{\overline{3}}$		42
Length of premolar series	59	56
Length of molar series		70
Antero-posterior diameter of $M_{\overline{3}}$		34

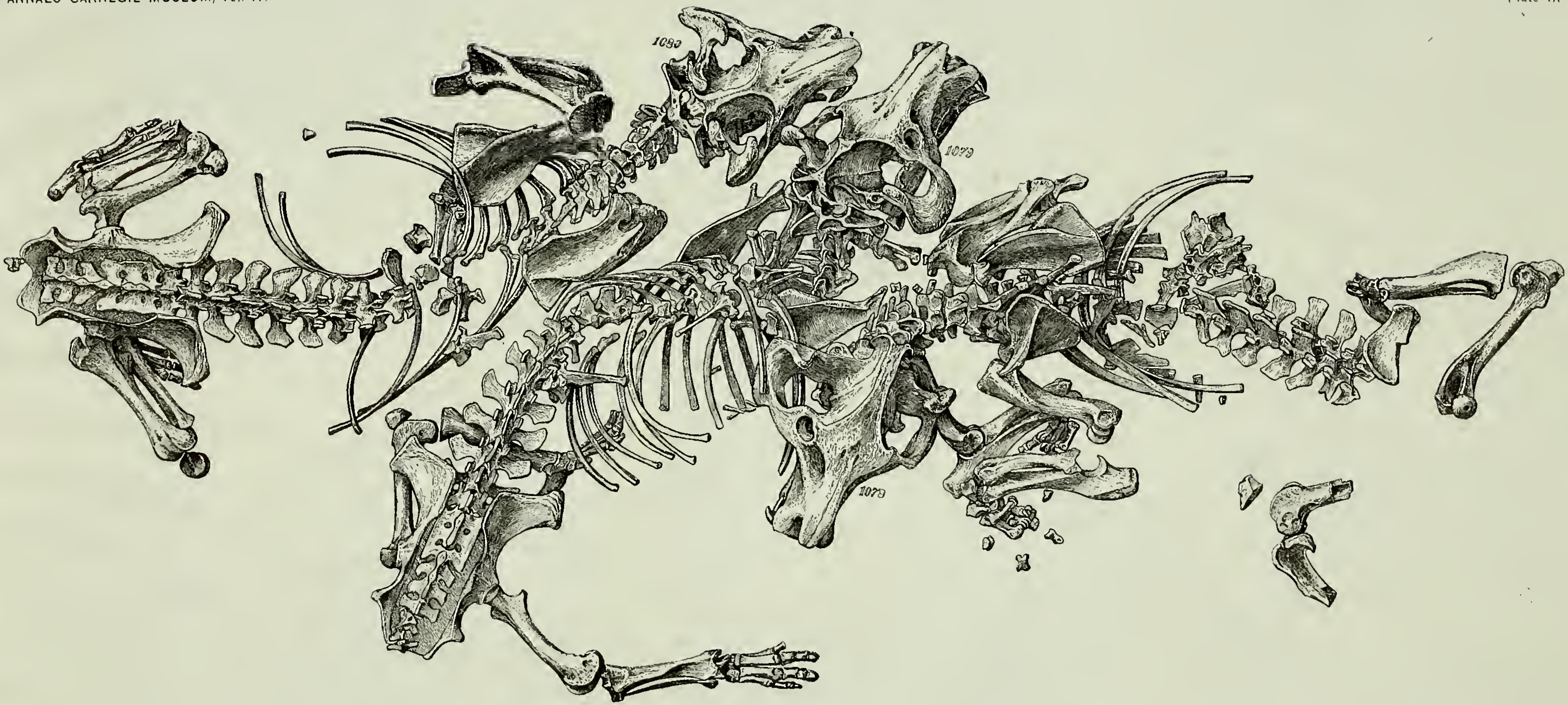
Promerycochœrus carrikeri,[6] sp. nov.

(PLATE IX)

(Type. No. 1080 Carnegie Museum Catalogue of Vertebrate Fossils.)

This species is found in the upper Monroe Creek beds and is most nearly allied to *Promerycochœrus chelydra* Cope. The skull is brachycephalic. The dentition, of the usual merycoidodont type, is I$\frac{3}{3}$, C$\frac{1}{1}$, P$\frac{4}{4}$, M$\frac{3}{3}$. On direct comparison the skull of *P. chelydra* is seen to differ from the series in the Carnegie Museum collection by a number of important characters. In *P. chelydra* the zygomatic arch is less robust and does not extend below the horizontal line of the dentition, the superior border of the premaxillary is more oblique, the frontal region is less convex, the vertical diameter of the cranium is less, the tympanic bulla is smaller and differently shaped, the posterior nares are located further back, the postglenoid process is smaller and more widely separated from the paroccipital process, the dentition is relatively somewhat shorter, and the type specimen is of smaller size than the average sized skulls of *Promerycochœrus carrikeri*. Among the more

[6] In recognition of Mr. M. A. Carriker, Jr., who pointed out the locality of the specimens to the writer.



Group of Skeletons Representing Three Specimens of *Promerycochœrus carrikeri* Peterson, as they were found in the matrix. The type is specimen No. 1080. The Group is installed in the Gallery of Vertebrate Paleontology in the Carnegie Museum, $\frac{1}{9}$.

important characters enumerated above are the greater vertical diameter of the cranium in *P. carrikeri*, which is due to the greater elevation of the region back of the orbit. The temporal ridges and the sagittal crest are very prominent, and the zygomatic arch extends downward in a manner suggestive of *Elotherium*.

The vertical diameter of the skull is not greater than that in *P. chelydra*, except as it is increased by the elevation of the occiput and the downward thrust of the zygoma. The group of three skeletons in the Hall of Vertebrate Paleontology is mounted in the original position in which the animals were found in the field. The specimens are among the most interesting collected by the writer and will be more fully described in a later publication.

MEASUREMENTS.

	mm.
Greatest length of the skull	316
Length from anterior border of orbit to tip of nasals	152
Length from anterior border of orbit to the occipital condyles	174
Length of alveolar border	175
Distance from M^3 to the occipital condyle	132
Greatest transverse diameter of the skull	295
Transverse diameter of the occipital condyles	67
Greatest transverse diameter of brain cavity	85
Transverse diameter of muzzle at base of canine	104
Antero-posterior diameter of the orbit	35
Vertical diameter of the orbit	35
Greatest vertical diameter of the zygomatic arch	165
Vertical diameter of jugal below middle of orbit	40
Length of superior dentition	175
Distance from incisors to M^1	105
Length of molar series	75
Antero-posterior diameter of canine near base	16
Transverse diameter of canine near base	19
Antero-posterior diameter of P^1	16
Antero posterior diameter of P^2	18
Antero-posterior diameter of P^3	18
Antero-posterior diameter of P^4	16
Antero-posterior diameter of M^1	22
Antero-posterior diameter of M^2	24
Antero-posterior diameter of M^3	32
Length of mandible	255
Length of alveolar border of mandible	183
Vertical diameter of angle at the condyle	120
Vertical diameter of angle at the coronoid process	118
Vertical diameter of mandible at M_3	58

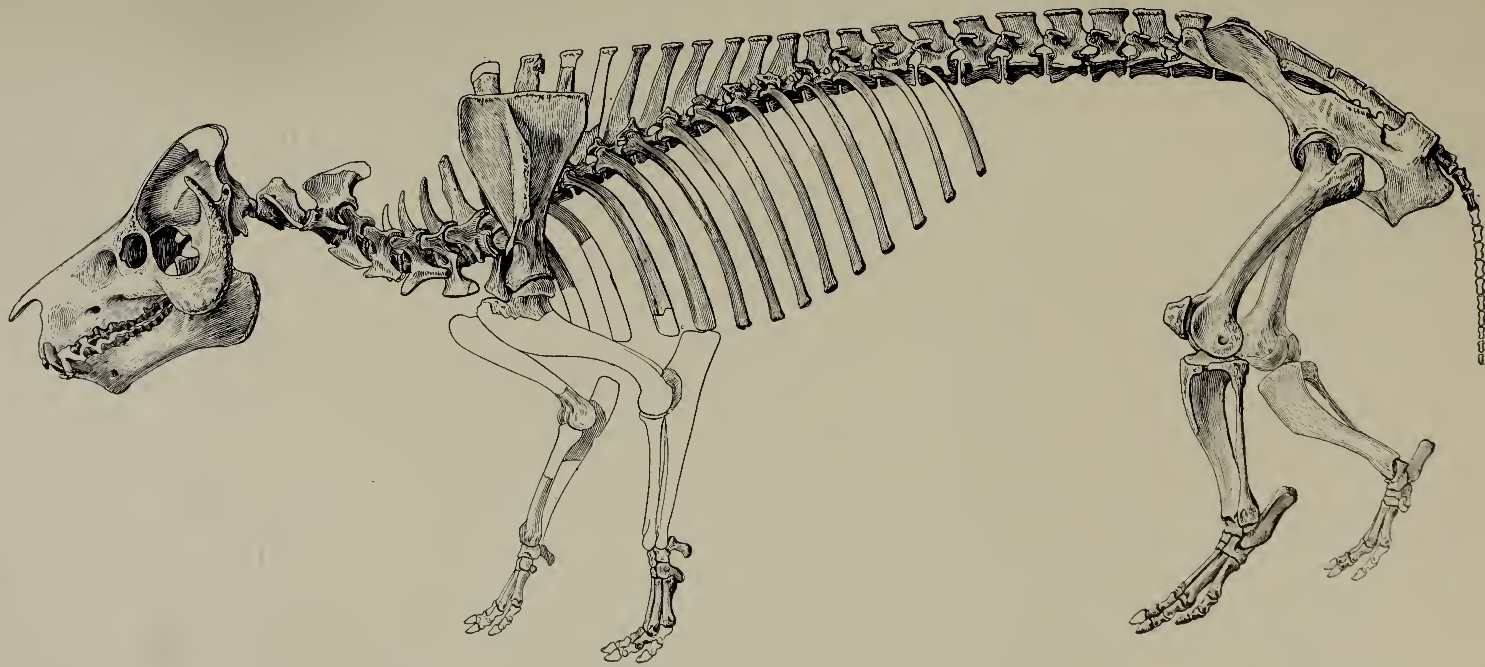
Vertical diameter of mandible at canine	57
Length of inferior dentition	180
Distance from incisors to $M_{\overline{1}}$	87
Length of molar series	85
Antero-posterior diameter of $P_{\overline{1}}$	17
Transverse diameter of $P_{\overline{1}}$	13
Antero-posterior diameter of $P_{\overline{2}}$	17
Antero-posterior diameter of $P_{\overline{3}}$	16
Antero posterior diameter of $P_{\overline{4}}$	20
Antero-posterior diameter of $M_{\overline{1}}$	20
Antero-posterior diameter of $M_{\overline{2}}$	22
Antero-posterior diameter of $M_{\overline{3}}$	40
Greatest diameter of scapula from the glenoid cavity to the vertebral border	233
Antero-posterior diameter of vertebral border of scapula	146
Antero-posterior diameter of neck of scapula	37
Greatest length of humerus	250
Greatest length of radius	175
Greatest length of ulna	245
Greatest antero-posterior diameter of pelvis	355
Distance from middle of acetabulum to the end of ischium	170
Greatest length of the femur	260
Length of the calcaneum	90
Length of metatarsal IV	81
Length of metatarsal V	65

RESTORATION OF PROMERYCOCHŒRUS CARRIKERI.

(PLATE X.)

The skeleton No. 1081 was found on the same level, nine feet (270 cm.) from the group (Pl. IX.) mounted in the Hall of Vertebrate Paleontology of the Carnegie Museum, and practically was one of them. The anterior portion of the skeleton was unfortunately eroded and lost, but from the fifth dorsal backward the skeleton is practically complete. The head of the left humerus, the distal end of the right humerus, and a small portion of both ulnæ were also found in position. Nearly all the ribs are represented.

The parts supplied in this restoration were taken from three different individuals of the same species, the skull and jaws from a specimen catalogued as No. 109; the cervicals, anterior dorsals, first lumbar and the left scapula (which are somewhat too large for the skeleton) were derived from the specimen catalogued as No. 1047; and the greater part of the fore feet are from specimen No. 1228. The humeri, radii, and ulnæ are mostly restored in plaster.



Restoration of *Promerycochœrus carrikeri* Peterson, $\frac{1}{9}$.

The vertebral formula of *Promerycochœrus carrikeri* is: cervicals seven, dorsals fourteen, lumbars six, sacrals eight, caudals fourteen (?). The skull is short and deep, the neck short and robust, the neural spines of the dorsals are high, the lumbar vertebræ are heavy, with strong zygapophyses and thin transverse processes which are much extended transversely at the distal extremities. There are eight well coössified vertebræ in the sacrum. The caudal region was of medium length, judging from the four anterior caudals which are at hand. The thoracic cavity is of large size. The limbs are short and heavy. The broad muzzle, the large feet and the proportions of the skeleton recall the general structural outlines of the hippopotamus. The animal was heavy and no doubt comparatively slow. Its habitat was perhaps on the borders of lakes and rivers.

MEASUREMENTS OF THE RESTCRED SKELETON OF PROMERYCOCHŒRUS CARRIKERI.

	cm.
Total length of the skeleton, approximately	172
Length of dorsal region	54
Length of lumbar region	30
Length of sacrum	28
Length of pelvis	36.5
Transverse diameter of pelvis, anteriorly	30
Height of skeleton at first dorsal	72

Phenacocœlus typus[7] gen. et sp. nov.

Much material of this genus was collected in the upper Monroe Creek beds at the head of Squaw Creek, Sioux County, Nebraska. The specimen, No. 1263 (Carnegie Museum Catalogue of Vertebrate Fossils), which consists of the greater portion of a skeleton, is selected as the type.

PRINCIPAL CHARACTERS.

Skull rather brachycephalic, merycoidodont in structure and in the pattern of the teeth $I\frac{3}{3}$, $C\frac{1}{1}$, $P\frac{4}{4}$, $M\frac{3}{3}$. There are two elongated and narrow foramina on top of the skull, situated at the anterior part of the frontals, one on either side of the median line, somewhat similar to those in *Leptauchenia* and *Cyclopidius*. The cranium is elongated, the facial region short, and there are noticeable antorbital vacuities and

[7] The generic name is given with reference to the vacuities of the skull, which are somewhat similar, but much smaller than in *Cyclopidius*, from which it is separated by the possession of three incisors in the upper and lower jaws.

deep lachrymal pits. The occiput is high, with large and deep lateral excavations, which are situated below and back of the posttemporal and lambdoidal crests. The occipital condyles have rudimentary accessory facets for the atlas. The tympanic bulla is of very large size and

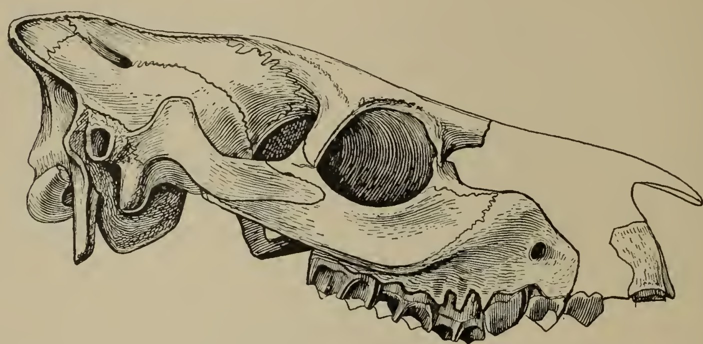


FIG. 4. Side view of skull of *Phenacocœlus typus*. $\frac{1}{2}$ nat. size. Type, No. 1263.

extends much below the postglenoid process. The sagittal crest is low. The orbit is well rounded. The infraorbital foramen is situated above the anterior part of $P^{\underline{4}}$. The nasals greatly overhang in front. The metatarsals are shorter than the metacarpals.

The genus belongs to the family Agriochœridæ,[8] revealing affinities to *Leptauchenia* and *Cyclopidius*. The type specimen is about one fourth larger than *Leptauchenia*.

MEASUREMENTS.	Type. (No. 1263.) mm.	Paratype. (No. 1276.) mm.
Greatest length of the skull	185*	192
Distance from condyles to incisors	170*	175
Distance from posterior border of orbit to incisors	102*	98
Distance from posterior border of orbit to condyles	80	87
Length of alveolar border of the maxillary	95*	92
Distance from the posterior end of the alveolar border of the maxillary to the condyle	75†	81

[8] According to the recent studies of C. W. Gilmore (*Proceed. U. S. Nat. Museum*, Vol. XXXI., pp. 513–514, 1906), and Earl Douglass (*Science*, Vol. XXIV., pp. 565–567, 1906); and also according to the Catalogue of the Fossil Vertebrata of North America, by O. P. Hay, it appears that the family name *Agriochœridæ* must be used in speaking of this group instead of the name *Oreodontidæ*, which has been heretofore almost exclusively used.

* Indicates approximate measurements.

† The fore and-aft crushing of the type skull in this region causes this difference in measurements.

Greatest transverse diameter of the skull	100*	112*
Transverse diameter of the condyles	28	33
Greatest transverse diameter of brain cast	45	52
Transverse diameter of postglenoid process at base	10	16
Antero-posterior diameter of postglenoid at base	9	9
Antero-posterior diameter of tympanic bulla	28	28
Transverse diameter of tympanic bulla	16	19
Antero-posterior diameter of the orbit	28*	28*
Vertical diameter of the orbit	27*	27*
Vertical diameter of jugal below the orbit	16	17
Length of superior dentition	97*	
Antero-posterior diameter of P^2, P^3, and P^4	33	
Antero-posterior diameter of molar series	48	
Antero-posterior diameter of P^2	12	
Transverse diameter of P^2	6*	
Antero-posterior diameter of M^3	20	
Transverse diameter of M^3	14	

RESTORATION OF PHENACOCŒLUS TYPUS.

The type of the genus *Phenacocœlus* is the basis for the articulated skeleton represented in Fig. 5. The specimen was found in position in a soft sandstone with the left side partly exposed and lost by erosion. The skeleton is mounted very nearly in the same position in which it was found. The parts of the specimen which are preserved are the following: one side of the skull and the angle of the right jaw, all the presacrals and ribs, the pleurapophysis of the first sacral, four of the anterior caudals, the right fore limb complete to the phalanges of the pes, the left scapula, part of the right ilium and ischium, the left hind foot and limb complete to the proximal end of the tibia, which is restored. There is only a short section of the shaft of the left femur. The rest of the skeleton as seen in Fig. 5 is restored in plaster. There are a number of other specimens of the same species in the collection, which might have been used in supplying missing parts, but it was thought best not to include in the restoration any other portions than those which had belonged to the type. The vertebral formula is: cervicals seven; dorsals fourteen; lumbars six; sacrals?; caudals nine (?). The animal had a rather short and deep head, a short neck, and a large thoracic cavity; the tail was probably short, judging from the proximal vertebræ, which from the first to the fourth decrease rapidly in size and in the prominence of the different processes. The pelvis is only moderately robust, the limbs are short, the metacarpals longer than the metatarsals, the ungual phalanges are depressed, broad, and flat as in *Mesoreodon chelonyx* Scott.

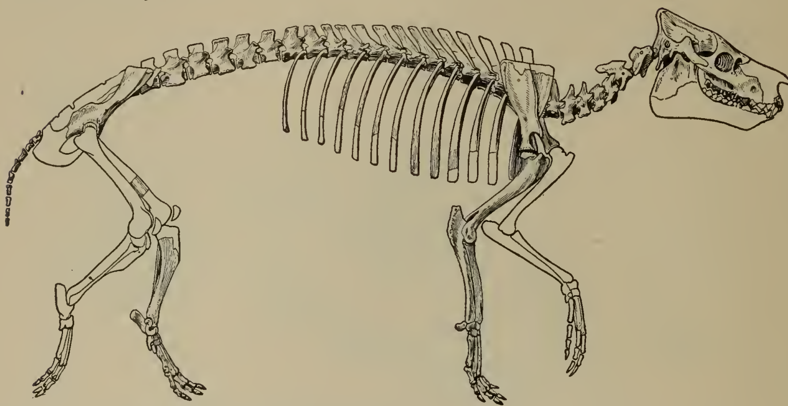


FIG. 5. Restoration of *Phenacocœlus typus*. $\frac{1}{9}$ nat. size. Type, No. 1263.

MEASUREMENTS.

	mm.
Total length of the skeleton	890
Total height of the skeleton at the second dorsal vertebra	450
Length of the scapula	106
Antero-posterior diameter of scapula at the superior border	71
Greatest length of humerus	140
Greatest length of radius	110
Greatest length of ulna	139
Length of carpus	22
Transverse diameter of carpus at the head of the metacarpals	27
Length of metacarpal III	55
Length of tibia, approximately	120
Length of tarsus	34
Transverse diameter of tarsus at the head of the metatarsals	25
Length of metatarsal IV	47
Length of phalanges of fourth digit of pes	48

Protomeryx cederensis Matthew.

Some fragmentary remains from the middle Monroe Creek horizon are provisionally referred to this species. The mandible of No. 1329 (Carnegie Museum Catalogue of Vertebrate Fossils) is relatively slenderer than that in *P. cederensis*, but the teeth are equally hypsodont. The upper molars are distinctly more hypsodont than in *Pro-*

tomeryx sternbergi from the John Day beds of Oregon. The lower jaw is more produced in front of the molar-premolar series than in *P. halli.* The slenderness of the mandible recalls that of *P. serus* Douglass, but $P_{\overline{2}}$ and $_{\overline{3}}$ are of less antero-posterior diameter in the latter species.

Nothocyon lemur? Cope.

The fragment of the mandible, No. 1286, is of the same depth as that of the species from the John Day formation (see U. S. Geological Survey of the Territories, Vol. III.,, 1884, Pl. LXX., Fig. 7). The carnassial tooth is of slightly greater antero-posterior diameter, but the transverse diameter is the same as in *N. lemur.* The specimen, which was found in the upper Monroe Creek beds, probably represents a later form than that of the John Day formation, but is here provisionally referred to the latter pending the discovery of more complete material.

MEASUREMENTS.

	mm.
Antero-posterior diameter of carnassial tooth	9
Antero-posterior diameter of heel of carnassial tooth	3
Transverse diameter of heel of carnassial tooth	3

FAMILY CANIDÆ.

Gen. et sp. indet.

Fig. 6 represents a fragmentary pair of lower jaws (No. 1603, Carnegie Museum Catalogue of Vertebrate Fossils) with canine $P_{\overline{1}}$ and $M_{\overline{1}}$ in position. The specimen apparently represents a new genus belonging to the family *Canidæ*, but the incompleteness of the material renders it untenable as a type, and I give only the figure and description for the guidance and assistance of the student.

The mandible is deep and heavy. The symphysis is extended well back and resembles that of *Hyænodon.* The inferior border of the horizontal ramus is but little rounded antero-posteriorly. Opposite $M_{\overline{2}}$ the angle turns upward more rapidly, as is usual in the Canidæ.

The canine of the left jaw is complete, while that of the right is represented only by the root. The roots of the two canines are quite close together, giving but a small space for the incisors. The canine has a high and pointed crown. The tooth is very robust, and there is evidence of the existence of a vertical groove on the postero-external angle and a heavy rounded vertical ridge directed posteriorly. The internal angle of the canine is restored with plaster.

$P_{\overline{1}}$ is close to the canine; it is single-rooted, with a rather high, but bluntly pointed crown and a heavy rounded cingulum on the internal base. $P_{\overline{2}}$ has an oblique position in the alveolar border; the anterior root, which is the smallest, is very close to $P_{\overline{1}}$. Back of $P_{\overline{2}}$ are four roots still preserved in the jaw. The space between the carnassial tooth and $P_{\overline{2}}$ would indicate that these teeth were of considerable antero-posterior diameter. The carnassial tooth is very characteristic. The paraconid is unusually small. The protoconid is large, quite bluntly pointed, with a vertical ridge on the anterior and posterior faces. The metaconid is entirely wanting. The heel-cusp is entirely central in position and is obliquely rounded, with a prominent anterior and a less prominent posterior vertical ridge. The entoconid ridge is hardly noticeable. Judging from the specimen $M_{\overline{2}}$ was of considerable size. The mandible is broken off back of $M_{\overline{2}}$.

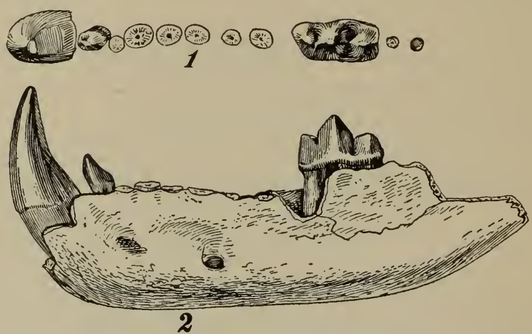


FIG. 6. 1. Crown view of teeth of undetermined canid. 2. External view of right ramus of undetermined canid. ½ nat. size. No. 1506.

MEASUREMENTS.

	mm.
Length of inferior dentition from $M_{\overline{1}}$ to and including the canine	97
Length of premolar series	59
Antero-posterior diameter of canine at base	15
Transverse diameter of canine at base	12
Antero-posterior diameter of $P_{\overline{1}}$	6
Transverse diameter of $P_{\overline{1}}$	5
Antero-posterior diameter of $M_{\overline{1}}$	21
Transverse diameter of $M_{\overline{1}}$	10

THE HARRISON BEDS.

This horizon has an exposed surface extending over large areas in Sioux County, Nebraska, and also stretching across the State-line into

Wyoming. The fine-grained and incoherent sandstones in this horizon do not differ much from the immediately underlying Monroe Creek beds. Flattened and horizontally columnar masses of concretions are perhaps more frequently encountered and are of greater extent in these beds than in the underlying formations. The fossils discovered also represent a fauna differing somewhat from that in the Monroe Creek beds.

LIST OF THE FAUNA.

Parahippus.
Promerycochœrus vantasselensis, sp. nov.
Merychyus harrisonensis, sp. nov.
Merychyus? sp. indet.
Syndyoceras cooki, Barbour.
Stenomylus gracilis, gen. et sp. nov.
Brachypsalis simplicidens, sp. nov.
Thinohyus siouxensis, Peterson.
Steneofiber fossor, Peterson.
Steneofiber barbouri Peterson.

DESCRIPTION OF NEW MATERIAL.

Parahippus ? sp. indet.

A number of individuals represented by feet and limb bones are in the collection from the Harrison beds. Unfortunately there are no teeth with any of the specimens and comparison must be conjectural.

No. 1474[9] (Carn. Mus. Cat. Vert. Foss.) represents good fore feet and limb bones of a larger individual than *Parahippus* (*Desmatippus*) *crenidens* Scott, but all the comparative measurements very nearly agree, and the material is provisionally regarded as belonging to this genus.

Specimen No. 1445 consists of the proximal end of the humerus, radius, and ulna, a complete median metacarpal and three phalanges. The remains are of an animal the legs of which are shorter and heavier than those of the species described by Scott.

[9] This specimen was presented to the writer by Harold J. Cook.

Promerycochœrus vantasselensis,[10] sp. nov.

(Type. No. 1230 Carnegie Museum Catalogue of Vertebrate Fossils.)

This species is based upon a number of skulls and parts of skeletons in the collection of the Carnegie Museum. The material was collected in the middle of the Lower Harrison beds on Vantassel Creek, Converse County, Wyoming. The type consists of the skull, the ramus of the right side of the mandible with the dentition, and other parts of the skeleton.

This species is very closely allied to *Promerycochœrus carrikeri*, but in *P. vantasselensis* the zygomatic arch is less robust, the sagittal crest is not so high, the anterior nares are more obliquely inclined posteriorly, and the nasals consequently are shorter than in *Promerycochœrus carrikeri*. These differences apparently suggest a change leading up to forms belonging to the genus *Merycochœrus* which are found in later horizons. The small incisors and the more anterior position of the infraorbital foramen of the present species are, however, characters of too much importance to allow us seriously to regard this species as ancestral to *Merycochœrus*. A comparison with the type of the imperfectly known species *Merychyus major* Leidy[11] shows that the infraorbital foramina of the two species nearly agree.

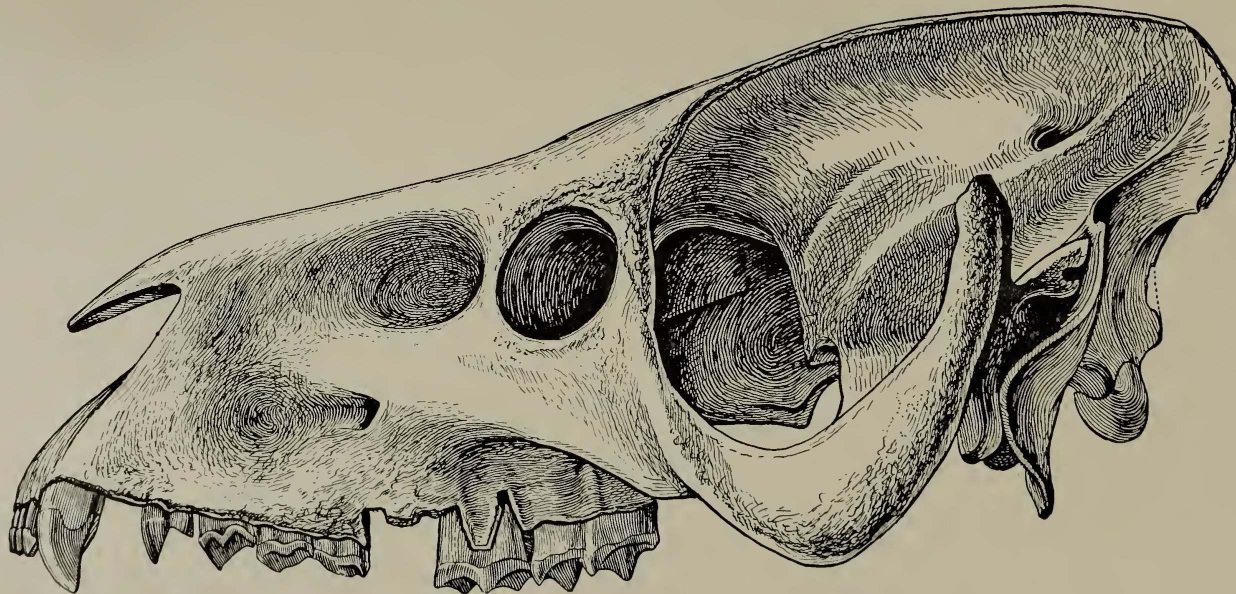
MEASUREMENTS.

	mm.
Greatest length of the skull	320
Distance from the occipital condyle to and including the incisors	305
Distance from the tip of the nasals to the anterior border of the orbit	115
Distance from the anterior border of the orbit to the condyles	172
Distance from the anterior border of the orbit to the incisors[11a]	200
Length of the alveolar border of the maxillary	170
Distance from the posterior end of the alveolar border of maxillary to the occipital condyle	127
Greatest transverse diameter of the skull	225
Transverse diameter of the occipital condyles	53
Vertical diameter of the tympanic bulla	30
Transverse diameter of the tympanic bulla	24
Greatest transverse diameter of the brain cavity	93

[10] The specific name indicates the locality where the type specimen was found.

[11] An emargination which undoubtedly represents the infraorbital foramen is found on the broken border of the maxillary bone above $P\frac{4}{}$ in the type of *Merychyus major*.

[11a] A slight depression by crushing in the region of the inion causes this measurement to be somewhat greater than it otherwise would be.



Cranium of *Promerycochœrus vantasselensis* Peterson, $\frac{1}{2}$.

Greatest vertical diameter of the zygomatic arch	95
Greatest diameter of the jugal below the middle of the orbit	30
Antero-posterior diameter of the orbit	36
Vertical diameter of the orbit	34
Length of superior dentition	170
Distance from incisors to M^{1}	108
Length of the molar series	78
Length of the inferior dentition	175
Distance from incisors to M_{1}	90
Length of molar series	87

Merychyus harrisonensis,[12] sp. nov.

(Type. No. 1341 Carnegie Museum Catalogue of Vertebrate Fossils.)

This species is established on a fairly well preserved skull which has been somewhat crushed vertically and is without the lower jaws. The type represents an animal a little larger than *Merychyus elegans* Leidy, and was found in the Lower Harrison beds on Vantassel Creek, Converse County, Wyoming.

The skull is mesetocephalic. The occiput is broad and rather low, which is perhaps partly due to crushing. The posttemporal crest continues downward and forward in an uninterrupted and almost straight line to the base of the zygomatic process, thus leaving the base of the mastoid and the external auditory meatus below, but closely adhering to the inferior margin of this crest.[13] The exit of the ear has an upward and backward direction much as in *Leptauchenia* and *Cyclopidius*. The dentition, which is much worn, is apparently less hypsodont than that in *Merychyus elegans*.

A closer study of the specimen reveals characters well worthy of note, which may assist in finally determining the value of the species here proposed, when more perfect material is found.

The occiput is overhanging, which is in part due to crushing. The region above the foramen magnum is deeply excavated. Below and posterior to the posttemporal crests there are deep excavations similar to those in *Phenacocœlus*. The basicranial axis is gently curved. The paroccipital process is of moderately large size, directed downward and decidedly outward (the latter direction may be due partly to crush-

[12] The specific name indicates the geological horizon in which the specimen was found.

[13] In other genera of the family this crest forms a prominent open angle at the base of the mastoid plate.

ing), and it is separated from the occipital condyle by a shallow notch, and is in contact with the posterior face of the tympanic bulla. The occipital condyles have a small vertical diameter; they are greatly convex from above downward and widely separated laterally by the emargination on the basioccipital. The foramen magnum is large. The cone-shaped postglenoid process is rather small when compared

FIG. 7. 1, side view of skull of *Merychyus harrisonensis*. 2, top view of skull. ½ nat. size. Type. No. 1341.

with that of *Merycoidodon culbertsoni* and *Phenacocœlus typus*. The tympanic bulla occupies a large area of the base of the cranium and has a peculiarly depressed and flask-like form. There is a conical swelling on the postero-external angle of the bulla, and a deep emargination or pit near this eminence for the tympanohyal which constricts the otherwise broad tube of the external ear. The postorbital process is of moderately large size and the orbit was apparently closed posteriorly.

The alveolar border of the maxillary is lower even than in *Merycoidodon culbertsoni*. The infraorbital foramen is double and is located over the back part of $P^{\underline{3}}$. $P^{\underline{1}}$ is similar to that in *Merychyus elegans*, and as in that species, the protocone is shifted partly, by wear, to the anterior portion of the crown. The second premolar is very convex externally; the base is slightly corrugated, but there is no true cingulum. Except the usual small excavation at the antero-internal base, the tooth is so much worn that all the characters of the grinding face are entirely lost. The external face of $P^{\underline{3}}$ is slightly concave antero-

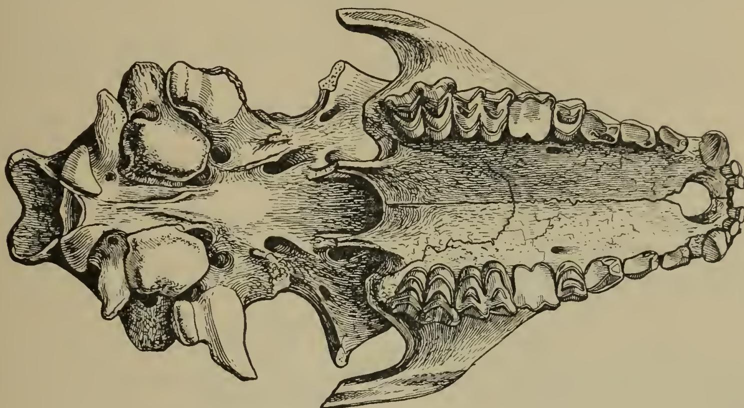


FIG. 8. Palate view of skull of *Merychyus harrisonensis*. ½ nat. size. Type. No. 1341.

posteriorly, and there is a decided cingulum; the tooth is much worn. $P^{\underline{4}}$ has a strong cingulum internally, while externally there is no cingulum. The external and internal cingula on $M^{\underline{2}}$ are only faintly indicated. $M^{\underline{3}}$ has a long postero-external heel; the tooth is longer than broad.

MEASUREMENTS.

	mm.
Greatest length of the skull	196
Distance from premaxillary to postorbital process of frontal	107
Distance from postorbital process of frontal to the inion	88
Distance from the premaxillary to the occipital condyles	176
Length of the alveolar border of the maxillary	96
Distance from posterior end of alveolar border to occipital condyle	82
Greatest transverse diameter of the brain cavity	54
Transverse diameter of frontals between orbits	70
Transverse diameter of occipital condyles	35
Vertical diameter of occipital condyles	13
Antero-posterior diameter of tympanic bulla	23
Transverse diameter of tympanic bulla	18

Vertical diameter of tympanic bulla	13
Total length of the dentition	95
Length of premolar series	35
Length of molar series	45
Antero-posterior diameter of canine at base	6
Transverse diameter of canine at base	8
Antero-posterior diameter of P^1	8
Transverse diameter of P^1	4
Antero-posterior diameter of P^2	10
Transverse diameter of P^2	7
Antero-posterior diameter of P^3	10
Transverse diameter of P^3	9
Antero-posterior diameter of P^4	9
Transverse diameter of P^4	12
Antero-posterior diameter of M^1	12
Transverse diameter of M^1	14
Antero-posterior diameter of M^2	15
Transverse diameter of M^2	15
Antero-posterior diameter of M^3	19
Transverse diameter of M^3	16

Merychyus, sp. indet.

The specimen (No. 1284) described below was found in the Lower Harrison beds on Squaw Butte, Sioux County, Nebraska. The remains consists of a nearly complete tibia with the middle part of the shaft of the fibula adhering to it; the astragulus, cuboid, navicular, cuneiform, and the greater part of the metatarsals.

Inasmuch as no part of the cranium or teeth were found with the specimen the writer hesitates to apply a specific name, though the material may represent a new species. It is provisionally referred to the genus *Merychyus*.

The tibia is quite long with a slender shaft; the cnemial crest is somewhat less developed, and does not reach as low down on the shaft as is the case in *Phenacocœlus typus*. On the posterior face of the shaft is a prominent ridge which extends from the postero-fibular angle of the proximal end, first obliquely downward, then more directly downward, and disappears 40 mm. from the distal end. This ridge is almost entirely wanting on the tibia of *Phenacocœlus typus*, while that in *Merychyus minimus*[14] is fairly well developed, but in a less degree than in the present specimen. The internal malleolus is directed vertically downward and the groove for the internal condyle of

[14] To be described later in this paper.

Skull of *Stenomylus gracilis* Peterson, $\frac{1}{2}$.

the astralagus has a fore and aft position very like that in *Merychyus*. The fibula had a complete shaft, judging from the comparatively large fragment adhering to the shaft of the tibia.

The astragalus and the cuboid are high. The navicular and calcaneal facets of the cuboid are very nearly of equal size. The facet on the cuboid accommodating metatarsal five is located on the tibial side of a small lip on the outer angle, which extends below the articular facet for the fourth metatarsal. The palmar hook of the cuboid is quite robust. The navicular and cuneiform are injured by erosion, but enough of them is preserved to show their close similarity to the corresponding bones in *Merychyus*. The second and fifth metatarsals are relatively longer than in *Merychyus minimus* and not nearly so heavy as those in *Phenacocœlus typus*. In comparing the second metatarsal (which is broken off at the distal epiphysis) with the corresponding bone of *Merychyus minimus* (No. 1331, Car. Mus. Cat. Vert. Foss.) it is seen that while the bones are of the same length the one here described is much the heavier of the two. It is also noticeable that metatarsals three and four are proportionally smaller than those in *Merychyus minimus*, and, when complete, no doubt they would be shorter. The proximal articulation of metatarsal five is very small and fits neatly into the overhanging lip on the fibular angle of the cuboid referred to above.

MEASUREMENTS.

	mm.
Total length of the fragment of the tibia	127
Transverse diameter of distal end of tibia	19
Antero-posterior diameter of distal end of tibia	14
Greatest height of astragalus	25
Greatest transverse diameter of astragalus	14
Vertical diameter of cuboid, anteriorly	15
Transverse diameter of cuboid, anteriorly	9
Vertical diameter of navicular, anteriorly	8
Vertical diameter of ecto-meso-cuneiforms	6
Transverse diameter of tarsus at head of metatarsals	19
Length of metatarsal II from proximal end to epiphysis of distal end	44

Stenomylus gracilis, gen. et sp. nov.

(PLATE XII.)

(Type. No. 1610, Carn. Mus. Cat. Vert. oss.

This remarkable cameloid form was found by the writer in the Lower Harrison beds on the Niobrara (Running Water) River, Sioux

County, Nebraska, in 1901. The type specimen consists of the greater portion of the base of a skull with the lower jaws complete, the limbs, the feet, and several cervical vertebræ. Only the skull and lower jaws are free from the matrix, and these are illustrated. The skull and lower jaws display characters which are entirely different from any cameloid living or extinct known to the writer. Certain cranial characters are quite suggestive of the Oligocene genus *Hypisodus*, but the limb and foot structures are distinctly cameline.

PRINCIPAL CHARACTERS.

$I\frac{?}{3}$, $C\frac{?}{1}$, $P\frac{2+}{4}$, $M\frac{3}{3}$. The more striking characters of the skull are the position of the posterior nares with relation to the pterygoids. The latter are located in the usual position, but they are very heavy and are completely united at their origin, their extremities diverging downwardly and outwardly. The posterior nares are large, ovate in outline, and are located well forward with the anterior border opposite the posterior part of $M^{\underline{1}}$. This is well shown in the illustrations. The tympanic bulla is of moderately large size; it is well co-ossified with the paroccipital process as in the camels generally. The basicranial axis is strongly angled. The occipital condyles are quite large and there are large accessory facets on the basioccipital. The occiput is rather low. The lambdoidal crests are broken off superiorly, but enough is preserved to show that they are of considerable prominence. There is no sagittal crest. The brain cavity is large and the frontals have a great transverse expansion between the postorbital processes, which give to the orbit an oblique outward position. The alveolar portion of the maxillary bone is very high for the accommodation of the extremely hypsodont teeth, the crowns of which, however, emerge but little below the alveolar border. The infraorbital foramen is above $M^{\underline{1}}$. Anterior to $P^{\underline{3}}$ the skull is unknown.

$P^{\underline{3}}$ is small; it has a simple crown and two roots. The ectoloph of $P^{\underline{4}}$ is smooth and nearly straight antero-posteriorly; there is, on the antero-external angle, a well developed vertical rib; the internal border is evenly rounded from before backward. The molars, especially the second and third, are of great antero-posterior diameter, while transversely they are much compressed. The vertical ribs on the antero-external angle of $M^{\underline{2}}$ and $M^{\underline{3}}$ are prominent; otherwise the external surfaces of the teeth are smooth. The intercrescentic cavities of the second and third molars are large and deep. The posterior crescents of $M^{\underline{3}}$ are but little worn, indicating a rather young, though fully adult, individual.

The principal characteristics of the mandible are seen in the shallow temporal fossa, the delicate and backwardly projecting coronoid process, and the rapidly decreasing depth of the horizontal ramus of the jaw from the angle to the symphysis. The incisors are quite large; they are closely crowded, and their crowns are spatulate. The incisors, canine, and $P_{\overline{1}}$ form a continuous closed series. The canine is incisiform and $P_{\overline{1}}$ has a single root and a high trenchant crown. $P_{\overline{2}}$ is isolated from $P_{\overline{1}}$ and $P_{\overline{3}}$ by diastemata; the tooth is small and two-rooted. $P_{\overline{3}}$ is also a small two-rooted tooth which is unworn in the type specimen. $P_{\overline{4}}$ is compressed laterally, but has a normal antero-posterior diameter. The molars increase rapidly in length from before backward; they are much compressed transversely. The limbs are long and slender and the metatarsals are coössified half their length from the proximal end. The navicular and cuboid are separate as in the camels. The metacarpals are coössified in a less degree than the metatarsals and are nearly as long as the latter.

MEASUREMENTS.

	mm.
Distance from $P^{\underline{3}}$ to and including the occipital condyle	152
Distance from $M^{\underline{3}}$ to and including the occipital condyle	76
Vertical diameter of the occipital condyle	20
Transverse diameter of the occipital condyle	32
Transverse diameter of the frontals at postorbital process, approximately	95
Antero-posterior diameter of $P^{\underline{3}}$	6
Transverse diameter of $P^{\underline{3}}$	3
Antero-posterior diameter of $P^{\underline{4}}$	10
Transverse diameter of $P^{\underline{4}}$ posteriorly	7
Antero-posterior diameter of $M^{\underline{1}}$	15
Transverse diameter of $M^{\underline{1}}$	10
Antero-posterior diameter of $M^{\underline{2}}$	25
Transverse diameter of $M^{\underline{2}}$	10
Antero-posterior diameter of $M^{\underline{3}}$	26
Transverse diameter of $M^{\underline{3}}$	8
Greatest length of the mandible	184
Depth of jaw at coronoid process	97
Depth of jaw at posterior part of $M^{\underline{3}}$	47
Depth of jaw at diastema in front of $P^{\underline{3}}$	18
Length of inferior dentition	137
Antero-posterior diameter of $P^{\underline{1}}$	5

Antero-posterior diameter of $P_{\overline{2}}$	5
Antero-posterior diameter of $P_{\overline{3}}$	5
Antero-posterior diameter of $P_{\overline{4}}$	9
Transverse diameter of $P_{\overline{4}}$	4
Antero-posterior diameter of $M_{\overline{1}}$	14
Transverse diameter of $M_{\overline{1}}$, posteriorly	7
Antero-posterior diameter of $M_{\overline{2}}$	22
Transverse diameter of $M_{\overline{2}}$	7
Antero-posterior diameter of $M_{\overline{3}}$	32
Transverse diameter of $M_{\overline{3}}$, anteriorly	6

In 1900 Mr. J. B. Hatcher discovered in the Harrison beds, portions of both mandibular rami (No. 1241) belonging to an adult animal. These are here referred to *Stenomylus gracilis*.

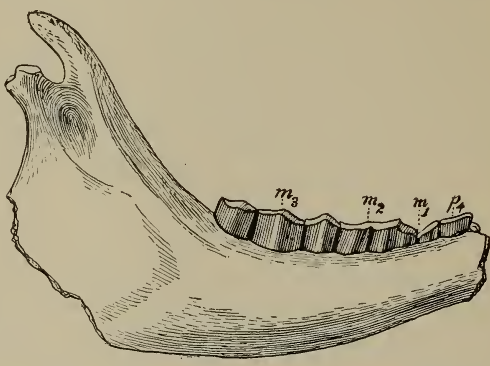


FIG. 9. External view of right mandible of *Stenomylus gracilis*. ½ nat. size. No. 1241.

Brachypsalis simplicidens sp. nov.

(Type. No. 1553, Carnegie Museum Catalogue of Vertebrate Fossils.)

The right mandibular ramus (No. 1553) on which this species is established has the entire dentition, except the incisors, in place. The posterior portion of the angle is not preserved. The specimen was found in the Harrrison beds, on Agate Spring Stock Farm, Sioux County, Nebraska, by Mr. Harold J. Cook, who presented it to the writer.

In comparing this specimen with *Potamotherium lacota* Matthew & Gidley, and also with the type of *Brachypsalis pachygnathus* Cope, certain resemblances are found, more especially in the latter species. The deep, short, and robust jaw with large teeth is especially characteristic of the two forms.

Dr. Matthew, who kindly compared this specimen with the types of the above-mentioned species, states that he would refer it to *Brachypsalis* rather than to *Potamotherium*, and that it is a "decidedly more primitive species than *B. pachygnathus*," which is from the upper Miocene. This species may represent the ancestral form of *B. pachygnathus.*

Specific Characters.

$I_{\overline{2}}$, $C_{\overline{1}}$, $P_{\overline{4}}$, $M_{\overline{2}}$. The lower jaw is short and heavy. The inferior border is evenly curved from the canine to opposite $M_{\overline{1}}$, where the mandible is injured. The external face of the jaw is convex from above downward. The temporal fossa is indicated as deep and of large size. There are two mental foramina; one near the canine, and the other below $P_{\overline{3}}$. The canine is short, robust, and oblong in cross-section. $P_{\overline{1}}$ is close to the canine and one-rooted, with a low simple crown. $P_{\overline{2}}$ is of nearly the same size as $P_{\overline{3}}$; the former is two-rooted, with a small postero-internal heel, and is obliquely placed in the alveolar border. $P_{\overline{3}}$ is like $P_{\overline{2}}$, but its position in the alveolar border is not oblique. $P_{\overline{4}}$ is a larger tooth, with the protoconid located nearer the middle than in the preceding teeth, and the posterior heel is also somewhat better developed. Unfortunately the carnassial tooth is broken off in front; the heel is complete and is rather short antero-posteriorly. $M_{\overline{2}}$ is small and has a low crown. The dental series curves outwardly in an unusual manner, $P_{\overline{4}}$ marking the location of the greatest angle of the curve. The specimen represents a fully adult animal.

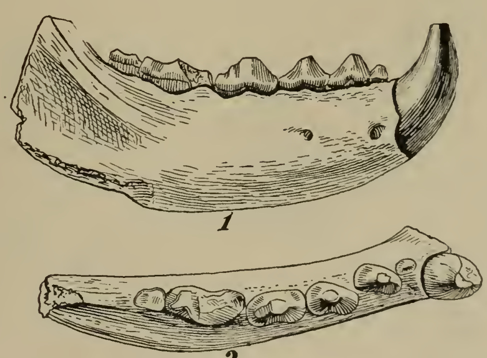


FIG. 10. 1. External view of right ramus of *Brachypsalis simplicidens.* 2. Superior view of *Brachypsalis simplicidens.* $\frac{2}{3}$ nat. size. Type, No. 1553.

MEASUREMENTS.

	mm.
Greatest length of the jaw fragment	86
Depth of mandible at $M_{\overline{1}}$	24
Depth of mandible at $P_{\overline{2}}$	20
Length of the dental series, including canine	68
Length of premolar series	33
Length of molars $_{\overline{1}}$ and $_{\overline{2}}$	22
Antero-posterior diameter of carnassial tooth	15
Transverse diameter of carnassial tooth at base	8
Antero-posterior diameter of heel of carnassial tooth	4

A Provisional List of the Fauna of the Agate Spring Fossil Quarry.

Parahippus.
Diceratherium niobrarense Peterson.
Diceratherium cooki Peterson.
Moropus elatus Marsh.
Dinohyus hollandi Peterson.
? Merycochœrus.
Merychyus elegans Leidy.
Amphicyon superbus sp. nov.
Nothocyon annectens sp. nov.

Diceratherium niobrarense Peterson.

(*Science*, Vol. XXIV., No. 609, pp. 281–282, 1906.)

(Plates XIII. and XIV.)

(Type. No. 1271 Carnegie Museum Catalogue of Vertebrate Fossils.)

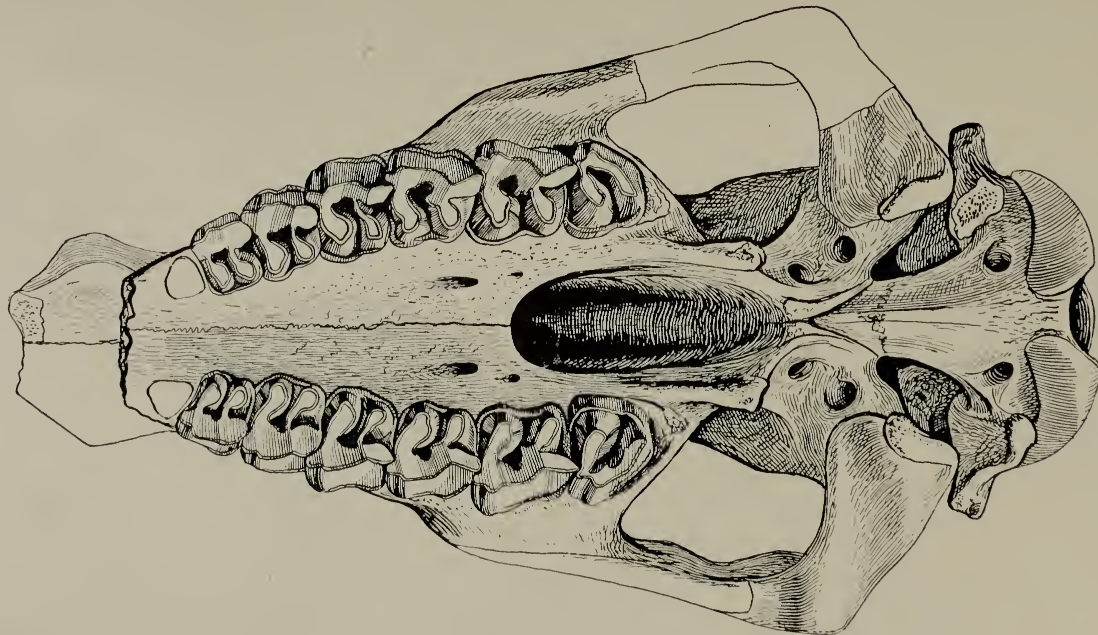
In comparing this species with the type of *Diceratherium nanum* Marsh,[15] and also with the complete and well preserved skull of that species (No. 7324) in the American Museum of Natural History,[16] certain differences are observed.

In the type of *Diceratherium nanum*, $P^{\underline{1}}$ is relatively larger than that tooth in *Diceratherium niobrarense*, the nasals are somewhat more produced in front of the nasal horn-cores, and are also apparently heavier than in the latter species. In the specimen in the collection of the

[15] The front of a skull and lower jaws in Yale Museum, No. 526.

[16] This specimen was referred by Cope to the species *Diceratherium nanum*, and is apparently identical with the type so far as comparison can be made.

Side View of Skull of *Diceratherium niobrarense* Peterson, $\frac{1}{3}$.



Palate View of *Diceratherium niobrarense* Peterson, $\frac{1}{3}$.

Side View of Skull and Lower Jaws and Crown View of Inferior Dentition of *Diceratherium cooki* Peterson, $\frac{1}{3}$.

American Museum of Natural History $P^{\underline{1}}$ and the nasals show very close similarities to those of the type specimen in the Yale Museum. The specimen in the American Museum is further distinguished from the type of *Diceratherium niobrarense* by the less convex contour of the skull from side to side, the smaller brain case and occipital condyles, the more complicated grinding surfaces of the teeth, and by a small

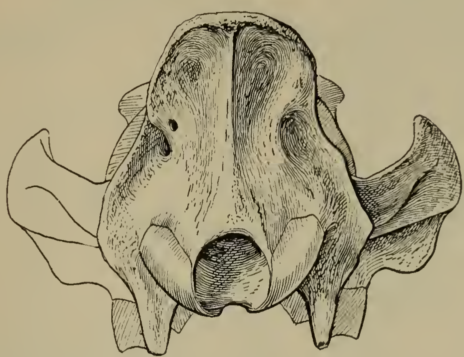


FIG. 11. Posterior view of skull of *Diceratherium niobrarense.* $\frac{1}{4}$ nat. size. Type, No. 1271.

tubercle in the median valley on the internal side of $M^{\underline{3}}$. The type of *D. niobrarense* and the specimen in the American Museum referred to *D. nanum* are very nearly of the same size. The type of *D. armatum* represents an animal of larger size, and there are other differences which were pointed out by Marsh (Am. Jour. Science (3), Vol. IX, p. 242, 1875).

Diceratherium cooki Peterson.

(Science, Vol. XXIV., No. 609, pp. 281–282, 1906.)

(PLATE XV.)

The modification of the teeth and the general construction of the skull of this species at once separates it from other American species. The European species *Diceratherium minimum* Cuvier is perhaps the most nearly allied. It is interesting to note that the configuration of the triturating surfaces of the teeth in *Diceratherium nanum* is more nearly similar to the present species than to *Diceratherium niobrarense* and *Diceratherium armatum*, and that the two latter have the teeth complicated in nearly the same degree.

In the abundant material of *Diceratherium cooki* in the Carnegie Museum a great variation in the size of the nasal horn cores is observed. This is undoubtedly due to differences in age, sexual characters, and individual variations. When the material from the Agate Spring Fossil Quarry is freed from the matrix full descriptions of the various forms will be given in the publications of the Carnegie Museum.

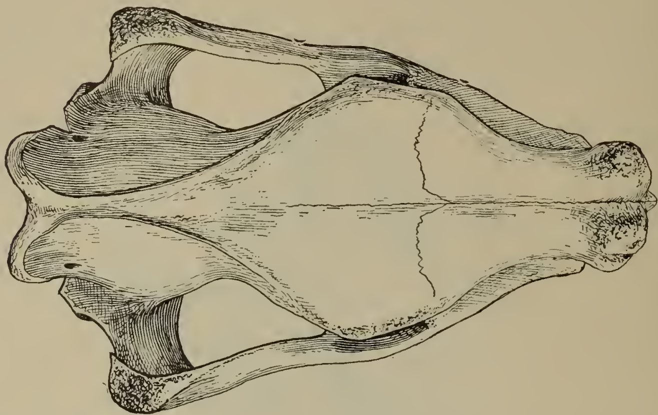


FIG. 12. Top view of skull of *Diceratherium cooki*. $\frac{1}{4}$ nat. size. Type, No. 1572.

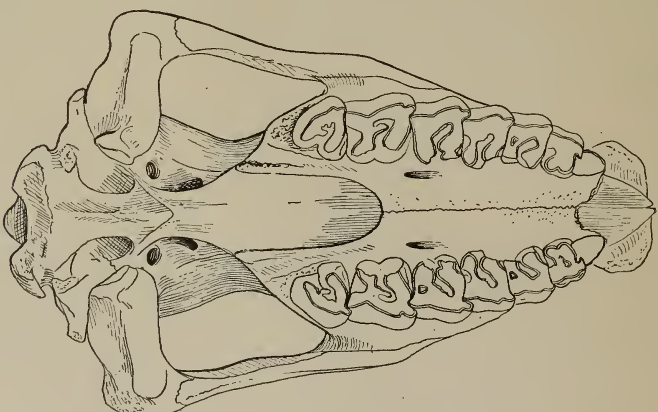
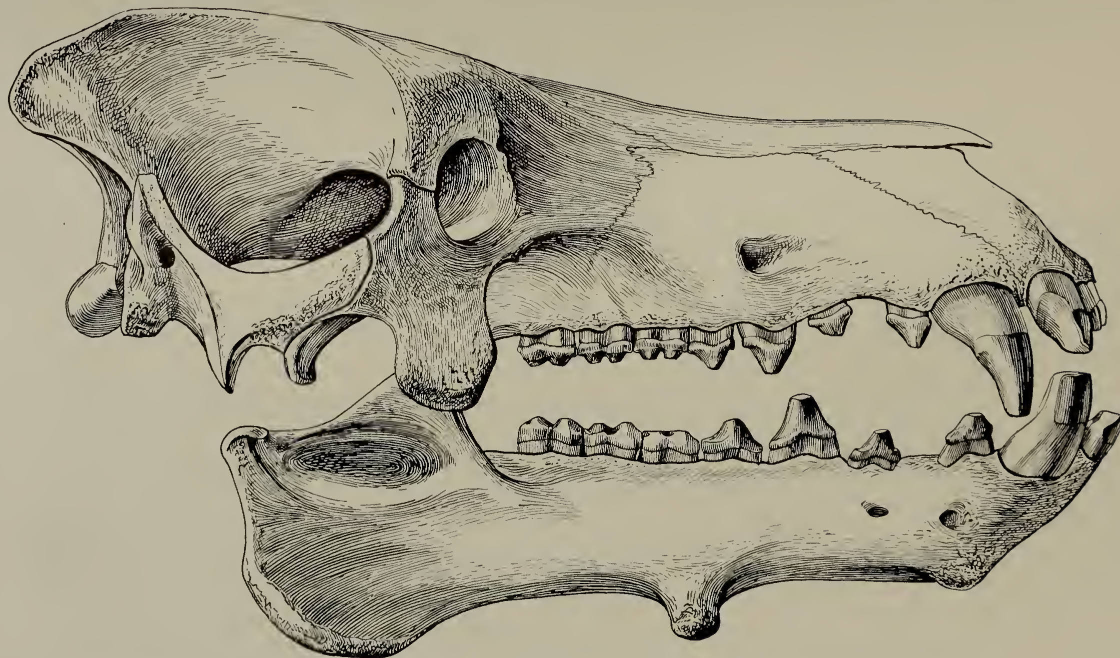
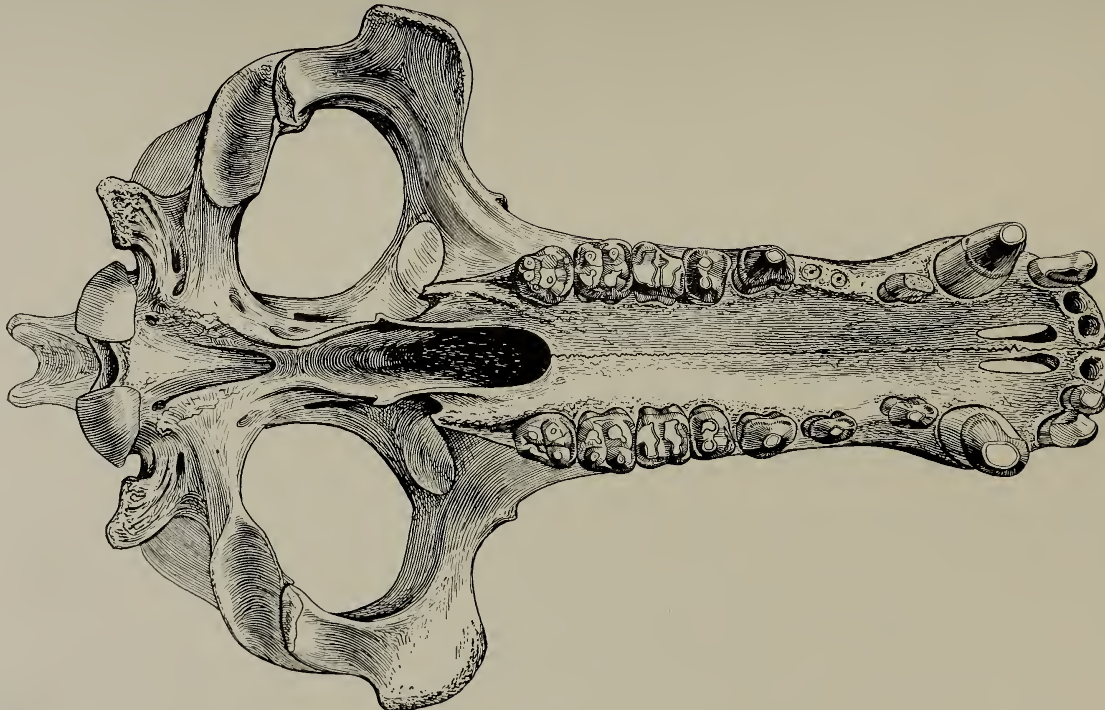


FIG. 13. Palate view of skull of *Diceratherium cooki*. $\frac{1}{4}$ nat. size. Type, No. 1572.



Side View of Skull and Lower Jaws of *Dinohyus hollandi* Peterson, $\frac{1}{6}$.



Palatal View of Skull of *Dinohyus hollandi* Peterson, $\frac{1}{6}$.

Dinohyus hollandi Peterson.

(*Science*, N. S., Vol. XXII., No. 555, pp. 211–212, 1905; No. 570, p. 719, 1905.)

(PLATES XVI. and XVII.)

The chief differences which distinguish the present genus from *Elotherium* are found in the modification of the dentition. The first upper premolar is proportionately larger, and $P^{\underline{3}}$ is reduced antero-posteriorly and enlarged transversely when compared with that tooth in *Elotherium*. The deuterocone of $P^{\underline{4}}$ is relatively larger than in the Oligocene genus.

In the inferior dentition a change corresponding to that in the upper jaw is apparent. Premolars one and two are large while premolar three is of a relatively less antero-posterior diameter than in *Elotherium*. The crowns of the premolars are more obtusely pointed than in *Elotherium*, and the tubercles of the molars are less distinctly separated than in the latter genus.

The zygomatic process of the jugal is much enlarged when compared with the corresponding process of the *Elotheria* from the Oligocene in the collections of the Carnegie Museum. This process in *Dinohyus* reaches to the glenoid cavity and assists in forming a strong buttress in front of it; while in the Oligocene genus (especially those forms from the lower levels) the process is rather slender and does not reach the anterior border of this articulation.

In the American Museum of Natural History is a well preserved specimen of *Elotherium ingens* (No. 572) from the Protoceras beds of South Dakota. The zygomatic process of the jugal of this specimen forms an independent downwardly directed process about 38 or 40 mm. in front of the glenoid cavity, but furnishes no apparent support for the condyle of the lower jaw. The broad and downwardly extended process of the jugal below the orbit, which is characteristic of *Elotherium* is much reduced in *Dinohyus*. On the inferior border of the mandible the anterior pair of protuberances is but slightly noticeable in *Dinohyus*.

More striking differences than those above given may be found in the structure of the limbs and feet when these portions of the type specimen shall be extracted from the matrix. It will then also be carefully compared with *Elotherium humerosum* Cope, the large form from the John Day formation of Oregon, which is represented only by limbs and feet in the collection of the American Museum of of Natural History.

MEASUREMENTS.

(Type specimen No. 1594, Carn. Mus. Cat. Vert. Foss.)

	mm.
Greatest length of skull	883
Distance from premaxillary to postorbital process of jugal	528
Distance from postorbital process of jugal to and including occipital condyle	305
Length of alveolar border of maxillary and premaxillary	465
Distance from median incisor to M^1	330
Length of molar series	130
Antero-posterior diameter of canine, at base	50
Transverse diameter of canine, at base	55
Antero-posterior diameter of P^1	37
Transverse diameter of P^1	22
Antero-posterior diameter of P^2	38
Transverse diameter of P^2	23
Antero-posterior diameter of P^3	44
Transverse diameter of P^3	33
Antero-posterior diameter of P^4	37
Transverse diameter of P^4	39
Antero-posterior diameter of M^1	42
Transverse diameter of M^1	43
Antero-posterior diameter of M^2	45
Transverse diameter of M^2	48
Antero-posterior diameter of M^3	45
Transverse diameter of M^3	45
Greatest length of mandible	700
Length of inferior dentition	460
Distance from median incisor to M_1	327
Length of molar series	142
Antero-posterior diameter of canine, near base	44
Transverse diameter of canine, near base	47
Antero-posterior diameter of P_1	37
Transverse diameter of P_1	21
Antero-posterior diameter of P_2	39
Transverse diameter of P_2	20
Antero-posterior diameter of P_3	54
Transverse diameter of P_3	28
Antero-posterior diameter of P_4	45
Transverse diameter of P_4	30
Antero-posterior diameter of M_1	43
Transverse diameter of M_1	32
Antero-posterior diameter of M_2	47

Skull of *Amphicyon superbus* Peterson, ½.

Transverse diameter of $M_{\overline{2}}$	36
Antero-posterior diameter of $M_{\overline{3}}$	49
Transverse diameter of $M_{\overline{3}}$	37

Amphicyon superbus, sp. nov.

(Type Specimen No. 1589, Carn. Mus. Cat. Vert. Foss.)

(PLATE XVIII.)

This species is represented by an exceptionally well preserved skull with the lower jaws, and portions of the skeleton. Only the skull and lower jaws are freed from the matrix and are illustrated in connection with this description. The specimen was found near the Agate Spring Fossil Quarry and in the same horizon. The type,[17] No. 1589, is remarkable for its close resemblance to *Canis;* in fact were it not for the relatively smaller brain case and the presence of $M^{\underline{3}}$ it might well be taken for a member of that genus.

The principal cranial characters of the type are as follows:

The skull is mesetocephalic, and the brain case is small. $I\frac{3}{3}$, $C\frac{1}{1}$, $P\frac{4}{4}$, $M\frac{3}{3}$. On comparing it with *Canis occidentalis* the following differences are noticeable. The fossil represents an animal very nearly the size of a fully adult gray wolf, but the skull is shorter and broader, the occipital condyles smaller, the basioccipital and basisphenoid of greater transverse diameter, the paroccipital processes further separated from the tympanic bulla, the mastoid larger, the tympanic bulla smaller, and the postglenoid process heavier. The most important differences from that of *Canis occidentalis* are perhaps the relatively smaller brain case, the presence of $M^{\underline{3}}$, the smaller sectorial tooth, with the larger internal tubercle, the larger $M^{\underline{2}}$, and the shorter and broader skull. In size and position all the foramina are nearly identical with those in *Canis occidentalis.*

The mandible, excepting the larger and deeper temporal fossa, is very similar to that of the wolf.

On comparing the type with that of *Amphicyon americanus* Wortman (*American Journal of Science*, Vol. XI., pp. 200–204, 1901) it is seen that the skull is smaller, the canines smaller and more rounded, the premolars larger, and the second and third premolars smaller. The internal cusp on the fourth upper premolar of *Amphicyon superbus* has a greater development, $M^{\underline{3}}$ has a more internal position in the alveolar border than in *Amphicyon americanus.*

[17] Two individuals of the same species were found together.

A fragment of a mandible (No. 408, Carn. Mus. Cat. Vert. Foss.) of *Amphicyon ? crucians* Filhol from the Quercy formation of Europe, with the molar series in place, shows close resemblance to the specimen under consideration. In *A. crucians* $M_{\overline{3}}$ is relatively smaller and the anterior portion of the crown is more elevated than in *A. superbus*.

MEASUREMENT.

	mm.
Greatest length of skull	253
Distance from occipital condyle to incisors	228
Distance from occipital condyle to $M^{\underline{3}}$	112
Distance from $M^{\underline{3}}$ to and including the incisors	117
Greatest transverse diameter of the skull	148
Transverse diameter of occipital condyle	46
Greatest transverse diameter of the brain case	58
Transverse diameter of the frontals at paroccipital processes	68
Transverse diameter of muzzle at canine	51
Length of premolar series	55
Length of molar series	34
Antero-posterior diameter of canine at base	13
Transverse diameter of canine at base	10
Antero-posterior diameter of $P^{\underline{1}}$	6
Transverse diameter of $P^{\underline{1}}$	5
Antero-posterior diameter of $P^{\underline{2}}$	11
Transverse diameter of $P^{\underline{2}}$	5
Antero-posterior diameter of $P^{\underline{3}}$	13
Transverse diameter of $P^{\underline{3}}$	7
Antero-posterior diameter of $P^{\underline{4}}$	22
Transverse diameter of $P^{\underline{4}}$, anteriorly	14
Antero-posterior diameter of $M^{\underline{1}}$	19
Transverse diameter of $M^{\underline{1}}$	24
Antero-posterior diameter of $M^{\underline{2}}$	13
Transverse diameter of $M^{\underline{2}}$	18
Antero-posterior diameter of $M^{\underline{3}}$	5
Transverse diameter of $M^{\underline{3}}$	8
Greatest length of mandible	182
Height of mandible at coronoid process	82
Length of premolar series	47
Length of molar series	46
Antero-posterior diameter of canine at base	12
Transverse diameter of canine at base	10
Antero-posterior diameter of $P_{\overline{1}}$	6
Transverse diameter of $P_{\overline{1}}$	4
Antero-posterior diameter of $P_{\overline{2}}$	10
Transverse diameter of $P_{\overline{2}}$	5
Antero-posterior diameter of $P_{\overline{3}}$	13

Transverse diameter of $P_{\overline{3}}$	6
Antero-posterior diameter of $P_{\overline{4}}$	16
Transverse diameter of $P_{\overline{4}}$	8
Antero-posterior diameter of $M_{\overline{1}}$	25
Transverse diameter of $M_{\overline{1}}$	11
Antero-posterior diameter of $M_{\overline{2}}$	14
Transverse diameter of $M_{\overline{2}}$	10
Antero-posterior diameter of $M_{\overline{3}}$	9
Transverse diameter of $M_{\overline{3}}$	7

Nothocyon (Galecynus) annectens sp. nov.

(Type Specimen, No. 1602, Carn. Mus. Cat. Vert. Foss.)

This species is provisionally referred to the genus *Nothocyon* though future discoveries of more and better material may necessitate separating it from that genus. The type (No. 1602) consists of the upper and lower jaws, the dentition being complete with the exception of the lower incisors. The specimen was found associated with the type of *Amphicyon superbus* in the upper part of the lower Harrison horizon near the Agate Spring Fossil Quarry, in Sioux County, Nebraska.

In size the type most nearly agrees with *Nothocyon lemur* from the John Day beds of Oregon. *Nothocyon latidens* is somewhat larger and the internal border of $M^{\underline{2}}$ has a greater antero-posterior diameter. According to Cope (Tertiary Vertebrata, p. 930) there are no intermediate tubercles on $M^{\underline{2}}$ in the latter species. Upon the whole, the dentition of the present specimen is more specialized than that of the forms from the John Day beds.[18]

The left side of the skull of the type has part of the orbit preserved; it was apparently of large size. The anterior border of the orbit is partly formed by the ascending process of the jugal. The postero-external portion of the maxillary is much convex antero-posteriorly, has a constricted area at $P^{\underline{2}}$ and a slight eminence over the canine. The muzzle evidently had a pointed appearance like that in *N. lemur*. The superior incisors are about uniform in size; the lateral incisor has a heavy cingulum on the internal face which extends obliquely downward and disappears at the external angle near the base. The canine is long, rather slender, and considerably re-

[18] Dr. Matthew, who kindly compared the specimen, points out that it reveals a combination of the characteristics of *N. lemur* and *N. latidens*.

curved. There is a slight groove near the base on the antero-internal angle, otherwise the enamel is quite smooth. $P^{\underline{1}}$ has a single sharp conical crown. $P^{\underline{2}}$ is implanted by two roots ; it has a high and sharp protocone and a very small posterior basal lobe. $P^{\underline{3}}$ is similar to $P^{\underline{2}}$, but somewhat larger, and possesses a slightly more pronounced posterior basal lobe, and a rounded and smooth external cingulum. The greatest difference between these forms and those from the John Day formation is in the proportions of the fourth premolar (carnassial). This tooth has a greater antero-posterior diameter than in *Nothocyon*

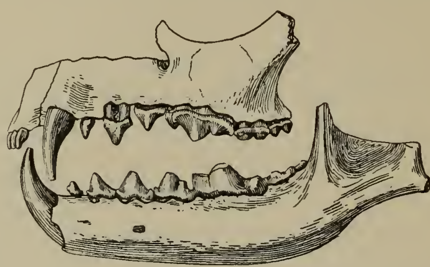


FIG. 14. Side view of upper and lower jaws of *Nothocyon annectens* Peterson. Natural size. Type, No. 1602.

geismarianus, though the latter species is of considerably larger size. In the present species $P^{\underline{4}}$ is surrounded by a cingulum and also has a fairly well developed deuterocone. The protocone and the postero-external blade are well developed and the fissure separating them is well marked. $M^{\underline{1}}$ has six tubercles on the grinding face ; two external, equal in size ; the anterior median large, while the posterior median is only a mere rudiment. The internal cingulum is developed into two equal-sized tubercles which are divided by a shallow fissure. The external cingulum is heavy and rounded. On $M^{\underline{2}}$ the anterior of the external pair of cusps is the larger of the two ; the median V-shaped ridge is somewhat similar to that in *N. lemur*, but its internal apex terminates in a tubercle, and there is in the present species a minute tubercle posteriorly in the median valley. The cingulum is very heavy internally, while externally it is not so well developed.

The mandible is slightly shallower than in *N. lemur*. The inferior border is evenly rounded from before backward to opposite $M_{\overline{3}}$, where the border rapidly ascends upwards and backwards, then more directly backwards, and forms a strong angle. The posterior exit of the dental canal is on a line horizontal with the grinding surfaces of the teeth. The base of the coronoid process is heavy, the masseteric fossa is deep, and there are two mental foramina, one below $P_{\overline{2}}$ and the other below $P_{\overline{3}}$.

The inferior incisors of the type are not preserved. The inferior canine is as heavy as the superior: it is strongly recurved, is somewhat grooved internally, has a light cingulum, and is covered with smooth enamel. There is a short diastema between the canine and $P_{\overline{1}}$; otherwise the teeth are set quite close together throughout. $P_{\overline{1}}$ has a simple crown with the protoconid shifted well forward. $P_{\overline{2}}$ and $P_{\overline{3}}$ have slight posterior marginal lobes and very minute anterior basal tubercles.

FIG. 15. Dentition of *Nothocyon annectens* Peterson. 1. Superior dentition. 2. Inferior dentition. Type, Nat. size.

cles. $P_{\overline{4}}$ is a larger tooth, and besides the posterior marginal lobe and anterior basal tubercle there is a well defined posterior accessory cusp. $P_{\overline{2}}$, $P_{\overline{3}}$, and $P_{\overline{4}}$ have rounded and small cingula. The carnassial tooth is very robust; its heel is broad and the external tubercle is somewhat larger than the internal. The anterior tubercles of $M_{\overline{2}}$ are closely connected and the posterior tubercles are low and small; there is a heavy anterior cingulum. $M_{\overline{3}}$ is rather small.

MEASUREMENTS.

	mm.
Length of upper dentition	38
Length of upper premolar series	21
Length of the molar series	10
Antero-posterior diameter of upper carnassial	10
Transverse diameter of upper carnassial, anteriorly	5
Antero-posterior diameter of M^1	7
Transverse diameter of M^1	8.7

Antero-posterior diameter of M^2	4
Transverse diameter of M^2	6
Length of inferior dentition from M_3 to and including the canine	38
Length of inferior premolar series	17
Length of inferior molar series	16
Antero-posterior diameter of M_1	9.5
Antero-posterior diameter of heel of M_1	3
Transverse diameter of heel of M_1	4
Antero-posterior diameter of M_2	5
Transverse diameter of M_2	3
Antero-posterior diameter of M_3	2
Transverse diameter of M_3	2

THE UPPER HARRISON (NEBRASKA) BEDS.

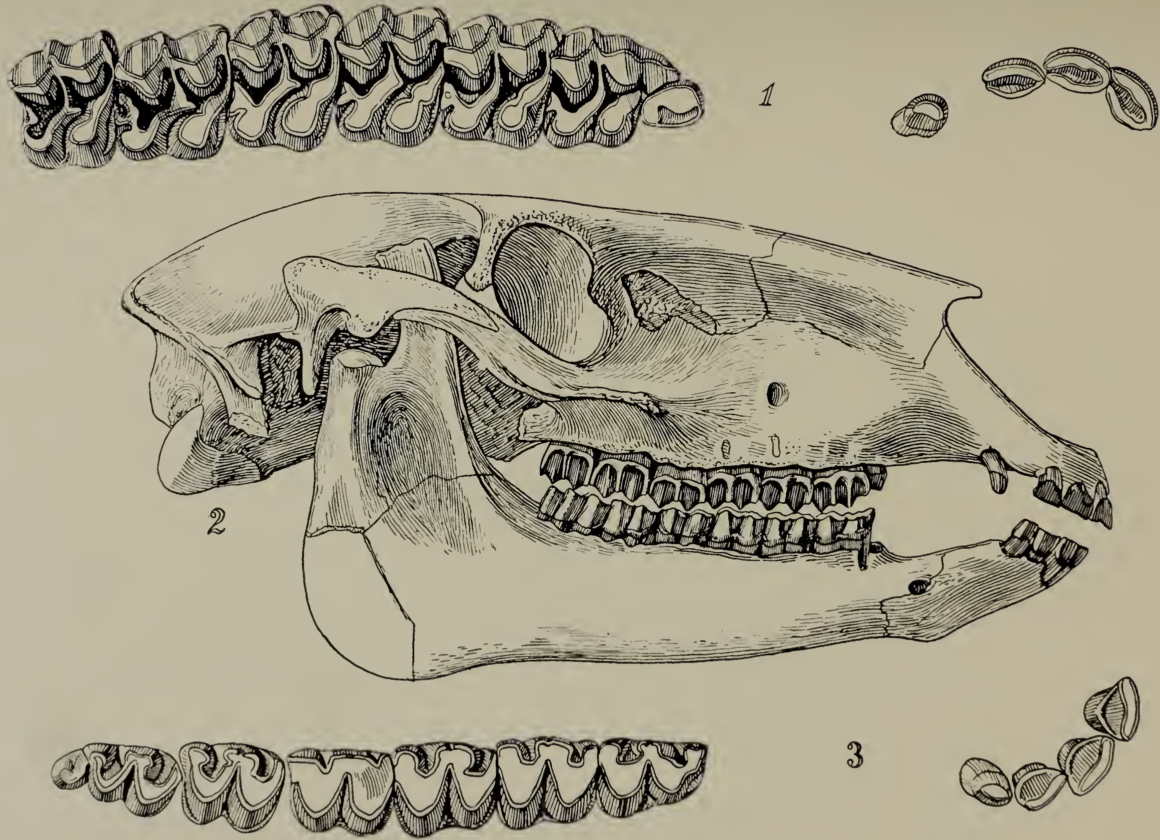
This horizon was definitely located both geographically and geologically by Hatcher in 1902.[19] No Proboscidian remains have as yet been found in this horizon, but the fauna include animals which are much modified, viz.: *Merycochœrus* and *Merychyus* among the Merycoidodonts, and many other forms of the *Artiodactyla*. *Parahippus* is well advanced, as are also some of the Carnivora. This horizon has yielded a richer fauna than any of the underlying beds of the lower Miocene in this locality. The horizon should perhaps be regarded as belonging to the middle Miocene.

LIST OF THE FAUNA.

Parahippus nebrascensis sp. nov.
Moropus ? elatus Marsh.
Merycochœrus.
Merychyus minimus, var. nov.
Blastomeryx.
? Procamelus.
Oxydactylus longipes Peterson.
Oxydactylus brachyceps Peterson.
? Thinohyus.
Canis vafer Leidy.
Ælurocyon brevifacies, gen. et sp. nov.
Testudo hollandi Hay.[20]
Testudo edæ Hay.[20]

[19] Proc. Am. Philos. Society, Vol. XLI., p. 117, 1902.

[20] Named and described by Dr. O. P. Hay, ANNALS OF THE CARNEGIE MUSEUM, Vol. IV., p. 18, *et seq*.



Parahippus nebrascensis Peterson. Fig. 1. Upper Teeth, $\frac{2}{3}$; Fig. 2. Skull, $\frac{1}{2}$; Fig. 3. Lower Teeth, $\frac{2}{3}$.

DESCRIPTION OF NEW MATERIAL.

Parahippus nebrascensis sp. nov.

(PLATE XIX.)

(Type No. 1440, Car. Mus. Cat. Vert. Foss.)

This species is based on a skull with the left mandible practically complete, the pelvis, the right femur, tibia, calcaneum, astragalus, and the proximal end of a metapodial of one individual. The specimen was found in the upper Harrison beds on Niobrara River, in Sioux County, Nebraska.

The remains represent a large species of this genus, and they are different in other respects from forms that have been described. On comparison with a cast of the type ($M^{\underline{2}}$?) of *Parahippus* (*Anchippus*) *texanus* Leidy, which is in the American Museum of Natural History, it appears that the present species more nearly resembles the type of *P. texanus* than any other species. The type of the latter represents a smaller animal than the species under consideration, and has the anterior median tubercle larger, and the ridge which connects the median with the internal tubercle more constricted. The postero-internal tubercle of $M^{\underline{2}}$ in *Parahippus nebrascensis* is more highly developed than that in *P. texanus*. The premolars are of proportionately large size when compared with the molars. This is characteristic of the genus. As usual the second premolar is the longest in the series. In *Parahippus nebrascensis* the protostyle of $P^{\underline{2}}$ is unusually well developed and it suggests the European species *Anchitherium aurelianense*.

The true contour of the skull is partially lost on account of lateral crushing. The lachrymal fossa is, however, plainly indicated. It is shallow when compared with that of *Hypohippus osborni* Gidley. The zygomatic arch is rather light, but the masseteric ridge of the jugal is proportionally more prominent, though shorter than in the recent horse. From the masseteric ridge upward and forward the face is gently concave, leaving no separate malar fossa. The orbit is large; its anterior border is opposite the anterior part of $M^{\underline{3}}$. Posteriorly the orbit is closed. The sagittal crest is well defined, but short. The occipital condyle is of large size and there are large accessory facets on the basi-occipital for the atlas.

The mandible is long and slender with a high and thin coronoid process and a well developed angle. Back of the canine, which forms a closed series with the incisors, there is a long diastema. On the left ramus is a small round alveolus for a single rooted $P_{\overline{1}}$, while the corresponding tooth apparently had dropped out and the alveolus almost closed on the right ramus of the jaw. The internal median tubercles of the inferior cheek-teeth are separated by a narrow groove, a character common to this genus. The cingula are well developed on the external faces of the cheek-teeth, while internally they are not nearly so well developed. Plate XIX is reproduced from carefully made drawings and illustrates many points which are omitted in this preliminary description.

The pelvis is broken off anteriorly and posteriorly and is depressed by vertical crushing; it shows, however, that it is relatively shorter antero-posteriorly and the anterior portion of the ilium is more rapidly expanded than in *Mesohippus*. The acetabulum is deep, as is also the pit for the round ligament. The pubis and ischium are quite robust, and the pubic symphysis is relatively heavier than in *Equus*. The obturator foramen is of considerable size and is subovate in outline.

The shaft of the femur is quite heavy and is nearly straight; the head is nearly sessile and has a deep narrow groove on the tibial border for the round ligament. The great trochanter is prominent, as are also the lesser and third trochanters. The distal end is characterized by its great antero-posterior diameter. The internal ridge of the rotular trochlea is much heavier than the external one, but is comparatively less highly developed than in *Equus*. The pit for the plantar muscle is deeper than in the recent horse.

The tibia is proportionally somewhat longer and slenderer than that of *Equus*. The fossa on the posterior face near the proximal end is deeper and is bounded by more prominent and sharper ridges laterally than in the latter genus. The cnemial crest extends lower down on the shaft of the bone and the internal malleolus of the distal end is relatively less developed than in the recent horse. The cuboid facet of the calcaneum is more oblique antero-posteriorly than that in *Equus*.

MEASUREMENTS.

	mm.
Distance from occiput to and including incisors	370
Distance from occiput to posterior border of orbit	157

Distance from posterior border of orbit to and including incisors	238
Length of the upper dentition	222
Length of upper premolar series	72
Length of upper molar series	64
Antero-posterior diameter of P^{1}	12
Transverse diameter of P^{1}	9
Antero-posterior diameter of P^{2}	26
Transverse diameter of P^{2}, posteriorly	24
Antero-posterior diameter of P^{2}	23
Transverse diameter of P^{3}	27
Antero-posterior diameter of P^{4}	23
Transverse diameter of P^{4}	27
Antero-posterior diameter of M^{1}	22
Transverse diameter of M^{1}	27
Antero-posterior diameter of M^{2}	23
Transverse diameter of M^{2}	27
Antero-posterior diameter of M^{3}	20
Transverse diameter of M^{3}, anteriorly	26
Greatest length of mandible, approximately	310
Vertical diameter of mandible at coronoid process	175
Vertical diameter of mandible at M_{3}	55
Vertical diameter of mandible at diastema in front of P_{1}	30
Length of lower premolar series	63
Length of lower molar series	66
Antero-posterior diameter of P_{2}	22
Transverse diameter of P_{2}, posteriorly	16
Antero-posterior diameter of P_{3}	20
Transverse diameter of P_{3}	17
Antero-posterior diameter of P_{4}	21
Transverse diameter of P_{4}	17
Antero-posterior diameter of M_{1}	21
Transverse diameter of M_{1}	16
Antero-posterior diameter of M_{2}	21
Transverse diameter of M_{2}	14
Antero-posterior diameter of M_{3}	26
Transverse diameter of M_{3}	12
Greatest length of femur	325
Transverse diameter of femur at proximal end	90
Transverse diameter of femur at distal end	71
Antero-posterior diameter of femur at distal end	86
Greatest length of tibia	325
Antero-posterior diameter of tibia at proximal end	74
Transverse diameter of tibia at proximal end	75
Antero-posterior diameter of tibia at distal end	41
Transverse diameter of tibia at distal end	54
Greatest length of calcaneum	98

Transverse diameter of calcaneum at sustentaculum	41
Greatest height of astragalus	53
Greatest transverse diameter of astragalus	46

Moropus elatus Marsh.[22]

Professor Marsh based his description of this species[23] upon a few foot bones. Since then but little additional material was found until the fortunate discoveries recently made by the field parties of the Carnegie Museum, and especially by Mr. W. H. Utterback in the Agate Spring Fossil Quarry during the present season. These important discoveries will, it is hoped, give us much welcome information in regard to this highly interesting animal. Mr. Utterback reports finding a great many vertebræ, ribs, limbs, and foot bones of one individual, besides numerous lower jaws, parts of limbs, and isolated bones, in the Agate Spring Fossil Quarry. The material is unfortunately as yet only partially prepared for study and description.

The specimen, No. 1424, was found near the base of the Upper Harrison beds on the Niobrara River in Sioux County, Nebraska, in 1901. The specimen consists of the radius, ulna, and part of the fore foot, the femur, the left tibia nearly complete, and part of the right tibia, a fragment of the fibula, the calcaneum and astragalus of both hind feet, and a few phalanges. The important question of the relative lengths of the fore and hind limbs is settled by this specimen

As in *Chalicotherium* (*Ancylotherium*) *pentelici* (Gaudry), the olecranon process of the ulna is short and heavy. Distally the radius and ulna are coössified,[24] and the two bones are rather slender and are very much elongated. The general shape of the carpus is similar to that in *Macrotherium giganteum* Gervais, but is not nearly so heavy. On the ulnar side of the scaphoid, at the distal end is a heavy and rounded process, which reaches over and articulates with the magnum in a similar manner to that in *Macrotherium giganteum*. The articulation for the scaphoid on the magnum is, however, more lateral in the latter

[22] Professors Cope and Scott have regarded *Moropus* as synonymous with *Chalicotherium*, while Osborn (*Am. Naturalist*, February, 1893, p. 122), regards *Moropus* as synonymous with *Macrotherium*, but recent study of the material collected by the parties of the Carnegie Museum reveals the fact that *Moropus elatus* is generically separable from these European genera.

[23] *Am. Jour. Science* (3), Vol. XIV., pp. 249–250, 1877.

[24] A large individual, No. 1604, from the Agate Spring Fossil Quarry, has the radius and ulna coössified throughout.

species than in the specimen under consideration. The unciform has a heavy projection on the antero-radial face, which extends upwards and radially over the ulnar border of the magnum. This character of the unciform is quite similar to that in *Chalicotherium*, but not so nearly like that in *Macrotherium giganteum*. On the posterior face of the trapezoid is an unusually deflected proximal articulation similar to that in *Chalicotherium*.

While the length of metacarpal II. is very nearly the same as in *Macrotherium giganteum* the bone is otherwise much lighter. Metacarpals III. and IV. are broken off a short distance below the heads.

The coössified first and second phalanges were found with this specimen and they are like those described by Professor Marsh.[25]

The head of the femur rests on a very short neck and the great trochanter apparently does not extend above the head. There is a broad and rugose third trochanter on the femur, a character which is wanting in *Chalicotherium*. The lesser trochanter is also quite prominent in our specimen. The condyles of the femur are broken. The tibia, which is short and heavy, has a prominent spine, which separates the broad articular facets for the distal end of the femur; the cnemial crest is well developed. The fibula, though small, has a complete shaft.

MEASUREMENTS.

	mm.
Greatest length of radius and ulna	600
Vertical diameter of scaphoid	40
Vertical diameter of trapezoid	30
Length of metacarpal II.	170
Transverse diameter of carpus at the head of the metacarpals	96
Length of femur, approximately	500
Length of tibia	385
Greatest length of calcaneum	113
Transverse diameter of tuberosity of calcaneum near the free end	35
Vertical diameter of astragalus	64
Greatest transverse diameter of astragalus	82

A pair of lower jaws (No. 1595, Carn. Mus. Cat. Vert. Fos.), which were found in the Agate Spring Fossil Quarry by Mr. W. H. Utterback, throw additional light upon the characters of this little known genus. $I_{\overline{3}}$, $C_{\overline{0}}$, $P_{\overline{3}}$, $M_{\overline{3}}$. The incisors are procumbent and crowded; they have long and heavy roots, broad and thick crowns,

[25] *Am. Jour. Sci.* (3), XIV., pp. 249–250, 1877.

and a light posterior cingulum. Premolars three and four are quite molariform. The jaw is long and slender, the symphysis well coössified, and there is a deeply emarginated diastema between the third incisor and $P_{\overline{2}}$. The dental series is well separated from the base of the coronoid process. The latter is thin transversely and broad antero-posteriorly, and has superiorly a gentle backward slope. The condyle is peculiar in having a broad and flat articular surface, not convex as is usual in mammals. The mandible is much constricted in front of $P_{\overline{2}}$. The mental foramina are large.

Chalicotherium bilobatum was established by Cope[26] on a mandibular symphysis and part of the left ramus of an adult animal from the Tertiary on Swift Current Creek in Canada. Cope states that "all the premolars [are] two-rooted, showing that they are but three in number"; this agrees with the specimen here described. Cope states further that the canines and incisors are wanting in the Canadian specimen. The "minute traces of alveoli of a canine and two incisors on each side, which were probably present in the fœtus" is of strong specific, if not generic importance, The type of *C. bilobatum* appears, from Cope's description, to be too imperfect for correct comparison and may result in placing it in the genus *Moropus*, when more complete material is found.

MEASUREMENTS.

	mm.
Greatest length of mandible	430
Distance from $I_{\overline{3}}$ to $P_{\overline{2}}$	53
Distance from $P_{\overline{2}}$ to and including $P_{\overline{4}}$	68
Distance from $P_{\overline{4}}$ to and including $M_{\overline{3}}$	119
Antero-posterior diameter of $P_{\overline{2}}$	17
Transverse diameter of $P_{\overline{2}}$	11
Antero posterior diameter of $P_{\overline{3}}$	23
Transverse diameter of $P_{\overline{3}}$	15
Antero-posterior diameter of $P_{\overline{4}}$	28
Transverse diameter of $P_{\overline{4}}$	19
Antero-posterior diameter of $M_{\overline{1}}$	32
Transverse diameter of $M_{\overline{1}}$	19
Antero-posterior diameter of $M_{\overline{2}}$	40
Transverse diameter of $M_{\overline{2}}$	22
Antero-posterior diameter of $M_{\overline{3}}$	44
Transverse diameter of $M_{\overline{3}}$	22
Vertical diameter of mandible at $M_{\overline{3}}$	70
Vertical diameter of mandible at $P_{\overline{2}}$	52

[26] *Am. Naturalist*, Vol. XXIII., pp. 151–155, 1889.

The fragment (No. 1596) of the left maxillary with P^3, P^4, and the molar series, was also collected in the Agate Spring Quarry by Mr. Utterback. The size of the teeth is very nearly as great as that of the specimen which Professors Scott and Osborn described (Bull. Museum Comp. Zool., Vol. XX, p. 100, 1890), but unfortunately the present specimen represents an older individual with teeth too much worn for accurate comparison. As the relative sizes of the teeth agree I judge that the specimens in the Carnegie Museum represent the same species as that which Osborn described. To the observations of the latter author I may add that M^2 and ^{3} are of very nearly equal diameters and of nearly the same structure throughout; they are, respectively, one third greater antero-posteriorly than M^1 and are characteristically similar to the teeth of *Titanotherium* as has been stated by others.

MEASUREMENTS.

	mm.
Antero-posterior diameter of P^3 and P^4	43
Antero-posterior diameter of molar series	134
Antero-posterior diameter of P^3	21
Transverse diameter of P^3	25
Antero-posterior diameter of P^4	23
Transverse diameter of P^4	27
Antero-posterior diameter of M^1	36
Transverse diameter of M^1	30
Antero-posterior diameter of M^2	54
Transverse diameter of M^2	37
Antero-posterior diameter of M^3	54
Transverse diameter of M^3	39

Merycochœrus? proprius Leidy.

From the material at hand there is apparently a wide range of individual variation in this species. When more material is collected and the different varieties are better known it may be necessary to separate certain specimens (Nos. 1399, 1306, Carnegie Museum Catalogue of Vertebrate Fossils) and give to them a new specific name. For the present the writer thinks it best to give only the principal differences between these and those of the type of *Merycochœrus proprius*.

No. 1399 is less robust and differs from the type of *Merycochœrus proprius* by having a relatively longer maxillary bone, and by having the premolar somewhat wider and longer, measuring antero-posteriorly. A pair of lower jaws, No. 1306 (Carnegie Museum Catalogue of Vertebrate Fossils), which I regard as of the same variety as the cranium No. 1399, has the mandible shallower and the lower premolars less crowded than in the type of *Merycochœrus proprius*.

From other remains in the Carnegie Museum which are like those in the American Museum which have been referred to *M. proprius* by Dr. Matthew (Memoirs Am. Mus. Nat. Hist., Vol. I., pp. 397–418, 1901) the specimens here described differ by having a longer sagittal crest, a less prominent ridge on the parietals, and a less developed process on the posterior part of the zygomatic arch. The brain cavity also is apparently larger.

MEASUREMENTS.

	No. 1399. mm.	No. 1306. mm.
Greatest length of the skull	322	
Distance from occipital condyle to incisors	314	
Distance from postglenoid process to M^3	79	79
Distance from M^3 to and including incisors	191	189
Transverse diameter of occipital condyle	56	
Greatest transverse diameter of skull, approximately	215	
Greatest transverse diameter of brain case	110	
Transverse diameter of frontals over the orbits	125	
Antero-posterior diameter of orbit	41	
Vertical diameter of orbit	41	
Antero-posterior diameter of the canine	12	12
Transverse diameter of the canine	13	12
Antero-posterior diameter of P^1		15
Transverse diameter of P^1		8
Antero-posterior diameter of P^2	16	17
Transverse diameter of P^2	11	11
Antero-posterior diameter of P^3	16	16
Transverse diameter of P^3	12	12
Antero-posterior diameter of P^4	15	15
Transverse diameter of P^4	17	17
Antero-posterior diameter of M^1	23	23
Transverse diameter of M^1	23	23
Antero-posterior diameter of M^2	34	33
Transverse diameter of M^2	26	26
Antero-posterior diameter of M^3	37	37
Transverse diameter of M^3 at median external rib of the tooth	26	26
Greatest length of mandible		265
Greatest vertical depth of mandible		134
Vertical depth of mandible at M_3		54
Vertical depth of mandible at P_1		45
Length of lower dentition		185
Length of premolar series		67

	No. 1306 mm.
Length of molar series	92
Antero-posterior diameter of $P_{\overline{1}}$	18
Transverse diameter of $P_{\overline{1}}$	10
Antero-posterior diameter of $P_{\overline{2}}$	17
Transverse diameter of $P_{\overline{2}}$	9
Antero-posterior diameter of $P_{\overline{3}}$	19
Transverse diameter of $P_{\overline{3}}$	10
Antero-posterior diameter of $P_{\overline{4}}$	19
Transverse diameter of $P_{\overline{4}}$	11
Antero-posterior diameter of $M_{\overline{1}}$	19
Transverse diameter of $M_{\overline{1}}$	16
Antero-posterior diameter of $M_{\overline{2}}$	29
Transverse diameter of $M_{\overline{2}}$	17
Antero-posterior diameter of $M_{\overline{3}}$	41
Transverse diameter of $M_{\overline{3}}$	17

Merychyus medius Leidy.

A number of incomplete specimens, Nos. 1049, 1337, and 1411, from the Upper Harrison beds are provisionally referred to this species, inasmuch as in size and dentition they nearly agree with Leidy's type. (The Extinct Mammalian Fauna of Dakota and Nebraska, Pl. XI., Figs. 12, 13, 14). Very careful comparison with the types of *Merychyus medius*, *Merycochœrus rusticus*, and the specimens in the Carnegie Museum shows that the dentition is so nearly identical as not to warrant separation. Other features of the cranium of the type specimen of *Merycochœrus rusticus*, however, differ from the specimens here referred to *Merychyus medius* in having the muzzle more produced in front of the nasals, and the infraorbital foramen placed further back as in *Merycochœrus proprius*. The type of *M. rusticus* was found on the Sweetwater River in Wyoming and may belong to a different geological horizon.

Among the specimens referred to *Merychyus medius* a fragment of a skull (No. 1409) presents a prominent sagittal crest which extends well forward. The temporal ridge is quite prominent posteriorly, but gradually fades away before reaching the orbit, which is incomplete through crushing. The frontals are slightly convex from side to side, except in the median line near the junction with the nasals, where they are slightly concave laterally. The nasals are not complete, but the contact of the naso-maxillary suture indicates that they are of a relatively greater length than in *Merycochœrus*. The brain cavity is of moderately large size. The lachrymal pit is large and deeply excavated. The position of the infraorbital foramen is above $P^{\underline{4}}$, which is a distinguishing feature of the genus *Merychyus*. It is of interest to note the greatly inflated region of the anterior part of the jugal and the lachrymal bones. There are deep, narrow, subovate excavations on either side of the median line of the basisphenoid. The tympanic bulla was evidently of large size, and the postglenoid is remarkably heavy. The posterior nares are not so far back as in *Merycochœrus proprius*.

MEASUREMENTS.

	No. 1337. mm.	No. 1411. mm.	No. 1049. mm.
Distance from postglenoid process to $M^{\underline{3}}$			62
Transverse diameter of brain case			66
Greatest transverse diameter of skull			160
Vertical diameter of jugal below orbit			32
Length of upper molar series	56		59
Length of upper premolar series		48	
Antero posterior diameter of $P^{\underline{1}}$		11	
Transverse diameter of $P^{\underline{1}}$		5	
Antero-posterior diameter of $P^{\underline{2}}$		13	
Transverse diameter of $P^{\underline{2}}$		9	
Antero-posterior diameter of $P^{\underline{3}}$		12	
Transverse diameter of $P^{\underline{3}}$		12	
Antero-posterior diameter of $P^{\underline{4}}$		12	
Transverse diameter of $P^{\underline{4}}$		14	
Antero-posterior diameter of $M^{\underline{1}}$	13	16	13
Transverse diameter of $M^{\underline{1}}$	16	19	
Antero-posterior diameter of $M^{\underline{2}}$	20	23	
Transverse diameter of $M^{\underline{2}}$	20	23	
Antero-posterior diameter of $M^{\underline{3}}$	24		26
Transverse diameter of $M^{\underline{3}}$	21		24
Length of mandible		206	
Vertical height of mandible at coronoid process		103	
Vertical diameter of mandible at $M_{\overline{3}}$	37	46	
Vertical diameter of mandible at $P_{\overline{3}}$	26	36	
Length of lower molar-premolar series	103	118	
Length of lower premolar series	43	51	
Antero-posterior diameter of $P_{\overline{1}}$	11	13	
Transverse diameter of $P_{\overline{1}}$	7	7	
Antero-posterior diameter of $P_{\overline{2}}$	10	12	
Transverse diameter of $P_{\overline{2}}$	6	6	
Antero-posterior diameter of $P_{\overline{3}}$	14	14	
Transverse diameter of $P_{\overline{3}}$	9		
Antero-posterior diameter of $P_{\overline{4}}$	15	16	

	No. 1337. mm.	No. 1411. mm.
Transverse diameter of $P_{\overline{4}}$	10	11
Antero-posterior diameter of $M_{\overline{1}}$	13	15
Transverse diameter of $M_{\overline{1}}$	12	12
Antero-posterior diameter of $M_{\overline{2}}$	17	20
Transverse diameter of $M_{\overline{2}}$	13	15
Antero-posterior diameter of $M_{\overline{3}}$	29	34
Transverse diameter of $M_{\overline{3}}$	14	15

Merychyus minimus subsp. nov.

This subspecies is based on a series of fifteen individuals from the Upper Harrison beds in Sioux County, Nebraska, now in the collection of the Carnegie Museum. Of this series No. 1466 is selected as the type. It consists of the skull, lower jaws, fragments of vertebræ, limbs, and a fore foot. The remains are all smaller than the type of *M. leptorhynchus* Cope which is the next largest variety, or subspecies. Besides the smaller size there are other slight differences which are quite constant and which distinguish it from the larger species, viz.: the slightly more advanced position of the infraorbital foramen, the relatively shorter sagittal crest, the shorter symphysis and the shallower

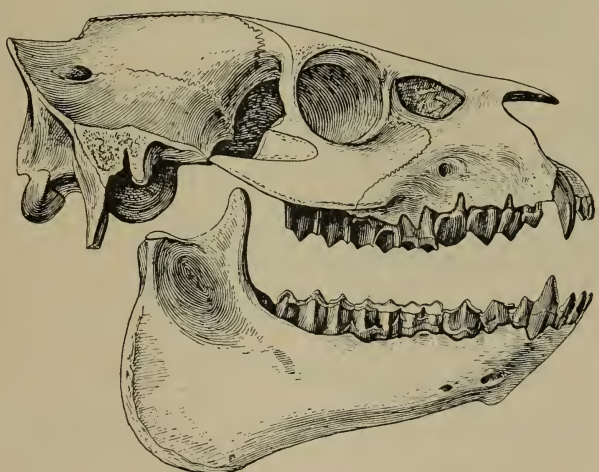


FIG. 16. *Merychyus minimus* Peterson. View of right side of skull, ½ nat. size. Type, No. 1466.

horizontal ramus of the lower jaw. The second and third upper premolars are more complicated than in *Merychyus leptorhynchus*, but this may prove to be only an individual difference of the latter species. The postorbital region of *Merychyus arenarum* Cope is proportionately longer than in the present species. *Merychyus elegans* Leidy and *Merychyus arenarum* Cope are very nearly of the same size, and the other slight differences between the two species may yet prove to be only individual variations. *Merychyus parigonus* Cope is doubtfully referred to this genus, as is also *Merychyus major*.[27] *Merychyus medius* is of much larger size than the present species. *Merychyus harrisonensis* differs from the present species by the larger size, the less angulate post-temporal crest, the more outwardly directed paroccipital process, the more depressed tympanic bulla, the more backwardly directed external auditory meatus, and the relatively smaller antero-posterior diameter of $M\underline{3}$.

MEASUREMENTS.

	mm.
Greatest length of the skull	160
Distance from occipital condyle to the incisors	146
Distance from occipital condyle to $M\underline{3}$	65[28]
Distance from $M\underline{3}$ to the incisors	83
Transverse diameter of occipital condyles	28
Transverse diameter of brain case, approximately	40
Antero-posterior diameter of the premolar series	30
Antero-posterior diameter of the molar series	39
Greatest length of the mandible	129
Length of the alveolar border of mandible	83
Vertical diameter of mandible at coronoid process	73
Vertical diameter of mandible at anterior part of $M_{\overline{3}}$	26
Vertical diameter of mandible at anterior part of $P_{\overline{4}}$	20
Length of lower premolar series	30
Length of lower molar series	43

Ælurocyon brevifacies gen. et sp. nov.

(Type No. 1590, Carn. Mus. Cat. Vert. Foss.)

The present genus and species is based on a mutilated skull, with most of the dentition of one side, the lower jaws, fragments of the pelvis and a femur, three metapodials, part of the posterior dorsals, and

[27] It may become necessary to remove this species from the genus *Merychyus* when more material is found in the locality where the type was discovered.

[28] Slight crushing of the region of the presphenoid causes this measurement to be a little conjectural.

most of the lumbar vertebræ. The specimen (No. 1590) was found in 1901, in the Upper Harrison beds on the Niobrara (Running Water) River, in Sioux County, Nebraska.

Though the general appearance of the specimen is cat-like, many characters indicate that it should not be included in the Felinæ and that it should be placed in the Mustelinæ. The general appearance of the dentition is strikingly similar to that in *Gulo luscus* Linnæus and the Cape ratel. The heavy lateral incisor, the large size and crowded position of the premolars, the short heel of the inferior carnassial, and the broad internal border of $M_{\overline{1}}$ are perhaps the most marked characters common to the genera *Gulo* and *Ælurocyon.*

Mellivorodon palæindicus Lydekker is smaller in size than *Ælurocyon.* The Indian fossil also lacks $P_{\overline{1}}$. Premolars $\overline{2}$, $\overline{3}$, and $\overline{4}$ are relatively smaller and the carnassial is larger antero-posteriorly. *Mellivorodon palæindicus* also is without the posterior basal accessory cusp on $P_{\overline{4}}$.

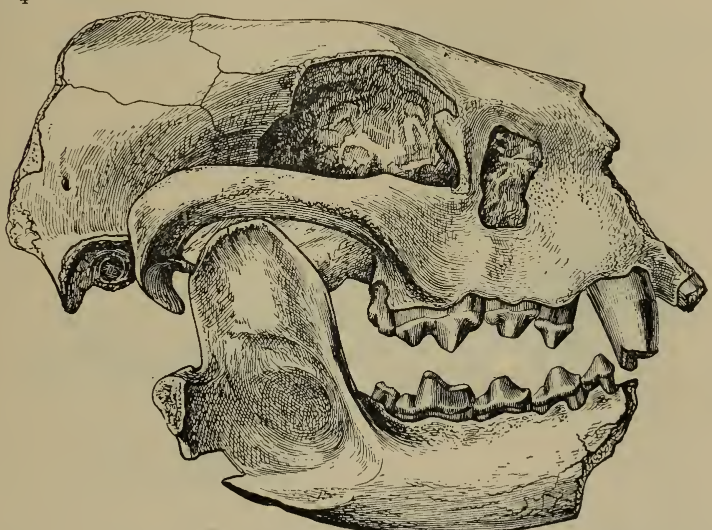


FIG. 17. *Ælurocyon brevifacies* Peterson. View of right side of skull, ½ nat. size. Type, No. 1590.

PRINCIPAL CHARACTERS.

$I\frac{1+}{1+}$, $C\frac{1}{1}$, $P\frac{4}{4}$, $M\frac{2}{2}$. The cranium is high; the face is short and cat-like; the inferior border of the lower jaw is evenly rounded from before backward; the temporal fossa of the lower jaw is deep and of large size, and the coronoid process is heavy and nearly vertical in its position. The teeth, especially the molar-premolar series, are relatively blunt. The third incisor is very large, the canine is short, robust, and oblong in cross-section. P^1 is one-rooted and its position is postero-internal from the canine. P^2 is heavy and has a simple crown. P^3 is nearly twice the size of the tooth preceding it, and has a small posterior basal cusp and an enlarged swelling of the cingulum on the anterior portion of the tooth. The carnassial tooth is massive, with a prominent deuterocone and a heavy posterior blade. The diameters of M^1 are small antero-posteriorly and large transversely; the internal and external borders are equally broad. The mandible is very robust and the posterior heel of the lower carnassial tooth is small. The sagittal crest is well defined, the orbit is large, the mastoid process relatively large, and the external auditory meatus is of moderately large size.

The lumbar vertebræ, the fragments of limb and foot bones, which were found associated with the skull and jaws above described, are unmistakably those of a carnivore, and presumably they belong with the same individual. The anapophyses and the interlocking of the zygapophyses of the lumbars are similar to those in *Hoplophoneus* and the Felinæ generally.

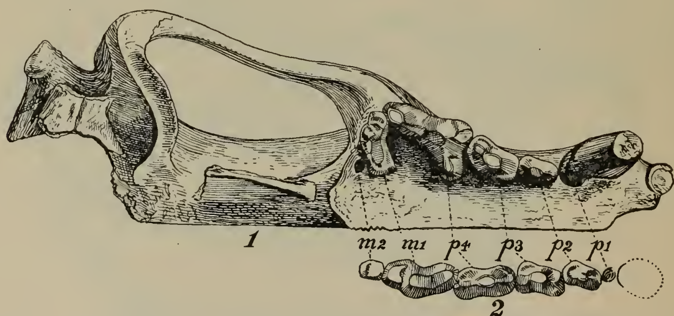


FIG. 18. Palate view of *Ælurocyon brevifacies* Peterson. 1. Superior dentition. 2. Inferior dentition, $\frac{1}{2}$ nat. size. Type, No. 1590.

A fragment of a pelvis indicates a heavy pubis which projects well downward and would, if complete, give to this region of the pelvic cavity a great vertical depth. In front of the acetabulum the ilium has a short constricted area, and the contact for the sacrum is well back, like that in the bear. The head of the femur is on a rather long neck, the great trochanter is low and small, as in *Gulo luscus;* the digital fossa is also like that in the latter genus. The metapodials are unusually short and heavy, their articulations and general appearance are much like those in *Mellivora* and *Gulo luscus.*

FIG. 19. *Ælurocyon brevifacies* Peterson. 1. Fragment of pelvis. 2. Head of femur. 3–5. Metapodials, $\frac{1}{2}$ nat. size. Type, No. 1590.

MEASUREMENTS.

	mm.
Greatest length of the skull fragment	189
Distance from glenoid cavity to M^2	55
Length of upper dentition from M^3 to and including canine	78
Antero-posterior diameter of canine, at base	16
Transverse diameter of canine, at base	13
Antero-posterior diameter of P^3	16
Transverse diameter of P^3	9
Antero-posterior diameter of P^4	24
Transverse diameter of P^4, anteriorly	16
Antero-posterior diameter of M^1	9
Transverse diameter of M^1	18
Total length of lower jaw fragment	129
Vertical diameter of mandible at coronoid process	75
Vertical diameter of mandible at M_2	37
Vertical diameter of mandible at P_3	35
Length of premolar series	44
Length of molar series	27
Antero-posterior diameter of P_2	11
Transverse diameter of P_2	7
Antero-posterior diameter of P_3	15
Transverse diameter of P_3	9
Antero-posterior diameter of P_4	17
Transverse diameter of P_4	10

	mm.
Antero-posterior diameter of $M_{\overline{1}}$	21
Transverse diameter of $M_{\overline{1}}$	10
Antero-posterior diameter of $M_{\overline{2}}$	7
Transverse diameter of $M_{\overline{2}}$	5

RODENTIA.

Fig. 20, which is here given, represents what appears to be an upper premolar tooth which was found in the Upper Harrison beds, two miles north of Agate Spring Fossil Quarry in Sioux County, Nebraska. The tooth may represent an undescribed genus related to *Meniscomys* or a primitive mylogaulid. In outline the tooth is less triangular than the former, and of less antero-posterior diameter than that in *Mylogalus*. The tooth is deeply grooved on the sides, plainly indicating the position of the two roots, which are fused together.

FIG. 20. Tooth of Rodent. $\frac{2}{1}$.

IV. A NEW SPECIES OF LONICERA FROM PENNSYLVANIA.

By Otto E. Jennings.

(Plate XX.)

Among some botanical specimens collected by Mr. W. E. Clyde Todd in western Ontario during the summer of 1906, and which were submitted to the writer for determination, was a branch of *Lonicera oblongifolia* (Goldie) Hooker, which differed so radically from specimens collected on several occasions in northwestern Pennsylvania by the writer, and regarded at that time as *Lonicera oblongifolia*, that a possible confusion of species was at once suggested. By the kind courtesy of Prof. J. M. Macoun, the writer was permitted to make a careful examination of the specimens of *Lonicera oblongifolia* in the Herbarium of the Geological Survey of Canada. These collections, together with the collections in the Herbaria of the Carnegie Museum, it is believed, represent a fairly representative series of the plants in question and it appears from them that there is ample justification for the recognition of a new species closely allied to *Lonicera oblongifolia* and belonging with it in the subsection Oblongifoliæ Rehder.

In his "Synopsis of the Genus Lonicera" Rehder[1] characterizes the subsection Oblongifoliæ, founding it upon "*Lonicera oblongifolia* Hooker" and including only that species and its *forma* "*calyculata*, Zabel," which Rehder says "differs only in the distinctly toothed calyx." The relations of the subsection to the other subsections of the genus are well stated by Rehder: "A monotypic group restricted to northeastern North America.[2] It has no strongly marked characters, but as it shows no close relation to any other species, it seems best to consider it as representing a separate subsection. Its nearest affinity is with the Alpigenae, but it differs chiefly in the obsolete bractlets, wholly adnate to the ovaries and therefore indistinct, by the very caducous bracts, the absence of glands, the kind of pubescence

[1] Rehder, Alfred. Synopsis of the Genus Lonicera. Missouri Botanical Garden, 14th Annual Report: 27–232. 1903.

[2] *L. c.*, p. 101.

and the small seeds. *L. oblongifolia* may be considered the American representative of the Alpigenae of the Old World, but it is less closely allied to that group than is *L. oblongifolia* to the Old World Rhodanthæ. Both species differ from their allies in the caducous bracts and the tendency of the bractlets to become obsolete."

Lonicera oblongifolia was first described by John Goldie in 1822 as *Xylosteum oblongifolium*[3]; Hooker first characterized it as a *Lonicera* in his *Flora Borealis Americana* in 1833.[4] The original description which was kindly copied for the writer by Mr. Edward J. Nolan of the Academy of Natural Sciences of Philadelphia, is as follows: "*Xylosteum oblongifolium*; baccis coadunatis, foliis oblongis lanceolatisque obtusis junioribus præcipue corollisque pubescentibus."

Habitat. — In one spot only in a swamp on the island of Montreal. *Fl. July.*

A *shrub* of about four feet in height, much branched, with pale glabrous bark. *Leaves* lanceolate, and very pubescent on both sides in the younger branches, oblong, obtuse, and only slightly pubescent beneath in the older ones, veiny. *Peduncles* about an inch long. *Germens* coadunate, producing two yellowish pubescent flowers. *Bracteas* two, excessively minute, broadly ovate, appressed, and, as well as the scarcely lobed calyx, glabrous. *Berries* red."

DESCRIPTION OF NEW SPECIES.

Lonicera altissima sp. nov.

Frutex gracilis erectus, 1.5–3.5 m. altus: cortice glabra cinerea: ramis juvenibus subpurpureis: foliis oblanceolatis vel obovatis, vel raro ovalibus, subdensis, marginibus revolutis utrinque glabris, supra pallidulo-viridibus, nervis depressis, subtus pallidis, glaucis, acriter reticulatis; apice acutulo vel retuso plerumque mucronato; basi sensim angustata in petiolum valde brevem (1 mm. longum) marginatum, vel sessile: floribus 1.2–1.8 cm. longis, geminis ad apices pedunculorum gracilium axillarium 2–3.2 cm. longorum; bracteis et lobis calycis plerumque in toto obsoletis; corolla flava, extra subpurpurea, intra purpurea, ad basin gibbosa, glabra vel raro ad basin subpubescente, bilabiata ad vel plerumque infra medium, lobis late obtusis; staminibus leviter exsertis, filamentis purpureis ad basin

[3] Goldie, John. *Jameson's Edinburg Philosophical Journal*, 6: 323, 1822.
[4] Hooker, Wm. J. "Flora Borealis Americana," 1: 284, 1833.

Lonicera altissima Jennings.

pubescentibus; stylis purpureis sæpe pubescentibus, cum filamentis æquilongis; ovariis glabris prope ad apicem connatis: baccis globosis, bioculatis 1.0–1.4 cm. crassis, sucidis, rubris, plerumque glaucis; seminibus 3–4 mm. longis, lævibus, lucidis, ochraceis plerumque plus minusve oblongo-lenticularibus.

A slender erect shrub 1.5–3.5 m. high: bark glabrous, gray: young twigs purplish: leaves oblanceolate to obovate, or rarely oval, thickish, margins revolute, glabrous on both sides, above light green, nerves sunken, below pale, glaucous, sharply reticulated; apex somewhat acute to retuse, usually mucronate; base gradually narrowed into a very short (1 mm. long) margined petiole, or sessile: flowers 1.2–1.8 cm. long, paired at the apexes of slender axillary peduncles 2–3.2 cm. long; bracts and lobes of the calyx usually wholly obsolete; corolla yellow, purplish tinged outside, purple inside, gibbous at the base, glabrous or rarely slightly pubescent at the base, two-lipped to the middle or usually below, lobes broadly obtuse; stamens slightly exserted, filaments purple, pubescent toward the base; style purple, often pubescent, same length as filaments; ovaries glabrous, united almost to the top: berries spherical, two-eyed, 1.0–1.4 cm. in diameter, juicy, red, usually glaucous; seeds 3–4 mm. long, smooth, shining, ochraceous, usually more or less oblong-lenticular.

The type specimens, now in the Pennsylvania Herbarium of the Carnegie Museum, were collected by the writer about one mile southeast of Linesville, Crawford County, Pennsylvania, in the Pymatuning Swamp. Specimens were collected in full bloom June 7, 1904, with ripe fruit, August 19, 1904, and again June 13, 1905, shortly after the bloom had fallen. The plants were growing in a water-soaked soil partly covered with Sphagnum and were associated with *Rhus vernix* Linnæus, *Alnus incana* (Linnæus) Willdenow, *Ilicioides mucronata* (Linnæus) Britton, *Spathyema fœtida* (Linnæus) Rafinesque, *Sarracenia purpurea* Linnæus, etc., the whole constituting an ecological formation probably transitional to the typical *Tamarack-Sphagnum* bog formation.

The specific name, *altissima*, has been given this plant because of its tall, slender habit. Many of the shrubs were over ten feet in height, a height probably not attained by any other shrubby *Loniceras* of northeastern North America.

Specimens closely approaching the type specimens of *Lonicera altissima* were seen by the writer, as follows: Swamps, Courtland, Ontario (Macoun, 62,956); Stittsville, Ontario (Macoun); New Haven, Vermont (Brainerd).

The following key, arranged mainly in accordance with the plan followed in Britton's Manual,[5] will serve to more clearly contrast the diagnostic characters of the species of *Lonicera*, as now recognized as occurring in northeastern North America.

KEY TO THE SPECIES OF LONICERA OCCURRING IN THE NORTHEASTERN UNITED STATES AND CANADA.

Vines.
- Flowers in heads or interrupted spikes.
  - Corolla two-lipped.
    - Corolla glabrous within. 1. *L. Caprifolium* Linnæus.
    - Corolla pubescent.
      - Leaves pubescent, at least beneath; corolla yellow.
        - Corolla-tube slightly gibbous at base; leaves pubescent, both sides, at least when young, ciliate. 2. *L. hirsuta* Eaton.
        - Corolla-tube strongly gibbous at base; leaves glabrous above, pubescent beneath, scarcely, if at all, ciliate. 3. *L. glaucescens* Rydberg.
      - Leaves glabrous, beneath very glaucous.
        - Corolla greenish-yellow, the tube somewhat gibbous.
          - Corolla-tube 6–10 mm. long; filaments hirsute at base. 4. *L. dioica* Linnæus.[6]
          - Corolla 10-14 mm. long; filaments nearly glabrous. 5. *L. Sullivantii* A. Gray.
        - Corolla light yellow or orange, its slender tube not gibbous. 6. *L. flava* Sims.
  - Corolla tubular, the limb nearly regular. 7. *L. sempervirens* Linnæus.
- Flowers in pairs on short axillary peduncles. 8. *L. Japonica* Thunberg.

Shrubs; flowers in pairs on axillary bracted peduncles.
- Bracts of peduncle subulate, linear, minute or none.
  - Leaves rarely cordate, more or less pubescent, or ciliate.
    - Leaves pale or glaucous, thick, strongly reticulate veined.
      - Peduncles shorter than flowers; fruit blue; leaves ciliate. 9. *L. cœrulea* Linnæus.
      - Peduncles equalling or longer than the flowers; fruit red; leaves not ciliate.

[5] Britton, N. L. "Manual of the Flora of the Northern States and Canada," 2nd edit., 1905.

[6] (*Lonicera ciliata* Muhlenberg.)

Leaves oblong to ovate, pubescent, stamens included, seeds about 2 mm. long.
10. *L. oblongifolia* (Goldie) Hooker.

Leaves oblanceolate to obovate, mostly glabrous; stamens exserted, seeds 3–4 mm. long.
11. *L. altissima.*

Leaves bright green, ciliate, not strongly reticulated; fruit red.
12. *L. Canadensis* Marshall.[7]

Leaves pale, persistently densely pubescent beneath.
13. *L. Xylosteum* Linnæus.

Leaves cordate, glabrous. 14. *L. Tatarica* Linnæus.

Bracts of peduncle broad, foliaceous. 15. *L. involucrata* (Richardson) Banks.

EXPLANATION OF PLATE XX.

A. *Lonicera altissima.* Branch. One half natural size.
B. Partly formed fruits showing; *b*, scars of bractlets. Natural size.
C. Seeds. Natural size.
D. Peduncle and flowers. Natural size.
E. Leaf showing strong reticulation, under side. Natural size.

([7] *Lonicera glauca* Hill.)

CONTENTS.

Publications of the Carnegie Museum Serial No. 49

ANNALS

OF THE

CARNEGIE MUSEUM

Vol. IV. No. II

July, 1907

For sale by Messrs. Wm. Wesley & Sons, 28 Essex St. Strand, London, England, Messrs. R. Friedlaender u. Sohn, 11 Carlstrasse, Berlin, N. W. 6., Germany, and at the Carnegie Museum, Schenley Park, Pittsburgh, Pa., U. S. A.

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W. J. HOLLAND, *Editor*

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ANNALS

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VOLUME IV. NO. II.

Editorial Notes.

This number of the Annals goes to press while the echoes of the voices of those who participated in the dedication of the new and enlarged buildings of the Carnegie Institute are still sounding through its halls. The occasion was most notable from every point of view. A memorial volume which will keep green the memory of the festivities is being prepared by the Secretary of the Board of Trustees.

The expressions of pleasure and satisfaction which fell from the lips of the distinguished men who were assembled on the occasion were most gratifying, especially to those who through many years have been laboring to bring about the consummation which was witnessed on April the 11th, 1907. It is not for the editor of the Annals of the Museum to speak of what was said in reference to other departments of the institution, but it was to him the cause of profound pleasure to hear from the lips of those most competent to judge words of unfeigned appreciation as they passed through our still unfilled and unfurnished halls. Our attitude in the Museum has been for some time past more or less apologetic, but our friends who visited us were unanimous in declaring that apologies were not in order, and that out of sincere hearts they were able to congratulate us upon what has already been achieved. It would savor of inordinate vanity to quote what was said by them by word of mouth and by letter, but these pleasant expressions have left their impress upon the minds and hearts of all, and we find ourselves, in spite of the fatigues and cares incident to the occasion cheered and prepared to address ourselves with great courage and assurance to the tasks of coming years. Pittsburgh has a Museum which may well challenge comparison with the other great Museums of America. For this we gratefully thank the generous man whose kind heart made possible what has been accomplished.

WE anticipate with pleasure the coming meeting of the American Association of Museums, which will take place in the first week of June. The time was perhaps a little unfortunately chosen, as the engagements of many of those, who are members of the Association and who are connected with our colleges and universities, or, who are intending to avail themselves of the summer months for collecting expeditions, will prevent them from being present. Nevertheless everything indicates that there will be a good representation of those who are engaged in the work of Museums in different parts of the country. Pleasant and profitable discussions will no doubt take place and a number of excellent papers will be presented. Every effort will be made by the Committee of the Trustees who are charged with entertaining the Association to make their visit to Pittsburgh agreeable.

THROUGH the kindness of Mr. H. H. Jack and Mr. E. H. L. Page the attention of the Director of the Museum was called to the fact that in the latter part of April there had been discovered in the quarries of the American Lime & Stone Company, near Frankstown, Pa., the remains of a mastodon and of some other animals lying on the floor of a small cave which was reached in the process of excavation. Mr. O. A. Peterson of the Museum was despatched to the spot. He returned after a few days bringing enough material with him to make it plain to the Director that he was justified in requesting Mr. Peterson to return to the locality and continue further search. The result of his investigation has been the uncovering of a remarkable number of species and individuals of animals, a number of which are now extinct in Pennsylvania, the bones of which were commingled on the floor of the cave. A paper giving a full account of the results of this investigation will be prepared in the near future.

MR. FREDERIC S. WEBSTER having accepted the superintendency of the Newsboys Home in the city of Pittsburgh, tendered his resignation as preparator in the section of zoölogy at the beginning of May. The resignation was accepted by the Director to take effect as of the first of September. During his connection of nearly ten years with the Museum Mr. Webster has accomplished much excellent work, and the best wishes of the Director and of his colleagues on the staff of the Museum accompany Mr. Webster as he embarks upon a new and untried field of activity, for which, however, his qualifications are undoubted, as he takes great pleasure in the society of the young.

ONE of the pleasant incidents in connection with the late dedicatory services was the offer by Mr. Carnegie as a gift to the German Emperor and to the President of the French Republic of replicas of the colossal *Diplodocus* similar to the one which was presented to the British Museum about two years ago. The German Emperor who was promptly notified by cable of Mr. Carnegie's generous purpose, sent the following cablegram to General Alfred von Loewenfeld, his personal representative, who had dispatched the message to His Majesty:

"Sprechen Sie Mr. Carnegie für seine Darbietung die ich gerne annehmen will und für die mir durch das Geschenk erwiesene Aufmerksamkeit meinen Wärmsten Dank aus.

WILHELM."

The telegram was read by General von Loewenfeld, on the occasion of the presentation of the Emperor's gift to the Institute, and everyone who was present noted the tone of profound reverence and deep respect with which the General, who possesses a noble voice, uttered the name appended to the telegram — "Wilhelm."

V. MERYCOCHŒRUS AND A NEW GENUS OF MERYCOIDODONTS, WITH SOME NOTES ON OTHER AGRIOCHŒRIDÆ.

By Earl Douglass.

(Plate XXI.)

Outline of Contents.

I. A History of the Generic Name Merycochœrus.

In the year 1857 Dr. F. V. Hayden, while on an exploring expedition, discovered opposite Fort Laramie in a stratum of "dull reddish brown indurated grit" (bed "D" of Hayden's section of the Miocene formations), portions of skulls and mandibles of a new genus of Merycoidodonts. In 1858 these were described by Joseph Leidy under the name of *Merycochœrus proprius*.[1] The genus was based on several portions of the upper and lower jaws.

Previous to this time only four species of Merycoidodonts (Oreodonts *auctorum*) had been described, *Merycoidodon culbertsoni* Leidy, in 1848, *Eucrotaphus jacksoni* Leidy, in 1850, *Oreodon gracilis* Leidy, in 1851, and *Oreodon major* Leidy, in 1854. These, with the exception of *Eucrotaphus jacksoni*, were represented, so far as the skulls and dentition are concerned, by good material enabling satisfactory comparisons to be made.

In the same paper in which *Merycochœrus proprius* was described Leidy established the genus *Merychyus* with three species, *Merychyus elegans*, *Merychyus major*, and *Merychyus medius*. In this same paper Dr. Leidy gave a few of the characters which distinguish *Merycochœrus* from the Merycoidodonts then known.

[1] *Proc. Acad. Nat. Sci. Phila.*, 1858, p. 24.

In his *Extinct Mammalian Fauna of Dakota and Nebraska*, published in 1869, Leidy described and figured part of a skull and a lower jaw, which are designated as the type of *Merycochœrus proprius.* They are now in the Academy of Natural Sciences in Philadelphia, and I have recently examined them. The skull is represented by portions of both upper jaws, the left the more complete, including portions of the premaxillaries, maxillaries, and malars. The teeth are represented by a third incisor and all the teeth posterior to it. Unfortunately the upper portion of the premaxillary is gone, so that it cannot be ascertained how far the premaxillaries were coössified. It seems a little doubtful, as Mr. Peterson has suggested to me, whether the mandible marked as part of the type belongs to the same individual, as the upper jaw does not quite fit, though this may be due to the defective mending of the mandible.

In the *Extinct Mammalian Fauna of Dakota and Nebraska* Leidy gives, among others, the following characters, which serve to distinguish this genus from those previously described : Size a third larger than that of *Eucrotaphus ?* (*Oreodon*) *major ;* the infraorbital arch is remarkable for its great absolute and relative depth, is two and one half times that of *Eucrotaphus major*, and is directed much more inward to the face than in *Oreodon.* The anterior origin of this arch is at the anterior portion of the second molar tooth and is not continued forward in a ridge to the middle of the premolar series as in *Oreodon.* This causes the face to be abruptly narrowed at the interval of the first and second molars. The side of the face "forms a wide unbroken, transverse concavity from the supraorbital arch to the canine alveolus." The infraorbital foramen is large and situated above the interval of the first and second molars. On account of the depth of the malar the orbit is more elevated than in *Merycoidodon*, and its anterior border is on a line with the interval between the first and second molar. The lachrymal bone appears not to have possessed the depression known as the lachrymal fossa.

The next species to be included in the genus was *Merycochœrus rusticus.* The specimen which is marked as the type is the property of the United States National Museum at Washington. It consists of nearly the same portions as the type of *Merycochœrus proprius.* It has, however, more of the anterior portion of the muzzle (including the premaxillaries, but none of the nasals) and the symphyseal portion of the mandible. These specimens were collected by Dr. F. V. Hayden on the Sweetwater River, eighteen miles west of "The Devil's Gate in Wyoming."

In the original description of *Merycochœrus rusticus*[2] Dr. Leidy gave some of the principal characteristics as revealed by the type. They are the following: The skull is a little more than two thirds the diameter of that of *Merycochœrus proprius*. The infraorbital arch is deep; the face has the same abrupt narrowing in front of the orbits as in *M. proprius*, and the infraorbital foramen occupies a corresponding position. In *Oreodon* (*Merycoidodon*) the face narrows more gradually anteriorly, and the infraorbital foramen is situated farther forward.

Leidy suspected from examining these specimens that the remains from the region of the Niobrara River which he had described under the name of *Merychyus medius* belong to the same species as the type of *Merycochœrus rusticus*, and that *Merychyus major* belonged with *Merycochœrus proprius*.

In his *Extinct Vertebrate Fauna of the Western Territories* (1873), Leidy figured (Pl. III.) what is considered as the type of *Merycochœrus rusticus*, and gave further particulars concerning the small collection from the valley of the Sweetwater River in Wyoming. He here points out differences between the teeth of *Merycochœrus* and *Oreodon* (*Merycoidodon*) which he had not done before.[3]

In *Merycochœrus* the crowns of the molars are higher than in *Oreodon* (*Merycoidodon*) and when the anterior molar is protruded, the posterior molars, though functional, are partly buried in the jaw and advance as they are worn away. Before the last tooth is fully protruded "the anatomical character of the triturating surface of the first molar is totally obliterated, and that of the second molar somewhat destroyed." He also says that the highest points of the crowns of the premolars, especially the upper ones, are in advance of the middle of the crowns, even after they are much worn. In *Oreodon* (*Merycoidodon*) the highest point is median.

At this time Leidy was under the impression that *Oreodon* (*Merycoidodon*) and *Merycochœrus* were distinct though closely related genera, the latter from a later geological horizon and the successor by evolution of the former; but that *Merycochœrus* is the same as *Merychyus* and from the same geological horizon. Yet in this same discussion he gave separate definitions to these genera.

[2] "Remarks on a Collection of Fossils from the Western Territories." *Proc. Acad. Nat. Sci. Phila.*, 1870, pp. 109–110.

[3] Leidy's "Extinct Vertebrate Fauna of the Western Territories," p. 199.

In his definition of *Merycochœrus* he includes both *M. proprius* and *M. rusticus*. The latter may belong to a different genus, as will be seen later.

One thing in Leidy's discussion of *Merycochœrus* is very interesting. He says: "The mental foramen, like the infraorbital foramen is proportionately larger than in *Oreodon* (*Merycoidodon*). Perhaps this difference in the size of the foramina, together with the other peculiarities of the face, may indicate that *Merycochœrus* was provided with large prehensile lips, or probably a short proboscis." (Page 203.)

Just following the paper in which Leidy first described the type of *Merycochœrus rusticus* is one by the same author entitled *Remarks on a Collection of Fossils from Dallas City, Oregon.*[4]

This collection consisted of remains of mammals obtained by Rev. Thomas Condon from the Valley of Bridge Creek, a tributary of the John Day's River. "The greater number and more striking specimens belong apparently to a species of *Oreodon*, larger than any previously described, and equaling in size *Merycochœrus proprius*. Indeed so far as we are familiar with the skull of both, the two are so nearly alike that one may be regarded as only a variety of the other, or at most may be viewed as distinct species of the same genus. I am, however, disposed to view one as the offspring by selection of the other, and regard them as corresponding species of two genera, which existed probably in different times or localities.

"The species, which I propose to distinguish under the name *Oreodon superbus*, is indicated by a mutilated skull, together with mutilated crania and portions of jaws with and without teeth, of half a dozen or more individuals."

What we should undoubtedly consider as the type of this species is the skull represented in Fig. 1, Plate I., of Leidy's *Extinct Vertebrate Fauna*.

In his *Synopsis of the Species of Oreodontidæ*[5] Cope included this species in the genus *Merycochœrus* with other forms from Oregon and Montana which did not belong there, and included Bettany's *Merycochœrus temporalis* in the species (*l. c.*, pp. 521–523). Cope says (p. 522): "Of this fine species I have nine crania extracted from the matrix, and a good many not yet cleaned." If these are identical with the type, the characters of this species ought now to be capable

[4] *Proc. Acad. Nat. Sci. Phila.*, 1870, pp. 111–113.

[5] *Proc. Amer. Philos. Soc.*, 1884.

of careful definition. This is important as the species was made the type of *Promerycochœrus*,[6] when that genus was separated from *Merycochœrus*.

When Cope wrote his *Synopsis of the Oreodontidæ*, he was unable to give real distinguishing characters to the genus *Merycochœrus* as he employed the name. In his key to the species, however, he made some divisions which are interesting. He divided the group into three sections.

In section I. the infraorbital foramen is above the middle of the fourth superior premolar, the posterior part of the zygoma is expanded, and the palate is moderately produced posteriorly. Species: "*Merycochœrus superbus*, *M. leidyi*, and *M. chelydra*."

Sec. II. Infraorbital foramen above first true molar; palate greatly produced posteriorly. "*Merycochœrus macrostegus ?* and *M. montanus*."

Sec. III. Infraorbital foramen above the anterior border of the second true molars. "*Merycochœrus rusticus* and *M. proprius*."

The two latter are distinguished as follows:

In *Merycochœrus rusticus* the zygoma originates above the second molar; size large; incisors small.

In *Merycochœrus proprius* the zygomatic arch originates above the third true molar; size larger; incisors large.

On page 535 of the same paper, Cope gives some of the distinguishing characters of *Merycochœrus proprius* and *Merycochœrus rusticus*. Of the former he says:

"This large species represents the extreme form of the genus in the anterior position of its dental series as compared with the brain-case. The zygomatic arch and infraorbital foramen are therefore more posteriorly placed than in any other species. The premaxillary bone is more prominent than in any other, and the incisor teeth have relatively larger dimensions. The size is about that of *M. superbus*. I have not seen any other than the typical specimen."

Of *Merycochœrus rusticus* he says:

"The smallest species, characterized among other things by the closure of that part of the narial fissure which separates the premaxillary bones below. According to Leidy's figure above quoted, the depth of the middle line of the undivided premaxillary is greater than the width of the bone, a state of things not approached by any of the

[6] *Amer. Jour. Sci.*, Vol. XI., 1901, p. 82. See also Matthew's "Fossil Mammals of Colorado," *Mem. Amer. Mus. Nat. Hist.*, Vol. VII., p. 398.

species of this genus described in the preceding pages. The premaxillary in *M. proprius* is not described."

Of the seven species enumerated and characterized in Cope's paper above quoted three —"*Merycochœrus*" *macrostegus*, "*Merycochœrus*" *chelydra*, and "*Merycochœrus*" *montanus* were described for the first time. The types of *Merycochœrus superbus*, *leidyi*, *macrostegus* and *chelydra* all came from the John Day beds of Oregon. With little doubt, the first three, and perhaps all, came from Bridge Creek. *Merycochœrus montanus* was found in the Ticholeptus or Deep River Beds of Montana.

In 1890 Prof. W. B. Scott[7] described a foot of a Merycoidodont from the Miocene of Nebraska under the name of *Merycochœrus cœnopus*.

In his *Mammalia of the Deep River Beds*[8] (1893) Scott described nearly the entire skeleton of what he supposed to be *Merycochœrus montanus*.

While collecting fossils in the Loup Fork horizon in the Lower Madison Valley in Montana (1894–1896) Earl Douglass discovered several portions of mandibles of Merycoidodonts. Three of these were remarkable for the depth of the horizontal ramus of the mandible and the shortening and crowding of the premolar series. In one of these afterward named *Merycochœrus altiramus*,[9] the mandible was surprisingly deep, especially at the angle.

In 1899, in the Flint Creek Beds (Upper Miocene) near New Chicago, Montana, Douglass found a nearly complete skull, including the mandible, of an extremely peculiar Merycoidodont which had a remarkably deep mandible like some of the specimens from the Madison Valley. The most peculiar characters were the extreme shortening of the nasals and several modifications of the skull, making it as clear as the structure of the skull could do, that the animal possessed a large upper lip or proboscis.

Mr. Douglass described the above specimens in the paper above quoted,[10] under the generic name *Merycochœrus*. In Part II., p. 82, he says:

[7] *Beiträge zur Kentniss der Oreodontidæ*, p. 346, Pl. XVI., Figs. 33 and 34.

[8] *Proc. Am. Philos. Soc.*, Vol. XXI., p. 151.

[9] "New Species of Merycochœrus in Montana," *Am. Jour. Sci.*, Vol. XI., part II., Jan., 1901, p. 73.

[10] *Am. Jour. Sci.*, Vol. X., pp. 428–438 and Vol. XI., pp. 73–83.

"As previously stated, the discovery of a complete skull of Merycochœrus shows that those previously described under that name must be divided into two genera, though at present the generic limits cannot be definitely defined. I include provisionally under the genus Merycochœrus, of which *M. proprius* is the type, *M. rusticus*, *M. laticeps*, *M. madisonius*, *M. elrodi*, and perhaps *M. compressidens* and *M. obliquidens*. Were the skulls of all these found, the genus might have to be divided again."

In this paper *Promerycochœrus* was proposed provisionally for the other species which had been included in the genus *Merycochœrus*, calling them *Promerycochœrus superbus*, *leidyi*, etc.

"Between these two groups as I have divided them there is an easily recognizable difference in the inferior dentition. In *P. montanus* and *macrostegus*, and, judging by the upper dentition in *P. superbus* and *chelydra*, the length of the premolar series nearly or quite equals that of the molar series. . . . In *Merycochœrus proprius*, *rusticus*, *laticeps*, *compressidens*, *altiramus*, and *madisonius*, the premolar series equals or is slightly less than the length of the first two molars and the anterior lobe of $M_{\overline{3}}$. In the first species it is a trifle more, and they decrease in about the order mentioned. . . .

"In all of these there is more or less crowding of the first three premolars, and $P_{\overline{2}}$ is placed obliquely in the jaw. In other respects the mandibles vary so much that we may expect that further discoveries will show that they do not all belong to the same genus."

In 1898, forty years after the type of *Merycochœrus* was described by Dr. Leidy, an expedition from the American Museum of Natural History in charge of Dr. W. D. Matthew, secured, among other extremely interesting fossils, almost complete skulls and skeletons of *Merycochœri*. This was an interesting discovery and it showed that widely divergent lines had been included in the same genus. These fossils were described by Dr. Matthew in his splendid memoir, *Fossil Mammals of the Tertiary of Colorado.*[11] While there may be a little doubt that the one described as *Merycochœrus proprius* should be included in the same species as the one described by Leidy, yet there appears to be little doubt that we have here the true *Merycochœrus.*

Dr. Matthew describes, from higher beds, other similar fossils which he thinks may belong to a different genus.

[11] *Memoirs Amer. Mus. of Nat. Hist.*, Vol. I., part VII.

II. The Later Tertiary Formations of the West.

The geological position of these fossils is of as much interest, perhaps, as their anatomical structure, and we cannot study the evolution of the different forms without knowing the sequence of the different horizons. I, therefore, take some space to discuss this matter.

Dr. Matthew states that *Merycochœrus proprius* is found "near the top of the White River formation (horizon C)."[12] This seems in harmony with Hayden's table in Leidy's "Extinct Mammalian Fauna," yet I believe that to those who have not had time to look up the matter with some care, there is apt to be a misunderstanding here, and Dr. Matthew's use of the term "White River" may give a wrong conception: nevertheless if one carefully reads the memoir, his meaning is very plain.

In 1862 Meek and Hayden[13] applied the names "*White River*" and "*Loup River*" (the latter overlying the former) to two divisions of the Tertiary in Nebraska and what is now South Dakota.

The *Loup River Beds*, were defined as follows:

"Fine loose sand, with some layers of sandstone, contains bones of Canis, Felis, Castor, Equus, Mastodon, Testudo, etc., some of which are scarcely distinguishable from living species. All fresh water and land types."

"On the Loup Fork of Platte River extending to an unknown distance beyond the Platte."

Thickness 300 to 400 feet. Referred to Pliocene.

The *White River* was defined as follows:

"White and light drab clays, with some beds of sandstone, and local layers of limestone. Fossils, *Oreodon*, *Titanotherium*, *Chœropotamus*, *Rhinoceros*, *Anchitherium*, *Hyænodon*, *Machærodus*, *Trionyx*, *Testudo*, *Helix*, *Planorbis*, *Limnæa*, Petrified wood, etc. All extinct. No brackish water or marine remains."

"Bad lands of White River under Loup River Beds, on Niobrara and across the country to the Platte."

Thickness 1,000 feet or more. Referred to Miocene.

In 1877 Cope[14] called Hayden's Santa Fe marls of New Mexico, *Loup Fork*, and originated the term *Loup Fork Epoch*, which included the *Loup River* beds of the Nebraska and Dakota region, beds of similar age in Colorado, and the Santa Fe Marls.

[12] "Fossil Mammals from Colorado," p. 401.

[13] *Proc. Acad. Nat. Sci., Phila.*, Vol. XIII., pp. 433, 434.

[14] *U. S. Geol. Surv. West of 100th Meridian*, Vol. IV., part II., pp. 20, 361.

There have been since then, two general names for the Tertiary of the western plains, but an attempt to more closely correlate the American with the European horizons has gradually led to the placing of the Loup Fork in the Miocene and the White River in the Oligocene — at least the portions of them that contained the greatest number of fossils — though there are beds in this region above the rich fossil-bearing beds of the White River and beneath the typical Loup River which, until recent years, have not yielded many fossils.

Nearly parallel with the development of our knowledge of the Tertiary of the region of the western plains, there has progressed, though on a less extended scale, the study of the John Day beds and their interesting faunæ and floræ. Though undoubtedly the lower beds in the John Day region are contemporaneous with portions of the White River, and are Oligocene in age, yet part of the fauna of the former has appeared to be of later date and earlier than the typical Loup River — earlier, even, than the Loup Fork in its extended sense. So in tables of the Tertiary strata of the western interior region about the following succession has come into current use :

Miocene..	Loup Fork Formation..	Nebraska beds,
		Deep River beds.
	John Day Formation....	Upper,
		Middle,
		Lower.
Oligocene	White River Formation	Protoceras beds,
		Oreodon beds,
		Titanotherium beds.

Dr. J. C. Merriam,[16] in 1901, divided the John Day series into lower, middle, and upper. In the lower division no good fossils were found. Among the fossils in the middle division are *Diceratherium* and *Eporeodon*. The latter is much like some of the Merycoidodonts of the Protoceras beds (Upper White River). The upper beds of the John Day series are those from which were obtained the large Merycoidodonts which have been referred to *Merycochœrus*, but which are now known as *Promerycochœrus*.

In the valleys of Montana several formations have been found, which, as the fossils were such that they could not be exactly correlated with other horizons, have been given various local names until their position could be determined. They range from Lower Oligocene

[16] "A Contribution to the Geology of the John Day Basin," *Bull. Dept. of Geol., University of Cal.*, Vol. 2, No. 9, p. 293.

to Upper Miocene, yet the lists of species never precisely coincide with those of other regions.

In the three regions above mentioned, the plains, Oregon, and Montana, it is a question how much the dissimilarities of the faunæ in these different localities are due to difference in time and how much due to geographic distribution. Undoubtedly both are important factors. Personally I am more and more impressed with the idea that only at long intervals have conditions in any one region been favorable for the preservation of vertebrate fossils, and these favorable local conditions may not have occurred at the same time in widely separated localities, though evidently a great similarity of conditions existed over a vast region during the deposition of the Lower White River beds.

It is evident that in the region in Colorado, which was studied by Matthew, the upper strata of what he calls the White River are the only representatives there of a long period of time during which fossil-bearing deposits accumulated in Nebraska, Oregon, and Montana.

I give a quotation which shows Dr. Matthew's views on the subject:

"The equivalence of the Titanotherium Beds and Oreodon Clays with the corresponding horizons in South Dakota scarcely needs discussion, as the faunæ are largely identical. The equivalence of the Leptauchenia assise with the Protoceras sandstones is more difficult to show, as the two have almost nothing in common. The Leptauchenia clays of South Dakota, in the localities examined by Wortman [17]*overlie* the Protoceras sandstones; but others have found them interbedded and almost certainly contemporaneous. The uppermost levels of the South Dakota clays, which no doubt are considerably above the sandstones, are said to be barren; and in Colorado we found fossils scarce in horizon *C*, but, when discovered, of much interest. They appear to indicate that these comparatively barren upper clays are considerably later than any of the more richly fossiliferous beds, and that the building up of the White River formation was continued into the Uppermost Oligocene or Lower Miocene. For in the top levels we found genera and even species hardly separable from those which occur in the Loup Fork formation above, in company with the known Loup Fork fauna, viz.: *Merycochœrus proprius*, *Anchippus texanus*, *Blasto-*

[17] "On the Division of the White River or Lower Miocene of Dakota," *Bull. Amer. Mus. Nat. Hist.*, Vol V., p. 95.

meryx, and others that indicate much more modernization than is apparent in the typical White River." [18]

It is evident, then, that Dr. Matthew uses the "White River" as the name of a formation which includes several beds belonging to several different horizons. Its upper member according to the usage of Dr. Matthew extends into the Miocene where it contains genera and species, hardly separable from the Loup Fork immediately overlying it, and these species are much more modernized than is apparent in the typical White River. *Merycochœrus*, then, probably is not a form belonging to the White River beds as these are commonly understood to be located in the geological series. So far as my observation and study go *Merycochœrus* does not occur below the Middle Miocene. With regard to Hayden's list in Leidy's "Extinct Mammalian Fauna," there is not space to discuss it here, only to say that few of the specimens enumerated in column "D" as contemporaneous with *Merycochœrus proprius* can be pointed to as definitely marking horizons, when it is considered that in those early days of discovery, fragments of jaws, etc., were very misleading. Then, too, in collecting from deposits, which are undoubtedly in part of stream origin, it would be strange if there were not some specimens put in the wrong list.

The typical *Merycochœrus* is probably older than the specimens from Montana which, in part at least, have been wrongly put in that genus.

III. **Pronomotherium** gen. nov.

I propose this name for a new genus, the type of which is a nearly complete skull with the mandible (Carnegie Museum Catalogue of Vertebrate Fossils No. 796) formerly described as *Merycochœrus laticeps* Douglass.[19] This specimen was very fully described in the paper cited. I am now better able to give the characters which distinguish it from the genus in which it was wrongly placed.

GENERIC CHARACTERS. — *Skull extremely short, brachycephalic, broad and low. Posterior portion reduced in length more than the anterior portion. Brain case small. Inclination of basi-cranial to basi-facial axis extreme. Anterior narial opening of two portions, one opening a little anterior to the orbits, the other a long slit between the*

[18] "Fossil Mammals from Colorado," p. 372. See also pages 401 and 402.

[19] "New Species of Merycochœrus in Montana," *Amer. Jour. Sci.*, Vol. X., Dec., 1900, p. 428.

Skull of *Pronomotherium laticeps* Douglass, ½.

upper borders of the maxillaries and opening upward. Premaxillaries united for a long distance and forming a spout-shaped depression which is concave transversely and convex longitudinally. Sides of face concave below horizontal portion of posterior nares. Malar below orbit very deep but squamosal portion of zygomatic arch light. Mandible heavy and angle extremely large and deep. Both the mandible and sides of the face, especially the malar portion, fitted for the attachment of heavy muscles. Premolar series of teeth shortened and crowded. Molar series increasingly hypsodont. Incisors small.

It will not be necessary to redescribe the skull, but I have made comparisons with the types of *Merycochœrus proprius*, *Merycochœrus ? rusticus*, and skulls of *Merycochœrus* collected by Mr. O. A. Peterson in the Harrison or upper Monroe Creek beds in Nebraska.

COMPARISON WITH MERYCOCHŒRUS PROPRIUS.

In *Pronomotherium laticeps* the premaxillaries, as seen from in front, are narrower and more concave, are trough-shaped, not simply having a narrow median channel near the alveolar border as in *Merycochœrus proprius;* the anterior palatine foramina are not so large; themalo-maxillary ridge is more prominent, the face not so nearly flat, but is much more deeply concave above the ridge just mentioned; the infra-orbital foramen is on the nearly horizontal shelf above this ridge instead of opening on the nearly vertical portion of the face; the incisive border is much narrower, so it is evident that the incisors were smaller. The first premolar is oblique, and there is no space between this and the second premolar. The space in front of $P^{\underline{1}}$ is much shorter than in *Merycochœrus proprius*. There are but faint traces of cingula on the teeth posterior to $P^{\underline{1}}$, while in the type of *Merycochœrus proprius* they are strong and heavy. The teeth are all narrower, $P^{\underline{2}}$ is shorter and $P^{\underline{3}}$ has not the peculiar pattern of the type of *Merycochœrus proprius* as it apparently had only two pits. $P^{\underline{4}}$ is of the same length but is narrower, giving it a quite different appearance. This is also true of $M^{\underline{1}}$. The second and third premolars are not such broad and heavy teeth, and the ridges and buttresses are not so heavy. The posterior outer lobe of $M^{\underline{3}}$ is much narrower and is directed outward, not extending much behind the posterior horn of the posterior inner crescent; the posterior half of the tooth is much narrower, and there are no median ridges on the outer surfaces of the outer crescents in the molars.

The mandible associated with the type of *Merycochœrus proprius* is very different in form from the type of *Pronomotherium laticeps* which is not quite so old an individual. The depth of the jaws is nearly the same at the chin, but in the last named specimen the lower border of the jaw begins to drop beneath $M_{\overline{2}}$, and under the posterior portion of $M_{\overline{3}}$ it becomes exceedingly deep. The incisors and canine are far less robust. The proportional length of the premolar to the molar series is apparently somewhat less. The molars and premolars have about the same pattern, but in the present type are more hypsodont. In nearly all respects the specimen of *Pronomotherium* has a more advanced or specialized appearance.

COMPARISON WITH MERYCOCHŒRUS? RUSTICUS.

The specimen of *Pronomotherium* is apparently much more like *Merycochœrus* (*?*) *rusticus* than *Merycochœrus proprius*. The symphysis of the premaxillaries, the concavities of the sides of the face, the way the infraorbital foramen opens, the sudden widening of the skull at the anterior portion of the zygomatic arches, the reduction in the size of the incisors, and the form of the chin and other portions of the mandible are much the same in both, yet there are slight differences in all of these.

Pronomotherium laticeps is considerably larger than *Merycochœrus* (*?*) *rusticus*, the anterior palatine foramina are smaller; the shelf at the bottom of the facial concavity — the top of the malo-maxillary ridge — is flatter and more horizontal; the malo-maxillary ridge is narrower and more angulate, not broadly and evenly convex as in *Merycochœrus* (*?*) *rusticus*. Premolars one and two do not incline backward and become much more worn on the posterior edges as in *Merychyus*. The fourth premolar has a larger inner cingulum, and molars one and two have more prominent buttresses.

It may be that *Merycochœrus rusticus* belongs in the same genus as *Pronomotherium laticeps*, but it is still very doubtful, as the type of the former is so incomplete, and Dr. Matthew refers the specimens from Colorado[20] to this species, with some doubt.

I have made detailed comparisons of *Pronomotherium laticeps* with specimens obtained by O. A. Peterson in the Loup Fork (Upper Monroe Creek or Harrison beds) of Nebraska. These are much like the specimens which Dr. Matthew refers to *Merycochœrus proprius* but

[20] "Extinct Mammals from Colorado," p. 412.

I defer these comparisons for my more complete memoir on the *Agriochæridæ* of Montana. It is sufficient to say here that this specimen differs in nearly every detail from the specimens from Nebraska.

THE SO-CALLED MERYCOCHŒRI FROM THE LOWER MADISON VALLEY, MONTANA.

With regard to part of these specimens nothing final can be said until the skulls or portions of them are found. The specimen named *Merycochœrus madisonius*[21] looks very much like the mandible of *Pronomotherium laticeps*. The associated upper jaw[22] is more like *Merycochœrus* in having the anterior inferior origin of the zygomatic arch farther forward than in the former.

"*Merycochœrus compressidens*"[23] in the form of the jaw more resembles that of the type of *Merycochœrus*, but it may be something else.

The so-called *Merycochœrus altiramus*[24] should be put in the genus *Pronomotherium* as a skull in the American Museum of Natural History shows no generic distinction from the type of *Pronomotherium*.

Cope's *Merycochœrus obliquidens*[25] evidently does not belong to either of these genera.

IV. AFFINITIES OF PRONOMOTHERIUM.

I do not know of anything very closely related to *Pronomotherium laticeps* except *Pronomotherium altiramus* and "*Merycochœrus*" *rusticus*. It may be from beds later than *Merycochœrus proprius* but probably not a direct descendant. It is doubtful if it is a descendant of "*Merycochœrus*" *rusticus*, but it was probably more nearly contemporaneous with the latter, than with the former. I know of nothing in lower horizons which is likely to prove ancestral to any of these.

Pronomotherium was an extremely aberrant artiodactyl. The upper lip and snout were certainly greatly modified to correspond with the extreme modification of the bones of the head. The character of the skull could hardly tell in a plainer manner, that the possessor

21 "New Species of Merycochœrus," *Am. Jour. Sci.*, Vol. XI., 1900, p. 75, Fig. 2.

22 *Ibid.*, p. 77.

23 *Ibid.*, p. 79, Fig. 4.

24 *Ibid.*, p. 73, Fig. 1.

25 "The Vertebrate Fauna of the Ticholeptus Beds," *Amer. Nat.*, XX., p. 368.

had a large lengthened snout or proboscis. How long it was of course is not known but it was probably quite long. The position of the condyles and the extremely heavy mandible indicates that the head was carried with the facial axis in approximately a vertical position or approaching a right angle to the vertebræ of the neck.

If we may judge by what appears to be its nearest known relatives, and by what few fragments of bone are preserved, this animal was short limbed, like most of the later *Merycoidodonts;* but we must await the discovery of more complete skeletons.

V. AGE OF THE FLINT CREEK AND MADISON VALLEY BEDS.

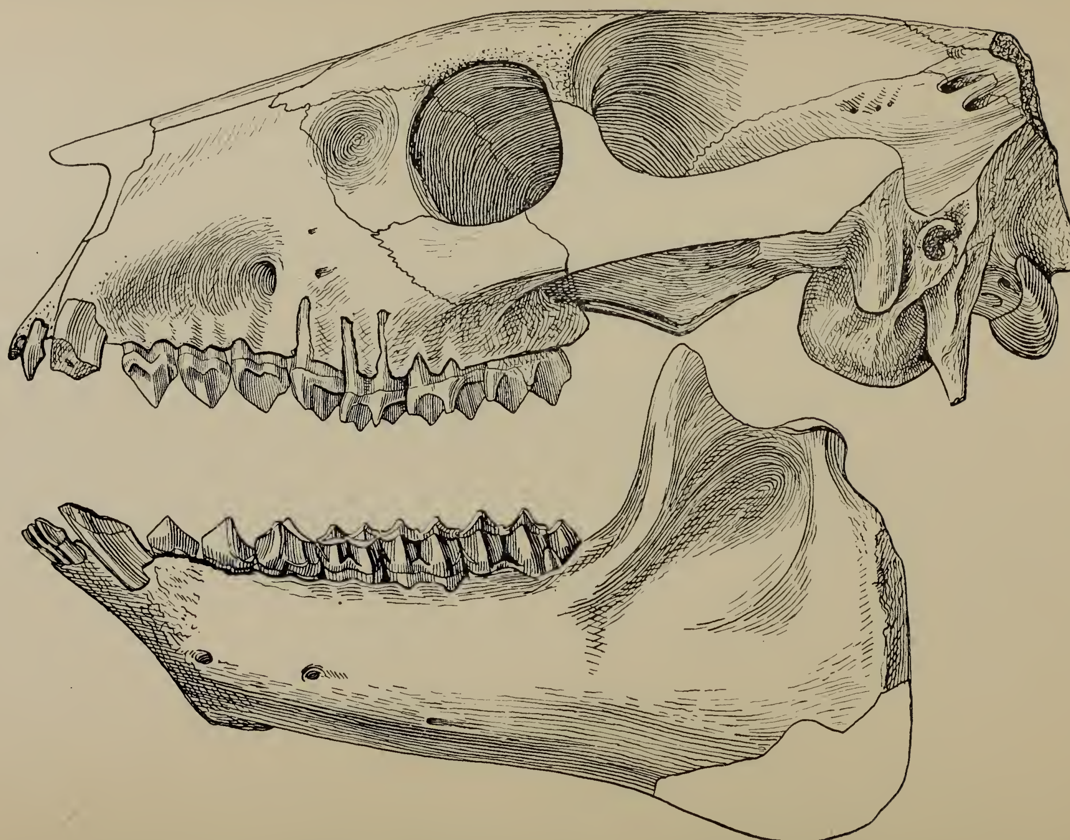
These beds both belong to the Loup Fork Epoch as it is usually understood. Either they are not quite contemporaneous or else they represent a somewhat different ecological condition, at least there is a different assemblage of fossils. This will be thoroughly discussed later after a revision of the fauna has been made. *Mylagaulidæ*, but perhaps of different genera, occur in both formations, *Pronomotherium* appears in the Flint Creek Beds and a related form *Pronomotherium altiramus* in the Madison Valley Beds. *Palæomeryx ?* appears in both beds but of smaller size in the latter. *Procamelus* of large size occurs in both.

On the other hand *Mylagaulus* is found in the Flint Creek and Deep River beds. *Ticholeptus* occurs in the latter, and perhaps in the former, as the specimen, *Merychyus smithi* is much more like *Ticholeptus*. *Palæomeryx ? borealis* occurs in the Deep River beds, and what appears to be the same species, in the Flint Creek beds.

It appears most probable, from the evidence, that the Flint Creek beds are in some ways intermediate between the Deep River and Madison Valley formations, yet some things in the first seem more modernized or specialized than in the last, yet we cannot judge by this, for there have been very highly specialized mammals all along the line, and some characters that were supposed to be modern are quite ancient. A careful study of the Horses, Camels, and other fossils of these beds may furnish a better basis for correlation.

Matthew [26] thinks that the Pawnee Creek Loup Fork holds a position distinctly lower than that of the Niobrara, Santa Fe, and the Republican River Basin. "It seems most nearly equivalent to the upper beds of Smith Creek, Montana (Deep River substage)."

[26] "Fossil Mammals of Colorado," pp. 373–4.



Eucrotaphus dickinsonensis Douglass (Type), $\frac{3}{4}$.

VI. SOME NEW MERYCOIDODONTS.

BY EARL DOUGLASS.

During the various expeditions of the Carnegie Museum in Montana and North Dakota many remains of Merycoidodonts have been obtained from various localities and geological horizons. Much of this material was supposed to be new to science, but it was not until the types and other specimens in the museums at Washington, Princeton, New York, and New Haven were examined, and the collections in the Carnegie Museum were cleared from the matrix and made accessible for study and comparison, that the new species could be intelligently described. The collection has been placed in the hands of the present writer by the Director of the Museum, Dr. Wm. J. Holland, with the request that preliminary accounts of the new material be given, pending the preparation of a more complete memoir.

The following species are based, it is believed, on sufficiently complete material. Other remains which are interesting and are undoubtedly new, but not complete enough to be satisfactorily treated as types, will be described in a later paper.

Eucrotaphus dickinsonensis sp. nov.

(PLATE XXII.)

(Type No. 1584, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type, which was collected by Earl Douglass in 1905, consists of a nearly complete skull and mandible with the greater portion of the spinal column, and fragments of limb and foot bones. The specimen was found near the top of the thick nodular beds of the Middle White River ("Oreodon") horizon of the Little Bad Lands near Dickinson in North Dakota. Though not suspected at the time when the specimen was collected, it is barely possible that it may have come from the upper beds which contain remains of *Eucrotaphus major* (?). The remains were not imbedded in their original position and they may have been derived from a higher level, though the specimen is quite different from any species of *Eucrotaphus* so far found in the upper beds. It is also different from the one specimen of *Eucrotaphus bullatus ?* which was found in the upper portion of the "Oreodon" Beds.

The size is about the same as that of *Merycoidodon culbertsoni*. The upper antero-posterior line of the skull is convex, the brain-case well rounded, and the sagittal crest low. The posterior portions of the nasals are attenuated and the lachrymal pits shallow. The face is concave above the premolars, especially anterior to the infraorbital foramen, which is over $P^{\underline{3}}$. The tympanic bullæ are very large and high and are elliptical in horizontal section. The pit for the tympanohyal and the stylomastoid foramen are nearly equal in size. The mastoid process is fairly heavy, but does not extend far downward between the exoccipital and the external auditory meatus. The paroccipital processes are five-sided at the base, four-sided lower down, and three-sided near the tips. There is a postero-external ridge and the antero-internal side, which is closely pressed against the postero-external side of the bulla, is concave. There is no foramen rotundum.

The crowns of the upper premolars incline backward or the outer crescents have a long convex cutting border and a shorter concave posterior border. The fourth upper premolar is different from that of Merycoidodonts in general, in having two anterior fossettes as in $P^{\underline{1}}$, $P^{\underline{2}}$, and $P^{\underline{3}}$.

The chin is slightly concave. The anterior border of the ascending ramus of the mandible is nearly perpendicular and the coronoid process is not deflected backward. There is a small sharp cusp on $M^{\underline{3}}$ between the posterior external crescent and the heel, which I have not observed in any other Merycoidodonts.

The specific name refers to the prosperous town of Dickinson, which is not far from the locality where the specimen was found.

MEASUREMENTS.

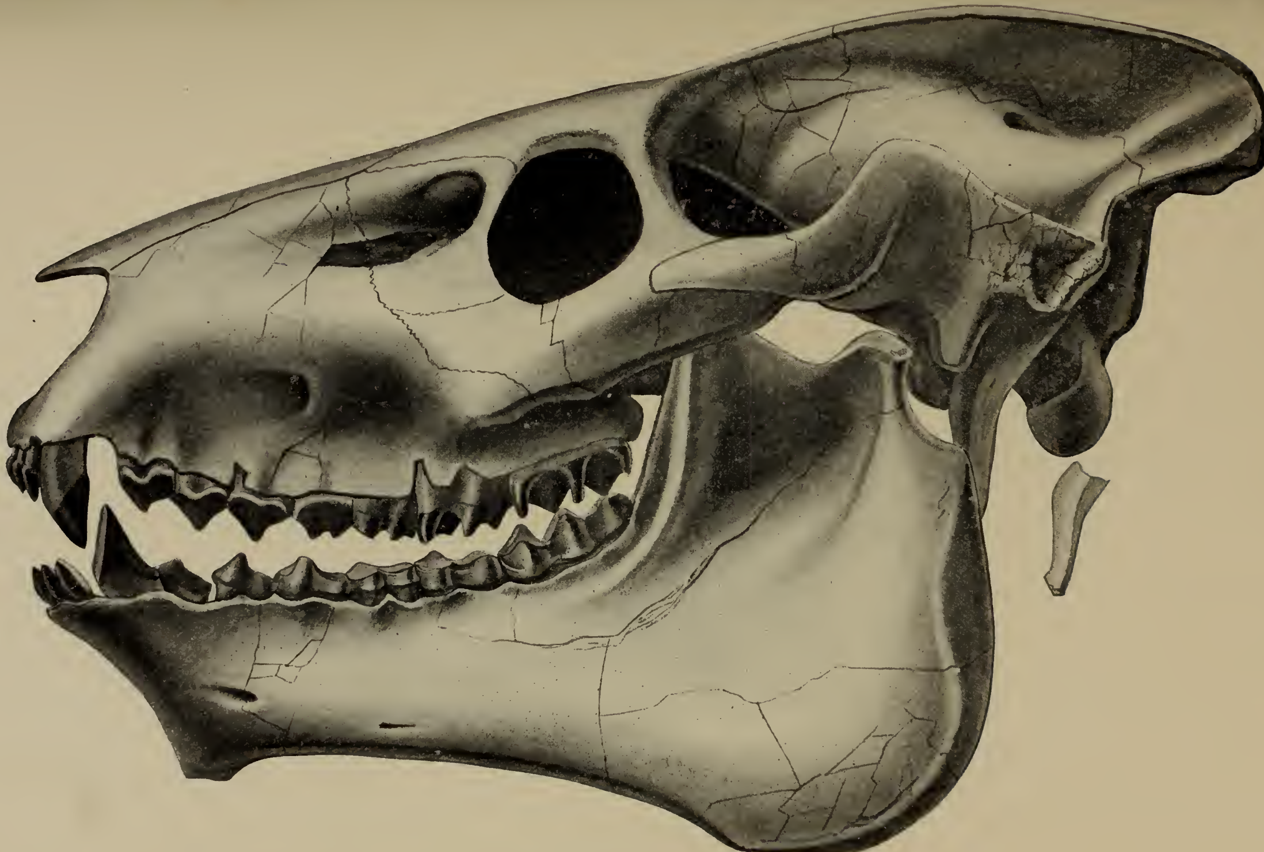
	mm.
Length of skull, basal measurement	184
Width of skull at posterior orbits	105
Length of molar-premolar series	85
Length of premolar series	40
Length of molar series	45

Eucrotaphus montanus sp. nov.

(PLATE XXIII.)

(Type No. 907, Carnegie Museum Catalogue Vertebrate Fossils.)

The type, which was collected by Earl Douglass, 1903, consists of nearly an entire skull with the mandible, a pelvis, a sacrum, and nearly all the presacral vertebræ. It was found near Stubb's old ferry on the Missouri River about eleven miles northeast of Helena, Montana, in a soft, sandy deposit. This was the only good speci-



Eucrotaphus montanus Douglass (Type), $\frac{2}{3}$.

Skull of *Merycoides cursor* Douglass, $\frac{3}{4}$.

men obtained in this locality and horizon, but the beds evidently overlie the Lower White River, which occupies a large area just north of this outcrop.

The upper molar teeth have nearly the same antero-posterior diameter as the corresponding teeth of the type of *Oredon* (*Eucrotaphus ?*) *major* Leidy,[1] but the transverse diameter is a little greater.

The species is a little larger than the specimen figured as *Oreodon major* in Leidy's "Extinct Mammalian Fauna of Dakota and Nebraska"; all the upper premolar and molar teeth are longer than wide; the incisors are small; the molars increasing in length posteriorly; $P_{\overline{2}}$ overlapping $P_{\overline{1}}$ inwardly; the length of the upper and lower molar series is nearly one and one-fourth times the length of the corresponding premolar series; the tympanic bullæ are inflated, and of medium size; the paroccipital processes are flattened on the inner surface where they press against the posterior outer portion of the tympanic bullæ. They are slender and are directed antero-posteriorly below the bullæ, but somewhat twisted on themselves near the ends; the arrangement of the elements at the posterior base of the skull is nearly as in the species of *Promerycochœrus* from the Cañon Ferry Beds; the orbits are fairly large, the malar moderately deep; the posterior portion of the zygomatic arch is only moderately heavy; the sagittal crest is high and thin; the infraorbital foramen is located over $P^{\underline{4}}$; the anterior portion of the mandible is low, but increasing in depth backward to the angle which is very large and rounded; the coronoid processes are low.

MEASUREMENTS.

	mm.
Length of skull, total	239
Height of skull	72
Length of upper premolar series	48.5
Length of upper molar series	55.5

Named after the state of Montana.

Merycoides cursor gen. et sp. nov.

(PLATE XXIV.)

(Type No. 1222, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type, which was collected in 1902 by Earl Douglass in the Miocene beds at Cañon Ferry, Montana, includes a skull and mandible nearly complete, the lower portion of a shoulder blade, part of a

[1] "Ancient Fauna of Nebraska," p. 55, Plate IV., Fig. 6.

humerus, the upper end of the radius, the head and distal end of the femur, portions of two tibiæ, a tarsus, a third and a fourth metatarsal, lacking the distal ends, and a rib that was broken and mended during the life of the animal.

Skull rather low, broad and heavy in proportion to its length; nasals shortened; muzzle inflated; frontal plane rather broad and flat; brain-case laterally inflated; sagittal crest and occipital low, the latter projecting posterior to the occipital condyles; zygomatic arches slender and the posterior angles low; no lachrymal vacuities; paroccipital processes three-sided and placed behind the tympanic bullæ, which are moderately large; basi-occipital forming a considerable angle with the plane of the palate; foramen rotundum just anterior to foramen lacerum medium. Limbs and hind feet slender for a Merycoidodont, the proportions being similar to those of Limnenetes but not so slender as in Merychyus.

Teeth brachyodont with a tendency to become hypsodont. The molar series somewhat exceeding the premolar series in length; canines and incisors small; dental series converging anteriorly; the last molar without a backward projecting lobe or heel.

MEASUREMENTS.

	mm.
Length of skull, total	211
Width of skull, greatest	117
Height of skull, greatest	51
Length of upper molar-premolar series	86
Length of upper premolar series	40
Length of upper malar series	46

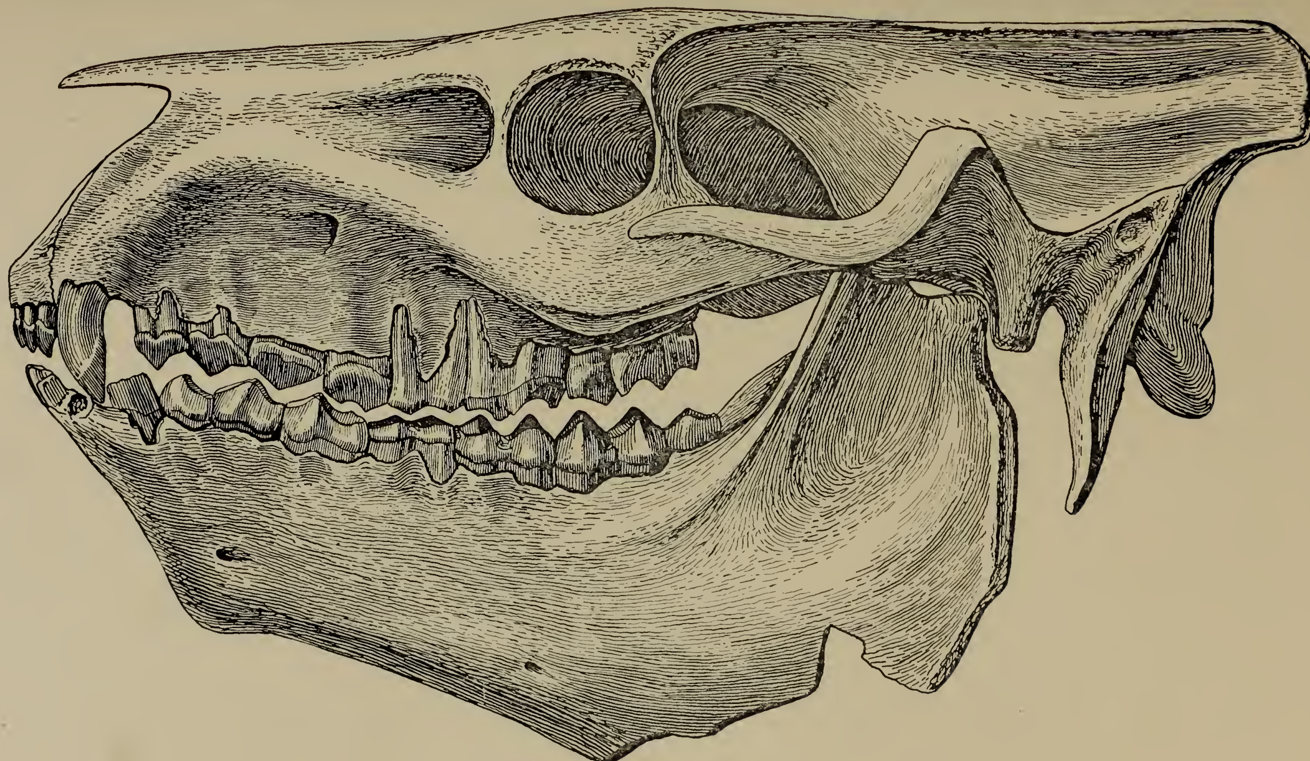
Mesoreodon (?) **latidens** sp. nov.

(PLATE XXV.)

(Type 908, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type consists of a skull and a mandible lacking portions of the angles. From the Cañon Ferry Beds (Miocene) on the Missouri River about twenty miles east of Helena in Montana. Collected by Earl Douglass, 1902.

This species is placed provisionally in this genus. It is quite different from the type specimen of *Mesoreodon chelonyx*, which is very close to some of the Upper Oligocene forms such as *Eucrotaphus* or *Eporeodon*, but other skulls from the Princeton collection (Nos. 10410 and 10418) seem to the writer to be somewhat different from the type and more nearly related to the present species which is undoubtedly omewhat later in age.



Mesoreodon (?) *latidens* Douglass (Type), $\frac{2}{3}$.

In the Carnegie Museum collection are two skulls (Nos. 908 and 1234) both of which are somewhat crushed vertically; but the original form was evidently rather low and broad and the upper contour nearly straight. The nasals are unreduced in length. They narrow quite rapidly anteriorly and gradually posteriorly to near the anterior portion of their contact with the maxillaries. The sagittal crest is thin but only moderately high. The malar is quite heavy beneath the orbits, but the zygomatic process of the temporal is long and slender. Its posterior upper angle is curved inward, scroll-shaped and nearer to the orbit than to the posterior part of the skull. The occiput is low and the external wings broad.

The tympanic bullæ are inflated, but not extremely large. The post-glenoid processes are external to the anterior portions of the bullæ, while the inner, thickened portions of the paroccipital processes are posterior to the outer portions of the bullæ. The external auditory meatus opens at the supra-auricular border.

The teeth are characteristic. They are only moderately hypsodont. The molar is larger than the premolar series in both jaws. The upper molar and premolar teeth in the type, with the exception of $P^{\underline{4}}$ are heavier than those figured by Scott as *Mesoreodon chelonyx* in his "Mammalia of the Deep River Beds"; the length is nearly the same, but they are much wider. The premolars are not triangular, but are more quadrate. $P^{\underline{2}}$ which is much larger than $P^{\underline{1}}$, is oblique, being directed antero-internally and postero-externally. The cingulum which almost forms a cusp on the postero-internal portion of the tooth encloses a comparatively broad, shallow basin. On $P^{\underline{3}}$ this postero-internal cusp is large. In specimen No. 1234 the teeth are not so heavy, and the skull may have belonged to a female. The length of the few foot bones which are preserved are nearly the same as those figured by Scott.

MEASUREMENTS.

	mm.
Total length of skull	244
Height of skull above angle of mandible approximately	155
Greatest width of skull	140
Length of molar-premolar series	125
Length of premolar series	57
Length of molar series	68

Promerycochœrus hatcheri sp. nov.

(PLATE XXVI.)

(Type No. 1303, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type is a nearly complete skull with the mandible. It was collected by the writer in 1902 from the same deposits and the same locality as the types of *Promerycochœrus grandis*, *P. hollandi*, and the species of *Merycoides* described in this paper.

The general form and proportions of the skull are very much like those of *Promerycochœrus grandis* but it is much smaller and the teeth are decidedly less heavy than in that species, the post-glenoid processes are not antero-posteriorly compressed, the antero-posterior diameter being nearly as great as the transverse, the zygomatic processes of the squamosals are slender, and the infraorbital foramen is about the interval between $P^{\underline{3}}$ and $P^{\underline{4}}$, not over the space anterior to $M^{\underline{1}}$. The anterior contour of the chin is straight, not concave, and the angle of the mandible is large. The upper portion of the ascending ramus is not like that of *Promerycochœrus grandis* but is much like the usual form in *Merycoidodonts*. The fossa postero-superior to the last molar is only slightly if at all enlarged. There is no median inner ridge or accessory cusp on $P^{\underline{3}}$. The outer face of the outer crescent of $P^{\underline{4}}$ is more concave than in the corresponding tooth of *Promerycochœrus grandis* and the median outer pillars on the molars are inclined more forward, while the anterior pillars on the last two molars incline more backward. The lower premolars are thin, being laterally compressed.

Named in honor of the late J. B. Hatcher, of the Carnegie Museum.

MEASUREMENTS.

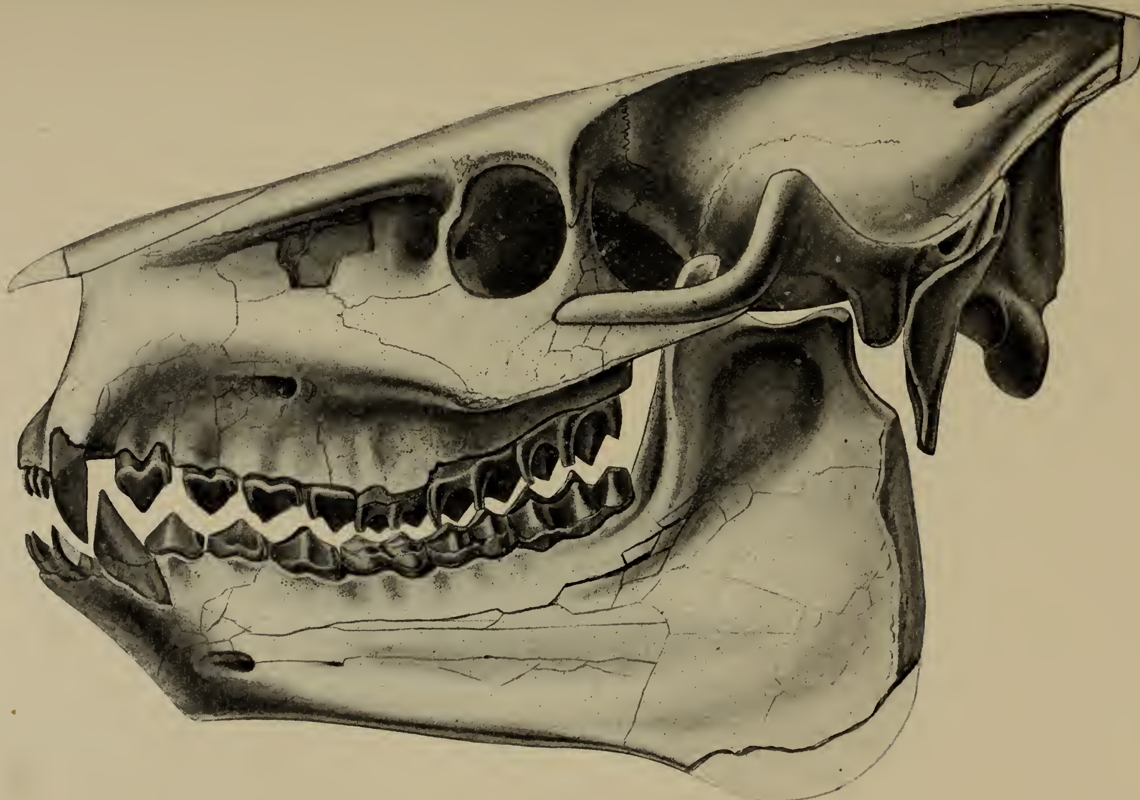
	mm.
Length of skull, greatest	.291
Length of skull, basal measurement	.280
Depth of skull, including angle of mandible	.190
Length of molar-premolar series	.145
Length of premolar series	.069
Length of molar series	.076
Length of last molar	.035
Height of last molar	.016

Promerycochœrus grandis sp. nov.

(PLATE XXVII.)

(Type No. 990, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type which was collected by the writer in 1902, includes a skull with mandible, cervical and lumbar vertebræ, a femur, a



Promerycochœrus hatcheri Douglass (Type), ½.

Promerycochœrus grandis Douglass (Type), $\frac{45}{100}$.

humerus, portions of a scapula, a radius, an ulna, a pelvis and a tibia. From the Cañon Ferry Beds (Middle or upper Miocene) at Cañon Ferry on the Missouri River about twenty miles east of Helena, Montana.

The species is one of the largest of the family. The skull is of the long and narrow type; the face is long and narrow; the upper line of the skull is nearly straight; the sagittal crest is quite high, but not heavy; the occiput overhanging; the brain-case is comparatively small; the posterior portion of the occiput is pillar-like, with two deep lateral concavities. The tympanic bullæ, though inflated, are not large in proportion to the size of the skull. The paroccipitals are high, their longest diameter is in a postero-internal and antero-external direction, and they lie posterior to the outer portion and external to the posterior portions of the tympanic bullæ against which they are closely pressed, they also come near to the high post-glenoid processes. The external auditory meatus is closely compressed between these two processes and has a flattened wing which is suturally united with the post-glenoid process on its posterior surface near its base. The basi-cranial axis is steeply inclined. The posterior angle of the zygomatic arch is not heavy or high; the anterior process of the squamosal is comparatively slender, but the malar beneath the orbit is deep. A broad convex ridge extends from the anterior portion of the arch to the posterior upper portion of the anterior nares; below this the face is somewhat concave. The mandible is long and the chin convex. One of the most peculiar characters of this animal is what appears to be an enormous enlargement of the fossa, usually small, which occurs on the anterior portion of the ascending ramus of the mandible above, and posterior to the last molar tooth. This fossa is deep, as well as large, and has for its posterior boundary a plate of bone separating it from the masseteric fossa which it has almost crowded out of existence. All the teeth are large, heavy, and closely crowded; in fact I know of no other member of the family with such strong dentition. The teeth have some peculiarities which there is not space at present to describe. The skeleton is not as robust as that of *Promerycochœrus hollandi*, although the skull is larger.

MEASUREMENTS.

	mm.
Total length of skull	390
Length of upper dental series	213
Width of skull just anterior to glenoid articular surface	180
Height of skull at posterior of M^3	100

Length of molar-premolar series	168
Length of premolar series	82
Length of molar series	96
Length of neck	260
Length of femur	250

Promerycochœrus hollandi sp. nov.

(PLATE XXVIII.)

(Type No. 1194, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type, which was collected by the writer in 1902, consists of the greater portion of a skull with a nearly complete mandible, a humerus, the cervical vertebræ, the great portion of a front foot, and a hind limb including the pelvis. From the Cañon Ferry Beds (Middle Upper Miocene) at Cañon Ferry, about twenty miles east of Helena, Montana.

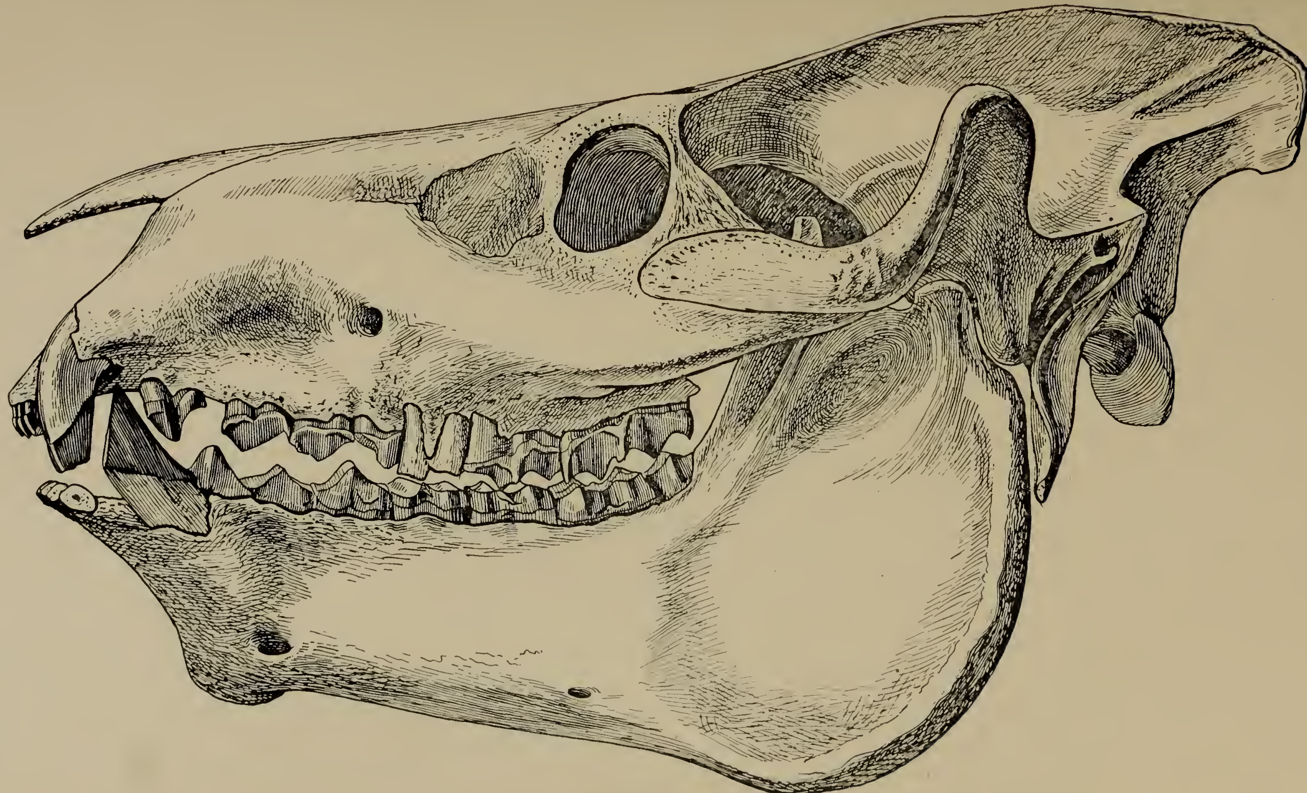
Size large; skull rather heavy and broad; posterior portion of zygomatic arches fairly heavy and turned upward; bones of skeleton heavier than in *Promerycochœrus grandis;* anterior teeth not large; horizontal ramus of mandible rather deep and anterior fossa on ascending ramus large, but not so large as in *Promerycochœrus grandis.*

Most of the above characters are those which distinguish this species from *Promerycochœrus grandis.* There is little difference in the actual basal measurements of the skulls of the types of the two species, but the skull of *P. hollandi* is broader, not so high, and the zygomatic arches are more widely expanded; the teeth in *P. hollandi* are not so large and strong, and the anterior fossa on the ascending ramus of the mandible is not nearly so large. The limbs are nearly the same in length in the two species, but are heavier in *P. hollandi.*

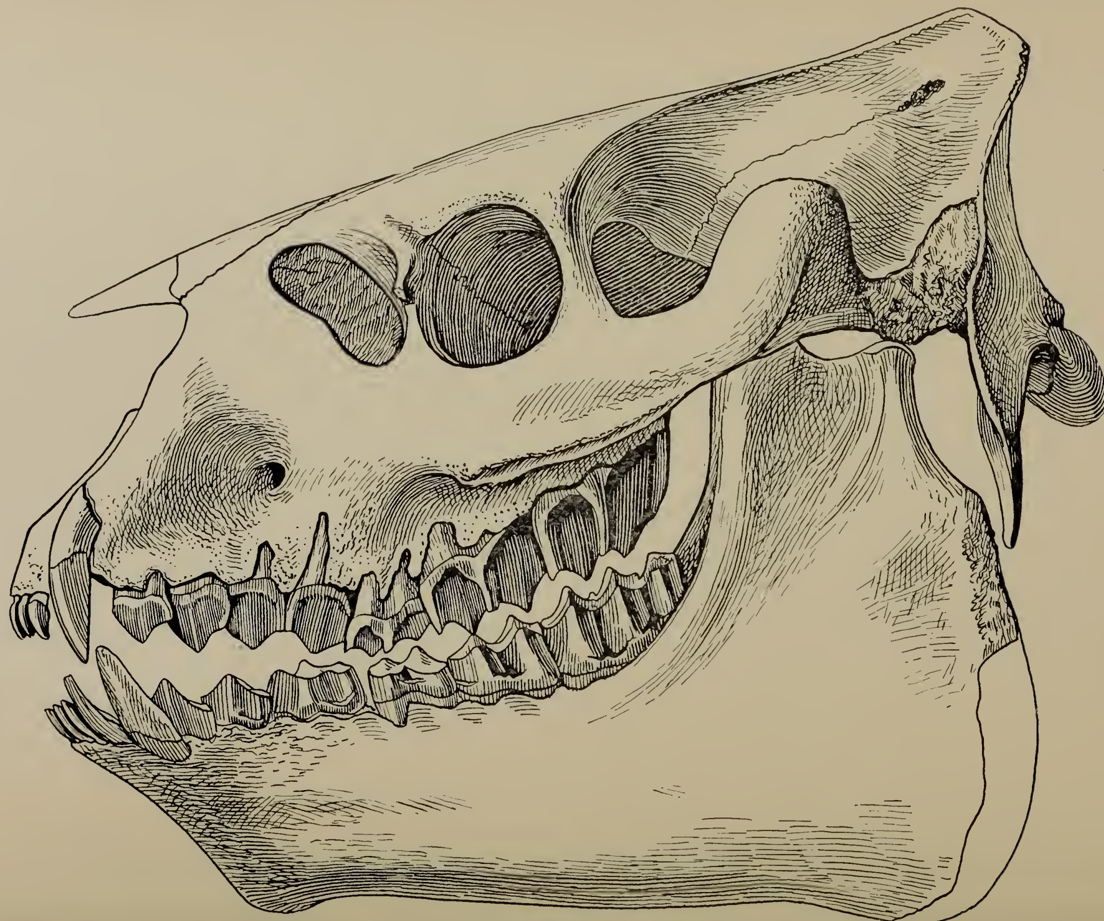
Named in honor of Dr. Holland, the Director of the Carnegie Museum.

MEASUREMENTS.

	mm.
Length of skull	342
Length of neck	250
Width of skull	234
Length of lower molar-premolar series	176
Length of lower premolar series	81
Length of lower molar series	95



Promerycochœrus hollandi Douglass (Type), $\frac{1}{2}$.



Ticholeptus breviceps Douglass (Type), $\frac{3}{4}$.

Ticholeptus breviceps sp. nov.

(PLATE XXIX.)

(Type No. 1191, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type, which was collected by the writer in 1903, consists of a skull, mandible, left humerus, left radius and ulna, right radius and part of the right humerus, a tibia, a fibula, a tarsus with two metatarsals, greater portions of the pelvis, and the right manus with several metacarpals and phalanges.

This specimen was found enclosed in a nodular mass in deposits composed of gravel and cream-colored sands, about one mile southeast of Woodin on Divide Creek six or seven miles south of the Continental Divide in Silver Bow County, Montana.

The skull is short and broad and the facial portions rather high, though the frontal plane is nearly flat. The teeth, especially the posterior molars, are hypsodont. The molar series is much longer than the premolar, the second and third molars being longer than the four premolars. The anterior narial border rises steeply above $P^{\underline{1}}$. The premaxillaries are coössified for a distance of 1.4 cm. The superior portion of the narial opening is large and rounded. The infraorbital foramen is above the anterior portion of $P^{\underline{4}}$. Apparently there were preorbital vacuities. The posterior portion of the skull has a flattened appearance; the paroccipital processes are broad transversely, thin antero-posteriorly, convex behind and concave in front. The tympanic bullæ are lost, but apparently they were extremely large.

The anterior teeth in the mandible are crowded. The length of the lower premolar series equals the combined length of the first two molars and the anterior lobe of the third. The horizontal ramus is only moderately deep, the angle large, and the upper part of the ascending ramus not very broad antero-posteriorly.

The limbs and feet are short, but not heavy. They are about the same length as those of *Merycoidodon culbertsoni*. The skull is shorter, broader, and higher than in that species.

MEASUREMENTS.

	mm.
Length of skull at base	196
Width of skull including zygomatic arches	138
Height of skull above and including $M^{\underline{2}}$	82
Length of upper molar-premolar series	101
Length of upper premolar series measured along alveolar border	43

Length of upper molar series measured along alveolar border	61
Length of lower molar-premolar series	110
Length of lower premolar series	46
Length of lower molar series	64

The specific name is given on account of the short skull.

Ticholeptus bannackensis sp. nov.

(PLATE XXX.)

(Type No. 995, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type, which was collected by the writer in 1903, consists of a portion of the anterior upper part of the skull, a mandible, and the greater portion of a skeleton. There is also a part of another skeleton (No. 1185), but no complete skull. Both specimens were taken from beds, which are undoubtedly of Miocene age, on Grasshopper Creek about ten miles above Bannack in Montana.

The portion of the skull which is preserved shows that the anterior nares were large, broad, and well rounded above. They are situated far back. This imparts to the face an appearance somewhat similar to that of *Merycochœrus*. It is uncertain whether or not the nasals were much shortened anteriorly. They are broad at the posterior border of the anterior nares and narrow rapidly backward, terminating above the anterior portions of the orbits.

The mandible is deep and the angle broadly rounded. The chin is sloping and concave above the angle. The horizontal ramus increases in depth from beneath $P_{\overline{3}}$ to below the middle of $M_{\overline{3}}$ where the angle begins.

The teeth are hypsodont. The faces of the inner crescents of the last two upper molars are concave vertically. The length of the premolar series is a little less than that of the last two molars, and a little more than that of the first two molars and the anterior lobe of the third.

Compared with other species the limbs are intermediate in length, fairly robust. The cuboid is unusually high for its width.

MEASUREMENTS.

	mm.
Length of mandible	217
Depth of mandible beneath $P_{\overline{4}}$	41
Depth of mandible beneath middle $M_{\overline{3}}$	54
Depth of mandible at coronoid process	128
Length of lower dental series	144

Ticholeptus bannackensis Douglass (Type), $\frac{2}{3}$.

Length of lower molar-premolar series	125
Length of lower premolar series	55
Length of lower molar series	70
Length of radius	155
Length of metacarpal III	71
Width of shaft of metacarpal III	12
Length of femur, head to distal end	205
Length of tibia	175
Height of cuboid	22
Width of cuboid	17
Length of metatarsal III	73
Width of metatarsal III	13

Named after the old mining towns of Bannack.

VII. ON FURTHER COLLECTIONS OF FISHES FROM PARAGUAY.[1]

By Carl H. Eigenmann assisted by Waldo Lee McAtee and David Perkins Ward.

The fresh-water fish fauna of tropical America is by far the richest in the world. It comprises about one tenth of all known fishes. It is entirely distinct from the North American fauna and from the Patagonian fauna. Its center of greatest diversity lies in the Amazons about the mouth of the Rio Negro. From this point it becomes attenuated northward until it reaches the vanishing point on the borders of the United States. Southward it extends on the eastern slope to somewhere, no one knows exactly where, south of Buenos Aires. On the western slope it does not extend so far south.

The key to the great diversity of the tropical American fauna is to be found in the enormous single water system extending from 10° north to 35° south latitude, and from 50° to 79° west longitude, providing a continuous north and south water-way of more than 3,000 miles and an east and west course of over 2,000 miles. It embraces the basin of the Orinoco, the basin of the Amazons, and the basin of the La Plata, draining over 3,000,000 square miles of territory, or an area about equal to that of the entire United States, exclusive of dependencies. It has long been known that the Orinoco and the Amazons are connected by the Cassiquiare, the waters of which at times flow one way, at times another. The following is from the "United States of Brazil" issued by the Bureau of American Republics.

"Another remarkable phenomenon of the Paraguay is the mingling of its principal head waters with those of the affluents of the Amazon. An affluent of the Jaurú River is sufficiently near the Guaporé River to be connected with the latter by a canal. The Aguapehy, another tributary of this river, is separated from the Alegre by a narrow isthmus 5 kilometers wide. In the eighteenth century an attempt was made to open up a canal here, and owing to the abundant rains a large canoe of twelve oars succeeded in passing from the one river to the other. One of the governors of the State also endeavored to open up a canal

[1] Contributions from the Zoölogical Laboratory of Indiana University, No. 65.

10 kilometers long in another part of the isthmus, but on account of the small amount of trade it was never completed. This would connect Montevideo and Para by a continental waterway 8,300 kilometers long. In the near future it is probable that railways will take the place of the canal. There are many places on the edge of the plateau, farther to the east, where a simple cut of a few meters would connect the tributaries of the Amazon with those of the Paraguay, transforming eastern Brazil into an island. There is a space of but 100 meters between the Estivado, a small tributary of the Tapajoz, and the Tombador, which empties into the Cuyaba."

In 1891 [2] I called attention to the great similarity of the faunæ of the La Plata and the Amazons. The former was at that time known to differ from the latter by negative characters only. At the same time I called attention to the radical difference between the fauna of the La Plata and the Amazons and the fauna of the coastal streams that empty into the Atlantic between these two great rivers.

Every additional collection from the Paraguay, and indeed from the entire system of the La Plata, tends to emphasize the similarity of its fauna with that of the Amazons.

The interest that centers in the Paraguayan fauna becomes apparent from the above considerations. It is through the basin of the Paraguay that the La Plata has probably received its Amazonian character. For this reason accurate representations of the members of the fauna are greatly desired and an attempt has been made to supply these in the photographs of a number of actual Paraguayan specimens which accompany this paper.

The basin of the Paraguay approaches in area the basin of the Ohio plus that portion of the basin of the Mississippi north of the entrance of the Ohio and exclusive of the basin of the Missouri River. The area then is very large. The means of communication for the most part are primitive, and probably but a fraction of the fauna is known. Two hundred and fifty-four species have been recorded from this basin. The regions that will probably yield the richest rewards in the future are the mountain brooks and pools of central Paraguay, the ponds of the Chaco, and the mountain sources of the Pilcomayo. In the *Proceedings* of the Philadelphia Academy of Sciences for 1903, pp. 497–537, Eigenmann and Kennedy reported on a collection of fishes made by Professor J. Daniel Anisits in the basin of the Paraguay.

[2] *Proc. U. S. Nat. Mus.*, Vol. XIV., pp. 1 et seq., 1891.

Professor Anisits has made further collections of the fresh-water fishes of the basin of the Paraguay which were sent to Indiana University for identification. By these collections several new species and new genera are added to the South American fauna, the known distribution of many species is extended, and what is, perhaps, of most importance, the South American fauna is rid of a number of nominal species, which have been relegated to synonymy. The collections of Professor Anisits are the most important and extensive which have been made in the basin of the Paraguay, and his energy and enthusiasm, together with his great care in the preservation and labelling of his specimens, promise to make the basin of the Paraguay ichthyologically among the best known regions of the neotropical realm.

Of particular interest in the present collection are the new species of *Dysichthys*, the only other species of which came from the Peruvian Amazon, and *Homodiætus*, a new genus of Stegophilini, some of the species of which live in the gill-cavities of the larger Siluroids.

The following localities are represented in the collections:

1. Rio Paraguay at Porto or Puerto Murtinho, Tuyuyu, and Corumba in Matto Grosso.
2. Rio Otuguis, a western tributary of the Paraguay in Paraguay near the boundary of Bolivia.
3. Bahia Negra on the west bank of the Paraguay in northern Paraguay.
4. Puerto Max in the lime region of Paraguay.
5. Tributary of the Paraguay in the Chaco Paraguayo.
6. Ipané-Tuya on the Paraguay.
7. Rio Paraguay and Laguna Pasito at Ascuncion.
8. Rio Negro, a tributary of the Paraguay opposite Ascuncion.
9. Laguna Ipacaray.
10. Mountain brooks at Sapucay, Central Paraguay.
11. Villa Rica, and a small brook of Colonia Gonzales.

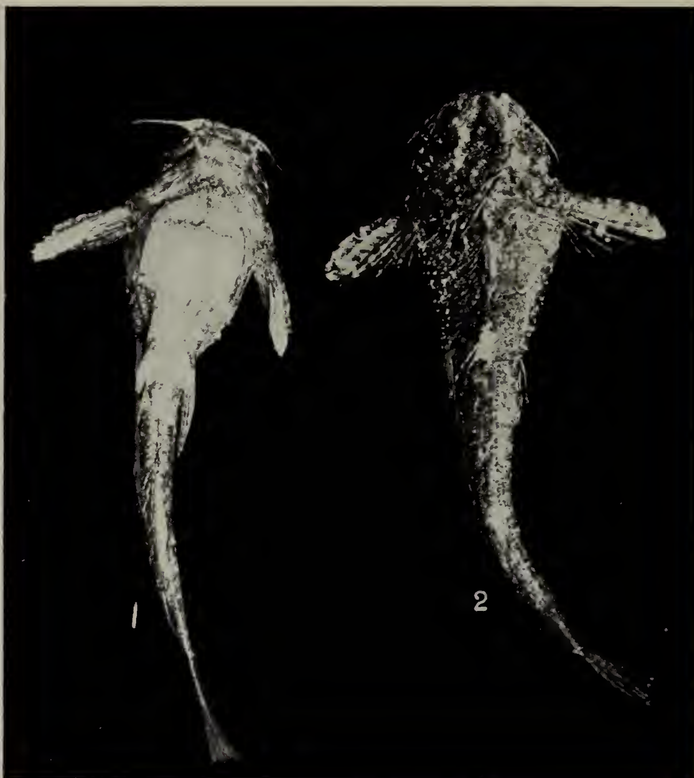
The types of new species are in the collections of Indiana University. A full set of cotypes are contained in the collections of the Carnegie Museum.

BUNOCEPHALIDÆ.

1. *Bunocephalus rugosus* Eigenmann and Kennedy.

One specimen from Corumba (322).[3]

[3] Professor Anisits' collector's number.



Figs. 1-2. *Dysichthys australe* Eigenmann and Ward. (Type.)
Ventral and dorsal views.

2. *Bunocephalus doriæ* Boulenger.

Two specimens from small brooks at Villa Rica (464); another from the Laguna Pasito (462).

3. *Dysichthys australe* Eigenmann and Ward, sp. nov. (Plate XXXI.)

Type No. 10123, one specimen, 28 mm. long from Corumba (317). Cotypes, No. 10124, ten specimens from Corumba (317). This species may be distinguished from *Dysichthys coracoideus*, the only other species of the genus, as follows:

a. First dorsal ray a little nearer tip of snout than base of caudal; maxillary barbels reaching to base of pectorals. D.I,5.. *coracoideus.*

aa. Distance of first dorsal ray from base of caudal one and one half times as great as its distance from tip of snout; maxillary barbels not reaching to base of pectorals; D.I,4.. *australe.*

Body slender, its greatest width at base of pectorals, 3¼ in the length; depth at origin of dorsal 6 in the length; head depressed; snout rounded; two ridges diverging from near the central portion of the snout, running backward above the eye, meeting again to form the nuchal crest, leaving a diamond-shaped depression between the ridges; nuchal crest continued back to base of dorsal fin; a crest on each side beginning at the operculum and running parallel with the lateral and nuchal crests; the ridges and knobs of the head well developed; interorbital space very concave; the part of crest bounding the orbit especially strong; a knob before and another behind the eye. The eyes placed almost laterally below the ridges; eye 1½ in the snout, 7 in the head, 3 in the interorbital; maxillary barbels not reaching to base of pectorals by ¼ of their length.

Coracoid processes parallel behind, their length 2 in the distance between them. Humeral processes slightly shorter; skin everywhere covered with very conspicuous papillæ, those on the sides of the body arranged in about seven rows; distance of dorsal fin from tip of snout 2½ times in the length; pectoral spine armed on both sides with long hooks. Dark brown, speckled with lighter; fins light brown; belly speckled with white; head 5; depth 6; width 3¼; D.I,4; P.I, 4; V. 6; A. 7; C. 10.

The only other species of this genus was described by Cope from Nauta on the Marañon about 2,000 miles from the present locality.

SILURIDÆ.

4. *Rhamdia quelen* (Quoy and Gaimard).

One specimen from Corumba (335).

5 *Pimelodella gracilis* (Valenciennes) (Plate XXXII., Fig. 2).

One specimen from Corumba (352), and another from Laguna Ipacarai (450).

6. *Pimelodella lateristriga* (Müller and Troschel).

Seven specimens from Villa Rica (469).

7. *Pimelodella mucosa* Eigenmann and Ward sp. nov. (Plate XXXII., Fig. 1).

Type No. 10125. One specimen from Bahia Negra (399). This species is most nearly allied to *P. eigenmanni* and *buckleyi* from which it may be distinguished as follows:

a. Lower caudal lobe the longer.

b. Maxillary barbel reaching to middle of caudal; postmental barbel to middle of pectoral spine; pectoral spine curved, with about fifteen straight, feeble spines on its posterior surface, anterior surface with minute denticulations along basal part and feeble recurved hooks near its tip, 1¼ in the head. *mucosa.*

aa. Upper caudal lobe the longer.

c. Maxillary barbel reaching beyond origin of anal; postmental about to middle of pectorals; pectoral spine as long as the distance between base of maxillary barbel and the opercular border, its inner edge distinctly though feebly serrate; adipose dorsal $3\frac{2}{4}$ to 4 in the length............*eigenmanni.*

cc. Maxillary barbel reaching to origin of anal; postmental to tip of pectoral; pectoral spine as long as the distance from the anterior border of eye to the opercular margin, practically smooth on its inner edge; adipose fin a little more than ⅓ in the total length..................................*buckleyi.*

Body compressed posteriorly; head sub-conical, depressed in front, its width 1⅓ in its length, its depth at the base of occipital process 1½, its width at the angle of the mouth 2⅔ in the head; occipital process rather slender, its width at base 2¾ in its length; maxillary barbel reaching to middle of caudal; mental barbel to operculum; postmental to middle of pectoral. Gill-membranes separate to below anterior margin of eye; very conspicuous pits along either side of the lower surface of the head. Eye $1\frac{2}{5}$ in the snout, 3½ in the head, 1¼ in interorbital, slightly nearer to posterior margin of operculum than to snout. Dorsal spine equidistant from snout and anal; its highest rays equal in height to the head in length. Adipose dorsal 3½ in the length, its distance from the dorsal fin being 1⅓ in the length of the latter. Caudal long and deeply forked, the lower lobe wider and longer than the upper, 3½ in the length. Anal rounded, its longest ray $1\frac{4}{5}$ in the head. Ventrals inserted on a vertical line with fourth dorsal ray, 1½ in length of head; pectoral spine 1¼ in

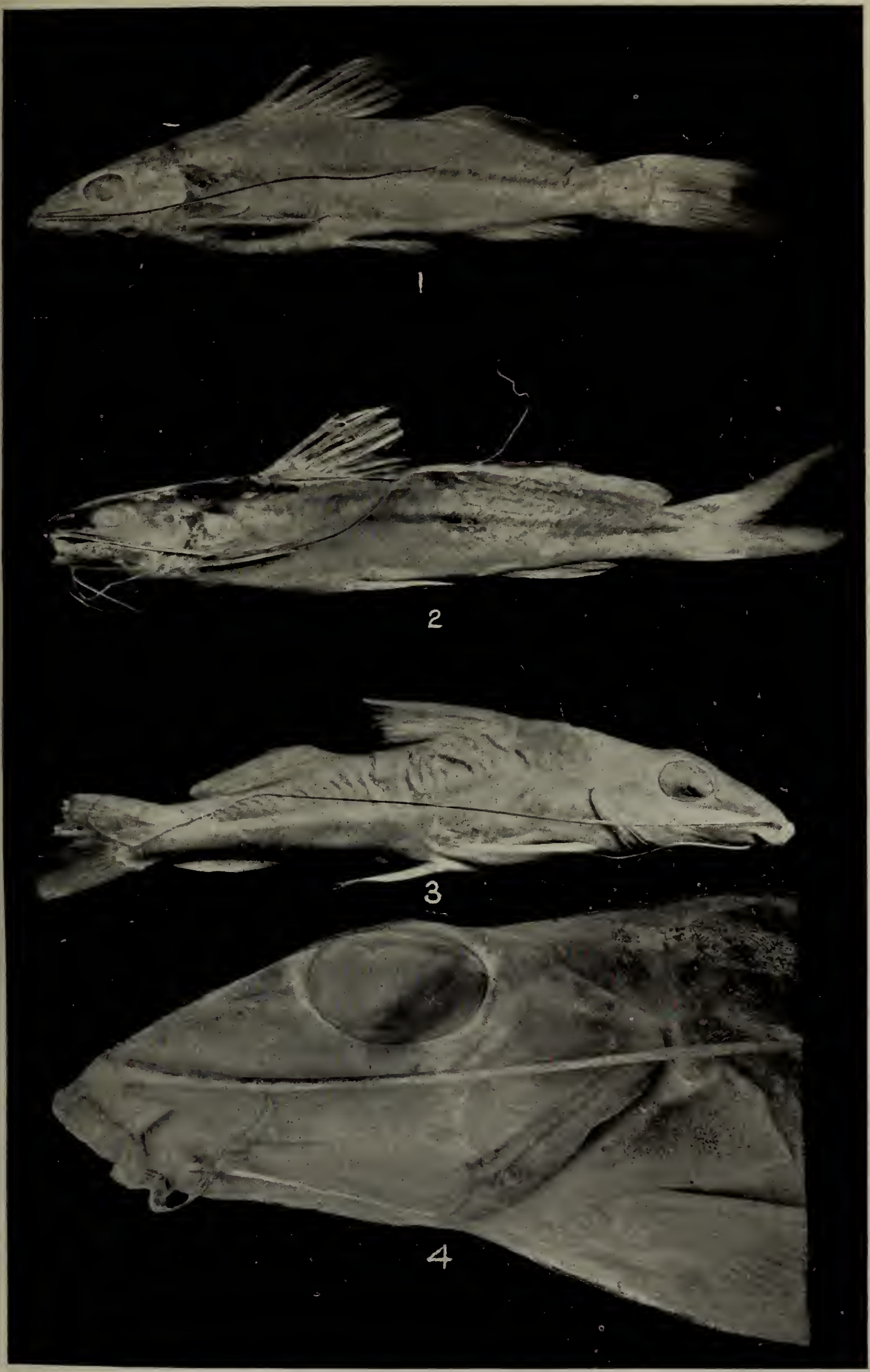


Fig. 1. *Pimelodella mucosa* Eigenmann and Ward. (Type.)
Fig. 2. *Pimelodella gracilis* Valenciennes.
Figs. 3-4. *Iheringichthys megalops* Eigenmann and Ward. (Type.)

the head curved, with about fifteen straight, feeble spines along the middle of the posterior surface, anterior surface with minute denticulations along the basal part, and feeble recurved hooks near its tip. Color light brown, a dark lateral band; fins blotched with black. Head 4; depth 5; D.I,6; A. 10.

8. *Pimelodus ornata* Kner. Cabezudo.

One specimen from Corumba (358).

9. *Pimelodus clarias* (Bloch).

One specimen from Porto Murtinho (286), one from Bahia Negra (398), two specimens from Corumba (291).

10. *Pimelodus fur* Reinhardt.

One specimen from Corumba (part of 290).

11. *Pimelodus valenciennis* (Kröyer).

One specimen, Laguna Ipacarai (451).

12. *Iheringichthys megalops* Eigenmann and Ward sp. nov. (Plate XXXII., Figs. 3–4).

Type No. 10126. One specimen, 175 mm. Bahia Negra, Rio Paraguay (No. 400).

This species resembles *Iheringichthys labrosus*, the only other species of the genus. In every character behind the head the two species appear identical. The differences in the head, comparing specimens of same size, are as follows:

a. Interorbital concave; width of occipital process at its base equal to its length; widest part of fontanel about 2 in interorbital. Eye $3\frac{3}{5}$ in the head; snout $2\frac{1}{6}$ in the head; postorbital part of head $3\frac{3}{5}$; interorbital 5; upper lip scarcely narrowed in the middle. .... *megalops*.

aa. Interorbital flat; occipital process distinctly narrower than long; widest part of fontanel about 3 in interorbital. Eye $4\frac{1}{4}$ in the head, 2 in the snout; snout $2\frac{1}{8}$; postorbital portion of head $3\frac{5}{12}$; interorbital 4 in the head; upper lip with a deep notch in the middle.......... *labrosus*.

Body not as wide as deep at shoulders, compressed toward caudal; head sub-conical, slightly depressed, its greatest width $1\frac{1}{3}$ in its length, its greatest depth about 2 in its length. Snout conical; entire upper portion of head granulose or striate; fontanel scarcely reaching to posterior margin of eye; occipital process as wide at base as long; distance between the nostrils slightly greater than half the diameter of the eye. Maxillary barbels extending very little, if any, beyond tip of caudal; postmental barbels extending to middle of pectorals; mentals not reaching pectorals. Eye elongate, very large,

$3\frac{3}{5}$ in the head, $1\frac{1}{2}$ in the snout, $\frac{7}{8}$ in the interorbital region. Preorbitals prominent; interorbitals distinctly concave; mouth very narrow, jaws not equal; lips very thick, upper lip with its free margin reflexed, scarcely, if at all notched; upper lip extending beyond the lower by $\frac{1}{4}$ diameter of the eye; teeth of the jaws in very narrow bands; no teeth on the vomer; teeth on the pterygoids inconspicuous. Dorsal spine strong, $1\frac{1}{4}$ in length of head, serrate on posterior margin; distance of adipose fin from dorsal slightly less than length of adipose, which is $4\frac{1}{4}$ in the length. Caudal forked. Pectoral spine strongly serrate on both margins, serrations on inner margin a little the stronger, the spine a little shorter than the head. Humeral process triangular, pointed behind, but not spine-like, scarcely reaching to middle of pectoral spine, its surface granulose-striate. Ventrals reaching to anal, margin of anal concave, some of the anterior rays extending much beyond tip of last. Anterior upper portion of the body spotted, otherwise plain.

Head $3\frac{1}{4}$; depth $4\frac{1}{4}$; D. I, 6; A. 11.

13. *Iheringichthys labrosus* (Kröyer) (Plate XXXIII., Fig. 1).

One specimen from Corumba (290), and four from Bahia Negra (382).

14. *Hemisorubim platyrhynchos* (Cuvier and Valenciennes) Jiripoca.

One specimen from Corumba (359).

15 *Doras costatus* (Linn.).

One specimen from Corumba (364); another from Laguna Ipacarai (449).

16. *Doras weddelli* Castelnau.

One specimen colored like the type figured by Castelnau. Tributary of Rio Pilcomayo (445).

17. *Oxydoras eigenmanni* Boulenger.

Eight specimens from Corumba (365).

18. *Hemidoras paraguayensis* Eigenmann and Ward sp. nov. (Plate XXXIV, Fig. 1).

Type No. 10127. One specimen, Corumba (366).

This species is closely related to *nattereri*, from which it differs in the characters set forth in the following key:

a. Depth equal to length of head; lower jaw sometimes with patches of teeth. Maxillary barbel extending to below the eye; caudal deeply forked...... *nattereri.*

aa. Body distinctly deeper than length of head; lower jaw without teeth. Maxillary barbel extending to gill-opening. Caudal scarcely forked, the lower lobe wider and longer than the upper............................. *paraguayensis* sp. nov.

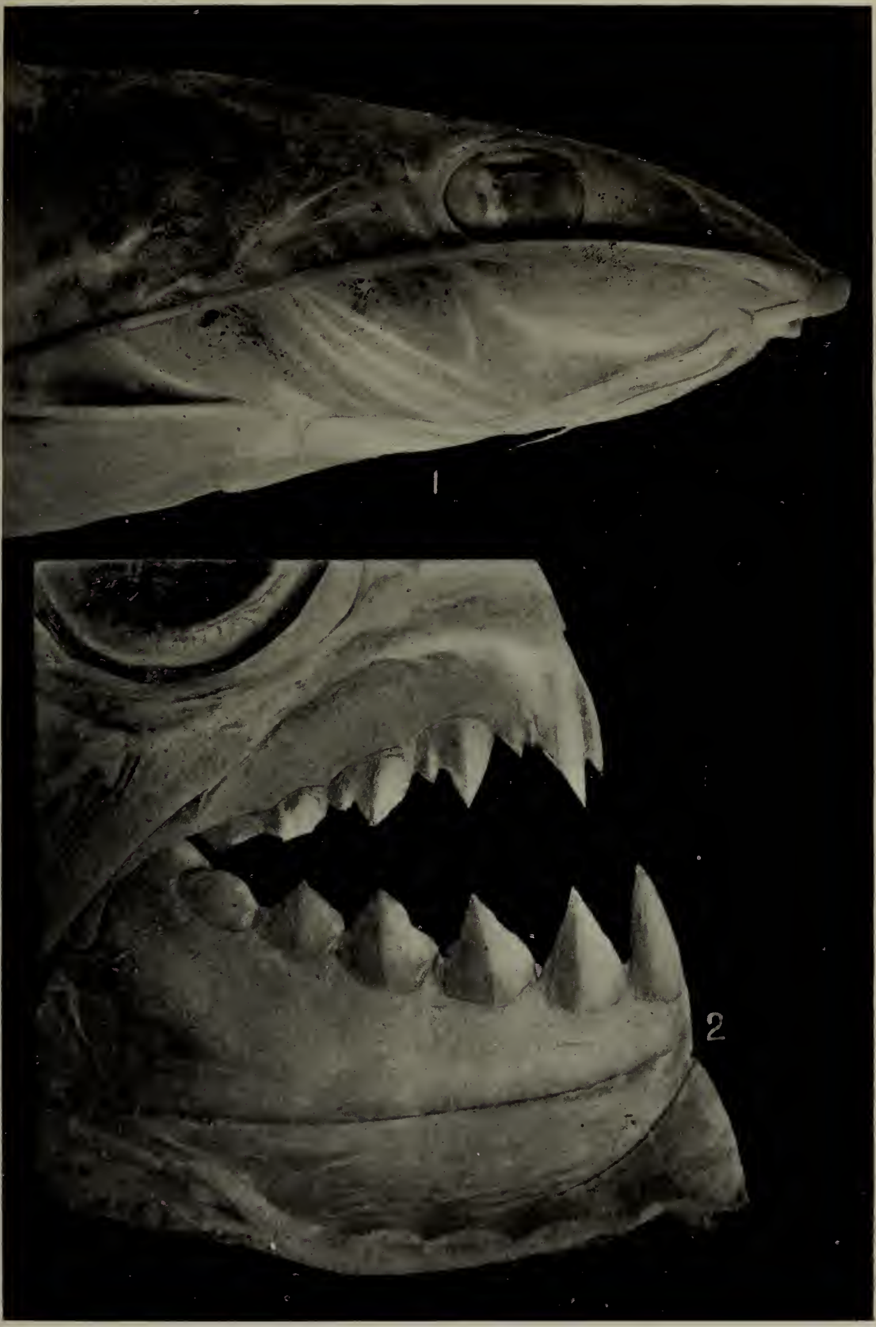


Fig. 1. *Iheringichthys labrosus* (Kröyer).
Fig. 2. Dentition of *Serrasalmo humeralis* (Cuvier and Valenciennes).

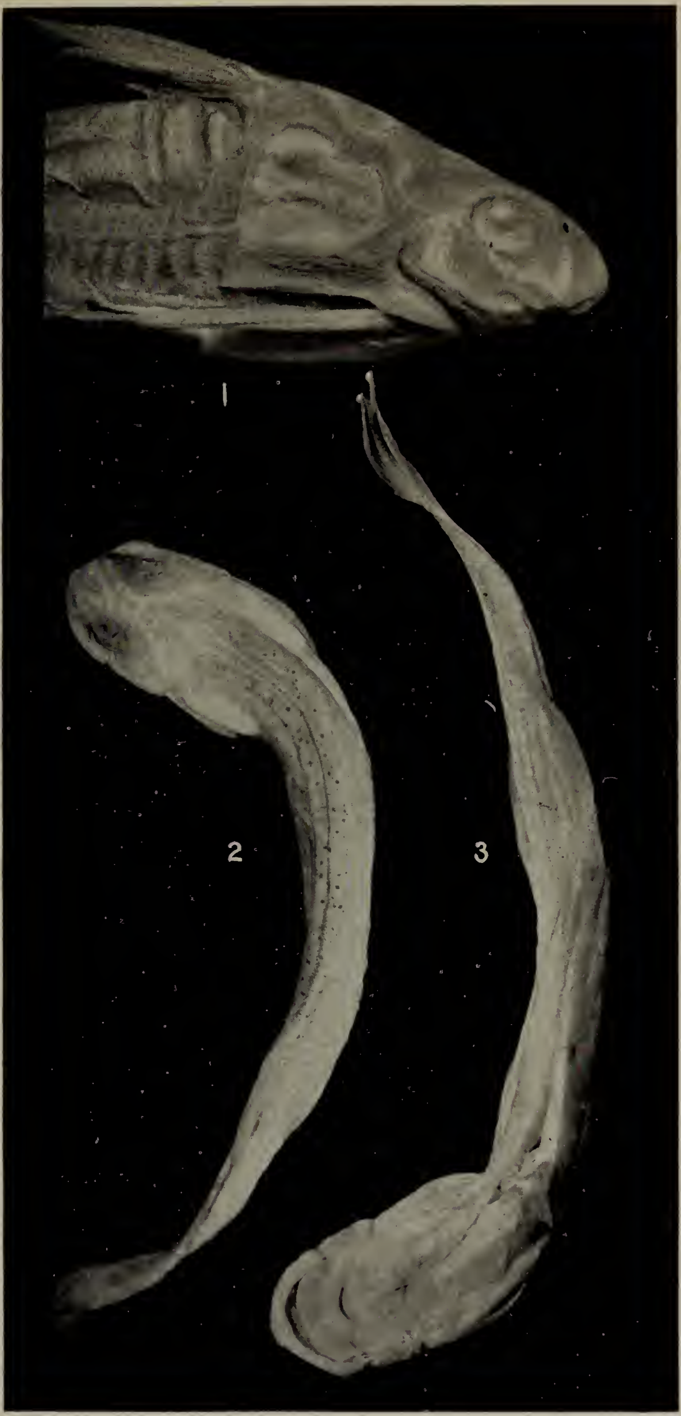


Fig. 1. *Hemidoras paraguayensis* Eigenmann and Ward. (Type.)
Figs. 2–3. *Homodiætus anisitsi* Eigenmann and Ward. (Type.)

Body short and deep; ventral outline almost straight to base of anal; profile steep to nostrils, rounded at base of dorsal spine; head short, slightly deeper than wide, its depth equal to its length. Interorbital region convex. Occipital region steep and convex. Fontanel an oval opening somewhat shorter than the eye, situated in a groove 1½ times as long as the eye. Eye large, 1¼ in the snout, 3 in the head, 1⅓ in the interorbital; snout short, rounded. Barbels all connected by a membrane, those of the maxillary extending to gill-openings, with a few cirri on their outer margins; gill opening extending forward to about ½ the distance of the eye. Coracoid process exposed, striate. Humeral process broad and long and with a strong keel, its surface striate. A few imbedded scutes in front of a large scute which is connected with the dorsal plate; the following lateral scutes much lower, each with a large median hook and a series of fine marginal teeth above and a series of one large and several fine teeth below the median hook. The lateral scutes on the caudal peduncle have a more enlarged median hook, and the fine marginal teeth fewer, or none. No plates on dorsal or ventral surface. Distance of the dorsal spine from the snout 2¼ in the length. Dorsal spine slightly curved, its anterior margin with rather long and fine teeth to near the tip, its posterior margin with short, wide-set teeth. Space between dorsal and adipose fins 3¾ in the length. Adipose fin as high as long. Caudal scarcely emarginate, the lower lobe much wider and somewhat longer than the upper. Anal fin as high as long, rounded. Ventrals not reaching anal by ⅓ their length. Pectoral spine strong, longer than the dorsal spine, reaching to the second third of the dorsal fins; both margins serrate, both surfaces striate. Color light brown; silvery below lateral scutes; anal and pectoral fins peppered with dark.

Head 3½; depth $2\frac{5}{8}$; lat.l.29; D.I,6; A.12; V. 7; P.I, 8.

19. *Auchenipterus nigripinnis* Boulenger. Bagre Sapo.

Two specimens, Corumba and Puerto Max (353).

20. *Trachycorystes striatulus* (Steindachner).

Two specimens. Tributary of Rio Pilcomayo (444).

PYGIDIIDÆ.

Homodiætus Eigenmann and Ward, gen. nov.

Type: *Homodiætus anisitsi* Eigenmann and Ward.

Dorsal behind the ventrals; no teeth on the vomer; gill-membrane united with the sides above and with the isthmus below, leaving the opening a very small slit in front of the pectorals; a longer and a shorter maxillary barbel on each side; upper jaw and lips with about eight widely separated series of teeth, the teeth narrow, more or less spoon-oar-shaped, those of the inner series slightly larger; teeth of the lip very movable, those of the jaw more firmly attached; lower lip without teeth, three series of the teeth on the lower jaw, those of the innermost series largest and forming a compact series. All the teeth more or less angularly bent backward near the tips. Opercle with about 4 spines; subopercle with 6; anal short, behind the origin of the dorsal; head depressed, the eye directed upward, mouth inferior; caudal emarginate; very large glandular swellings behind the pectoral.

This genus is most closely allied to *Stegophilus* and *Miuroglanis*. It differs from *Stegophilus* in having two maxillary barbels and from *Miuroglanis* in having an emarginate instead of a rounded caudal and in having several series of labial teeth which are apparently wanting in *Miuroglanis*.

The genus *Stegophilus* as defined by Eigenmann and Eigenmann includes both species with a rounded and an emarginate caudal. Were the species large we should not hesitate in placing them in separate genera and a different rule should not apply here.

The genera of the Stegophilinæ may be defined and distinguished as follows:

a. Upper lip with several series of numerous, small, movable teeth; each jaw with several series of minute teeth; mouth inferior.
- *b*. Gill-membrane broadly united with the isthmus.
  - *c*. Caudal widely forked, the upper lobe produced in a filament; a single maxillary barbel .... *Pseudostegophilus*.
  - *cc*. Caudal emarginate.
    - *d*. A single maxillary barbel .... *Henonemus*[4] nov.
    - *dd*. Two maxillary barbels .... *Homodiætus* nov.
  - *ccc*. Caudal rounded.
    - *e*. A single maxillary barbel .... *Stegophilus*.[5]
    - *ee*. Two maxillary barbels .... *Miuroglanis*.

[4] **Henonemus** Eigenmann & Ward *genus nov.*

('εν = one, νῆμα = thread; in allusion to the single barbel.)

Type *Stegophilus intermedius* Eigenmann & Eigenmann.

This genus is distinguished from *Homodiætus* by the possession of a single barbel at the maxillary.

[5] The genus *Stegophilus* as here understood contains two species, *insidiosus* and *reinhardti*, which differ very much from each other in the development of caudal fulcra and which may represent two distinct genera.

bb. "Rimæ branchioles confluentes, membrana branchiostega cum isthmo haud connexa; cauda rotunda, barba maxillaris unica, radia caudalia accessoria nulla"..*Acanthopoma.*[6]

aa. No labial teeth; teeth in the jaws in a single series.

f. Teeth pointed, in a single series in the pre-maxillaries only; mouth sub-inferior; caudal rounded or but slightly emarginate; a single maxillary barbel ....*Vandellia.*

ff. Teeth broad, incisor-like in both jaws; caudal forked; two maxillary barbels. *Pareiodon.*

21. *Homodiætus anisitsi* Eigenmann and Ward sp. nov. (Plate XXXIV., Figs. 2–3).

Type No. 10155, one female 43 mm. long; small creek at Villa Rica, Paraguay (466).

Head 6½; depth 5¾; D. 8; A. 8.

Elongate compressed, head much depressed; head nearly as wide as long; snout broad, its horizontal outline rounded; mouth very large, hemicircular in outline, 2⅕ in the head; lower surface of head flat, upper arched, the eyes directed upward, sidewise and forward; eye equals snout, 3½ in head, about equal to the interorbital; no free orbital margin; origin of maxillary barbels below the last quarter of the eye; outer and longer barbel shorter than eye, inner barbels much shorter, minute but distinct; a distinct thin, free, lower lip extending for but a short distance from the angle of the mouth; teeth of upper lip distinctly visible when mouth is closed; pectorals extending some distance beyond the axillary gland, their length 2⅔ in distance from their base to ventrals, equal in length to their distance from the tip of the mouth; origin of dorsal equidistant from tip of caudal and poste-

[6] Lütken in Videnskabelige Meddelelser for 1891, Kjobenhavn, 1892, describes *Acanthopoma* as follows:

Caput depressum parabolicum, cauda subcompressa: maxillæ in tentaculum breve continuæ; os inferum, supra seriebus dentium minutorum plurimis; rimæ branchiales confluentes, membrana branchiostega cum isthmo gulari haud connexa; spinæ operculares et interoperculares plures; pinna dorsalis post pinnas ventrales, inter has et pinnam analem posita.

ACANTHOPOMA ANNECTENS.

Maal:

Totallængde	100	mm.
Hovedets Længde	15	"
Hovedets Brede	15	"
Legemets største Højde	10.5	"
Fra Snudespidsen til Rygfinnen	60	"
Fra Snudespidsen til Gattet	64	"

rior margin of eye; caudal with numerous accessory rays, slightly emarginate, the upper lobe longest, longer than pectoral; anal inserted below the end of the dorsal; ventrals short, reaching the vent; vent equidistant from tip of mouth and tip of caudal.

Straw-color, back with numerous large, conspicuous, stellate, black chromatophores and many more smaller, much less conspicuous, brown ones; sides with a few small stellate, black, chromatophores, gradually giving rise to a regular series along the middle of the tail; a dusky streak along the sides between the myotomes of the body and the thin covering of the abdominal cavity; a small, intense black spot at the base of the middle caudal ray; middle caudal rays dark, becoming intensely black toward tip; oblique bars extending from the end of the second ray below median dark one downward and forward to the tip of the lower caudal fulcra and then as a black line forward along the tips of the fulcra; another one like it in all respects from the tip of the second ray above the median dark one upward and forward to the tip of the caudal fulcra and then forward along their tips as a black line; remaining fins more or less dotted.

Alimentary canal straight, without convolutions or bends, the thin-walled stomach lying lengthwise and giving rise to a short, thin intestine which merges into the much longer and larger, but thin-walled large intestine which appears to be filled with minute grains of sand.

LORICARIIDÆ.

22. *Hemiodontichthys acipenserinus* Eigenmann and Eigenmann. (Plate XXXV., Fig. 1).

One specimen. Corumba (No. 333).

23. *Sturisoma robusta* (Regan) (Plate XXXVI., Figs. 1–3).

One specimen from Corumba (354).

24. *Loricaria typus* (Bleeker) (Plate XXXV., Figs. 2, 3).

Four specimens from Corumba (331), one from Puerto Max (406), and two from Laguna Pasito, Ascuncion (460).

25. *Loricaria apeltogaster* Boulenger.

One specimen, Corumba (348).

This specimen differs from the other specimens described in having the entire surface of the lower lip covered with short cirri.

26. *Loricaria carinata* Castelnau (Plate XXXVII., Figs. 1–2).

One specimen from Puerto Max (405) and two from Corumba (330). Three from a brook at Villa Rica (465).

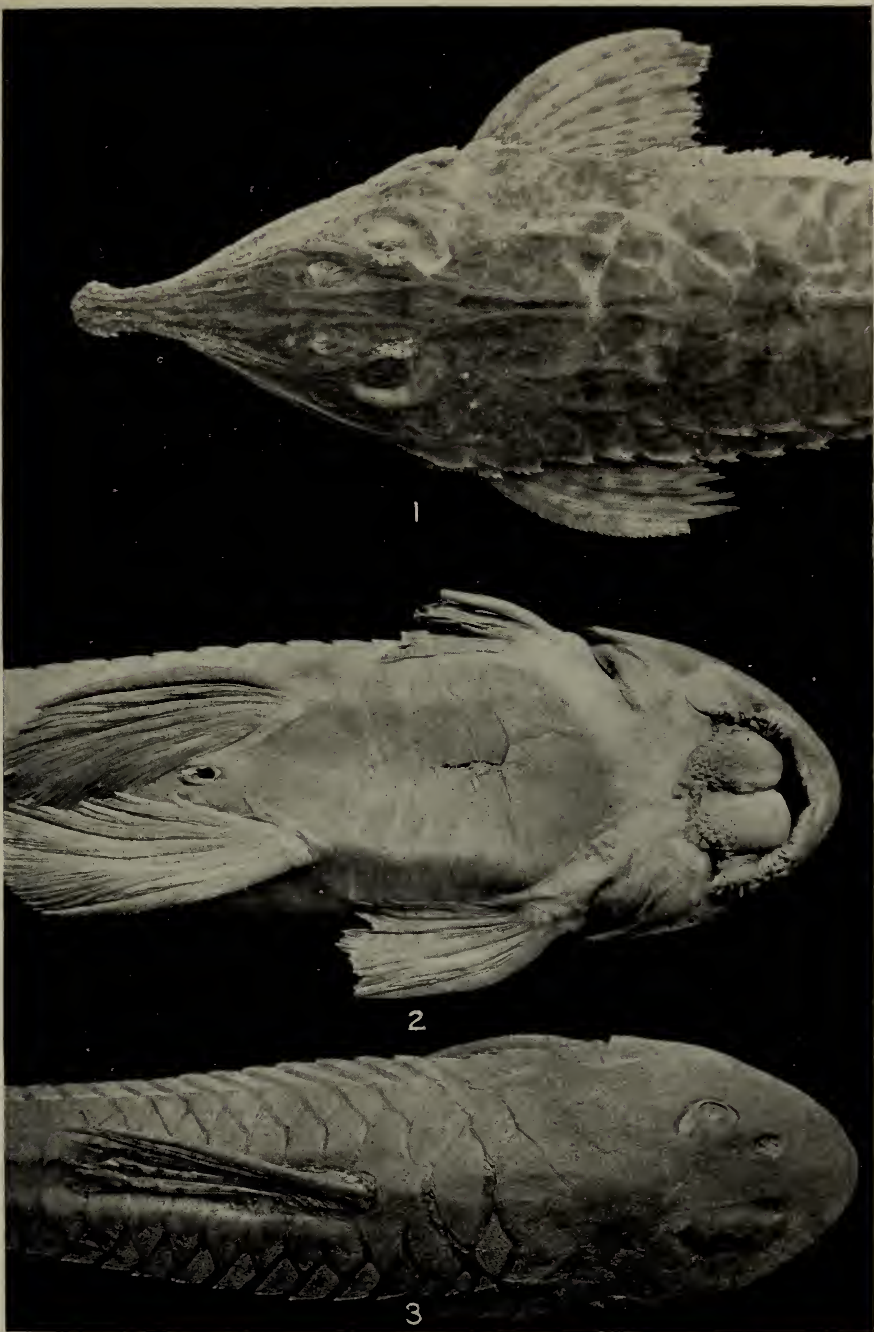


Fig. 1. *Hemiodontichthys acipenserinus* (Kner.).
Figs. 2–3. *Loricaria typus* (Bleeker).

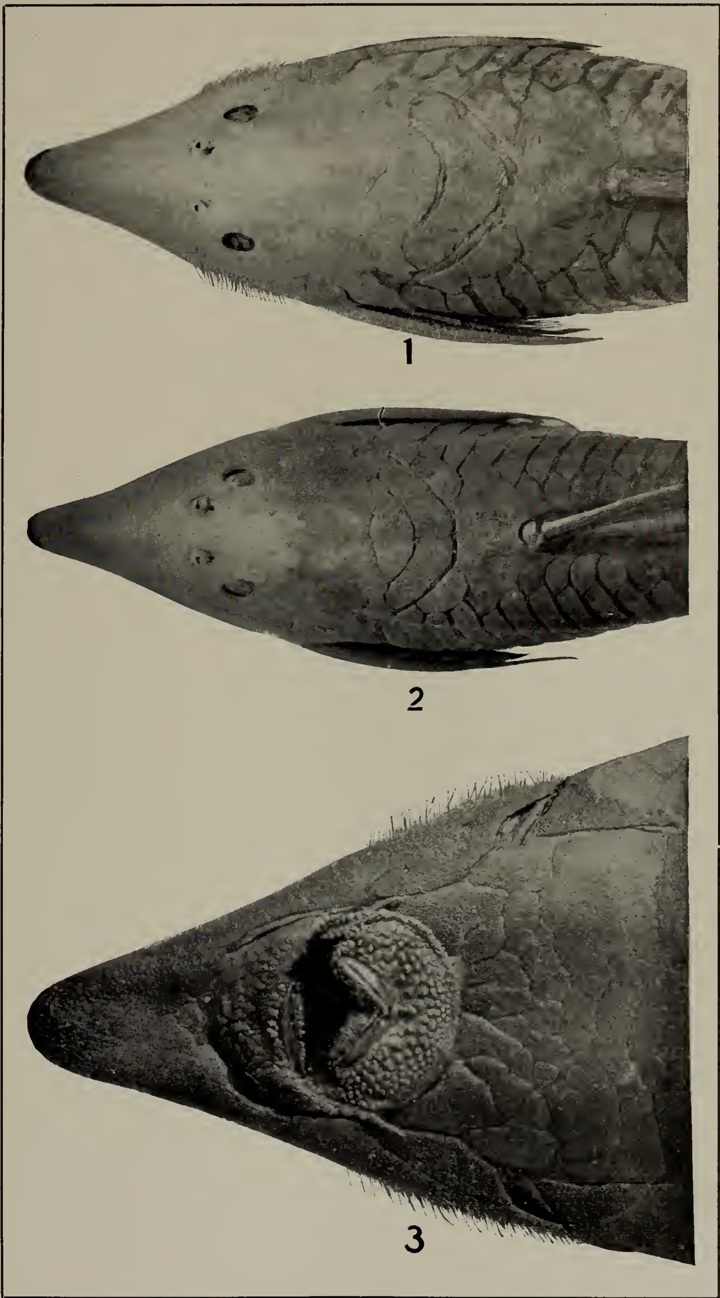


Fig. 1. *Sturisoma robusta* (Regan) ♂, dorsal view.
Fig. 2. *Sturisoma robusta* (Regan) ♀, dorsal view.
Fig. 3. *Sturisoma robusta* (Regan) ♂, ventral view.

Figs. 1–2. *Loricaria carinata* Castelnau.
Figs. 3–4. *Loricaria labialis* Boulenger.

27. *Loricaria parva* Boulenger.

Ten specimens, Corumba (339, 349, 300, 301). Four from Laguna Pasito, at Ascuncion (461).

28. *Loricaria labialis* Boulenger (Plate XXXVII., Figs. 3–4).

Four specimens from Corumba (319).

29. *Otocinclus vittatus* Regan (Plate XXXVIII., Fig. 1).

One specimen (part of 304), Corumba; two specimens (446), tributary of the Pilcomayo.

Description of the Corumba Specimen. — Body rounded in front, compressed toward tail; its greatest width less than depth; profile straight, less steep than in *affinis*. Occipital process terminating in an elevated, triangular process; ventral and dorsal profiles similar; sides of head vertical, eyes distinctly lateral. Interorbital convex; a groove running from snout to nares. All the bones of the head hispid; head nearly covered with spines; spines minute on occipital, strongest on border of snout. Orbit 2 in the snout, 4 in the head, 2 in the interorbital. Snout pointed. Lower surface of the head naked except a triangular space below the eye. Lateral plates hispid. Distance of dorsal fin from tip of snout 2⅛ in the length. Dorsal spine as long as head. Caudal forked. Pectoral extending little beyond origin of ventrals. Ventrals reaching nearly to anal. Color light brown above with a broad dusky bar extending from snout to end of caudal; tips of caudal dark; black bands extending from end of dark band on middle caudal rays first backward, then forward, forming with the median band a Υ-shaped figure.

Head 3½; D.I, 6; A. 6; V. 6; P.I, 6; C. 16; Lat. l.23.

The two from Pilcomayo are very beautiful, well-preserved specimens, which are slightly longer than the Corumba specimen, being 34 mm. and 25 mm. long. They agree with it in all except the color, which is faded. Traces are visible of the dusky lateral band and markings on the caudal fin. The specimens have the appearance of having been preserved in some corrosive sublimate preparation, or having lived in a cave; one of them has D.I, 7.

KEY TO THE SPECIES OF OTOCINCLUS.

a. Sides with a longitudinal band.

b. Middle caudal rays black. D.I, 6 or 7.

c. Tips of caudal dark; black bands extending from end of the dark band on middle caudal rays first backward and then forward, forming with the median band a Υ-shaped figure; a well-defined band from tip of snout to caudal, widest at the caudal peduncle, blackest on caudal.

Eye 4 in the head; lat. l.23 .... *vittatus*.

cc. Fins, aside from the basal caudal spot, plain; lateral band a weak line on lateral line; lat. l.21 .... *vestitus*.

bb. Middle caudal rays not black; D.I, 7; Lat. l.23–25 .... *affinis*.

aa. Sides spotted; D.I, 7; A.I, 5; lat. l.25.

d. Six spots along lateral line; a series of corresponding spots along the back; dorsal and caudal spotted. Eye 4; lower lip thin and entirely naked. *flexilis*.

dd. Two large spots along the lateral line; a series of corresponding dorsal spots; caudal with 3 vertical dusky bars, sometimes spots. Eye 4.25; lower lip coarsely tubercular .... *fimbriatus*.

30. *Plecostomus plecostomus* (Linnæus).

Three specimens, Corumba (340). These specimens with several sent in the first collection which were not recorded from Ascuncion; Rincomeda on Rio Apa, Arroyo Trementina give us a range of specimens from 60 to 390 mm. in length. There is a great modification in the shape of the head. It becomes lower, broader, and very much more rounded with age. The caudal, which is cross banded in the young, becomes spotted. The dorsal which has a single series of spots between the rays comes to have two series. It is evident from the series that *Plecostomus boulengeri* is but the young of *Plecostomus plecostomus*, as Regan has recently stated.

31. *Plecostomus johni* Steindachner.

I am inclined to think that both *Plecostomus commersoni* and *vermicularis* mentioned in the first paper on Paraguayan fishes and *Plecostomus ternetzi* Boulenger should be placed here. The *vermicularis* is a small specimen and its identification must be more or less of a guess.

Our largest specimen is about 200 mm. long. In this the region in front of the gill slit, a band across the breast and a large triangular patch on the middle of the belly are granular and there is a series of larger plates along the sides of the belly between the pectorals and ventrals. Otherwise the lower surface is naked. In the smaller specimen there is also a median granular band between the ventrals. In the shape of the head, spines of the lateral plates, lateral line, etc., the specimens agree with *Plecostomus ternetzi*. Our larger one differs in having the dorsal with large spots, but these spots are quite obscure. In the smaller specimen the dorsal is uniform dark, as in the type of *ternetzi*.

32. *Xenocara gymnorhynchus* Kner.

One specimen, mountain brook at Sapucay, Central Paraguay (452),

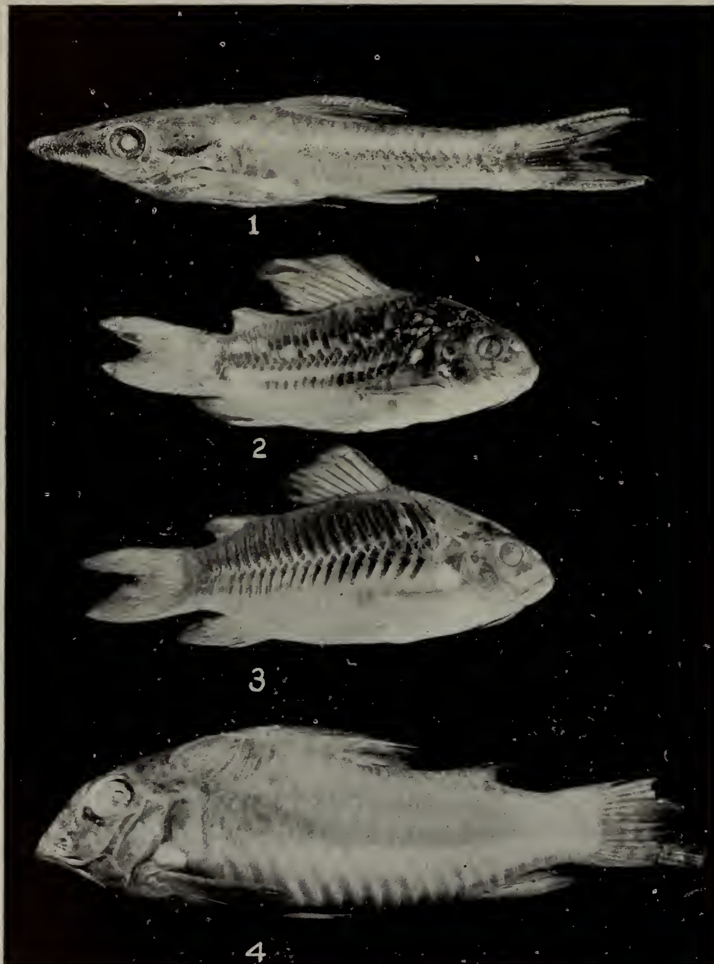


Fig. 1. *Otocinclus vittatus* Regan.
Figs. 2–3. *Corydoras microps* Eigenmann and Kennedy.
Fig. 4. *Corydoras aurofrenatus* Eigenmann and Kennedy.

CALLICHTHYIDÆ.

33. *Callichthys callichthys* Linnæus.

Two specimens from Bahia Negra (412).

34. *Hoplosternum pectoralis* (Boulenger).

Two specimens from a swamp near Ascuncion (297).

Two others, Laguna Pasito, at Ascuncion (463).

35. *Hoplosternum littorale* (Hancock).

One specimen from Bahia Negra (411).

36. *Corydoras microps* Eigenmann and Kennedy (Plate XXXVIII., Figs. 2, 3).

Four specimens, mountain stream, Sapucay, central Paraguay (453), six from small brooks at Colonia Gonzales, Villa Rica (467).

37. *Corydoras aurofrenatus* Eigenmann and Kennedy (Plate XXXVIII., Fig. 4).

Two specimens, small brook at Villa Rica (472).

38. *Corydoras australe* Eigenmann and Ward, sp. nov.

Type No. 10129, one specimen, Corumba (304). Cotypes, 10130, five specimens Corumba (304); two specimens (447), tributary of the Rio Pilcomayo.

This species is very closely related to *hastatus* and may be identical with it. The coloration of the caudal in the two species is identical, but the lateral band in *hastatus* is jet-black, while in this species it is an indistinct line.

Anterior profile strongly rounded and nearly vertical to the nostrils, less steep and almost straight from nares to dorsal. Head slightly longer than deep; width 1⅓ in its length; occipital process slender and triangular, meeting the dorsal plate; fontanel quite elongate, extending into the occipital bone; preorbital small. Eye very large, orbit one in the snout, 3 in the head, 1⅔ in interorbital. Mouth inferior, snout rounded, short; rictal barbels extending to middle of eye; lower lip terminating in two barbels. Coracoid process striate, forming a ridge on the side of belly. Distance of the dorsal spine from the snout 2 in the length, height of dorsal spine a little less than length of head. Caudal deeply forked. Pectoral spine longer than dorsal spine, its surface striate, comparatively free from serrations. Straw color. An indistinct dusky line from gills to base of caudal, terminating in a large arrow-shaped spot which is bordered posteriorly with white, which itself is narrowly margined with blackish, the caudal dusky beyond (as in *hastatus*). A faint line from behind ventrals to behind anal. Head back of eyes dusky, the color extending down and back on the sides posterior to the gill-openings. Head 3½; depth 2½; D.I, 7; P.I. 7; V. 7; lat. l.22.

CHARACIDÆ.

39. *Hoplias malabaricus* (Bloch.) Trahira.

Three specimens, Corumba (362); one specimen, Bahia Negra (396).

40. *Hoplerythrinus unitæniatus* (Spix).

Two specimens, Bahia Negra (402).

41. *Pyrrhulina australe* Eigenmann and Kennedy.

Five specimens, Upper Paraguay at Corumba (309, 316).

42. *Psectrogaster curviventris* Eigenmann and Kennedy. Blanquillo.

One specimen, Bahia Negra (374), and one specimen Puerto Max (408).

43. *Curimatella alburnus* (Müller and Troschel).

One specimen, Bahia Negra (375).

44. *Curimatus elegans nitens* Holmberg.

Curimatus elegans paraguayensis E. & K.

Two specimens, Ascuncion (276). Two specimens from mountain streams at Sapucay (457).

45. *Curimatus bimaculatus* Steindachner.

One specimen, Corumba (357).

46. *Prochilodus scrofa* Steindachner.

One specimen, Bahia Negra (396).

47. *Anisitsia othonops*[7] (Eigenmann & Kennedy).

One specimen, Bahia Negra (403).

48. *Parodon paraguayensis* Eigenmann (Plate XXXIX., Fig. 1).

Nineteen specimens, Ascuncion (275).

49. *Nanognathus borelli* Boulenger (Plate XXXIX., Fig. 2).

Anostomus fasciatus Eigenmann & Kennedy, Proc. Phila. Acad. Sci. 1903, 512, 1904 (Rio Paraguay at Ascuncion and Estancia la Armonia).

The specimens mentioned by E. & K. and three additional ones from Corumba (338, 357) and one from Puerto Max (409) differ from *fasciatus* in having no caudal spot. They differ from the typical *dissimilis* Garman in having but 40–42 scales in the lateral line and the head 4½ in the length, instead of 4⅔.

[7] Misprinted orthonops in E. & K.'s article, *l. c.*, 511.

Fig. 1. *Parodon paraguayensis* Eigenmann.
Fig. 2. *Schizodon borelli* Boulenger.
Fig. 3. *Aphiocharax dentatus* Eigenmann and Kennedy.

50. *Leporinus frederici* (Bloch).

Two specimens, Puerto Max (407).

51. *Leporinus trifasciatus* Steindachner.

A single specimen from Bahia Negra, 310 mm. (401), and another one from Ascuncion.

Head 3⅔; depth 4; eye 5½ in the head, 3 in interorbital. Scales 6–42–5.

52. *Leporinus affinis* Günther.

One specimen (195), Arroyo Trementina.

53. *Leporinus hypselonotus* Günther.

Two specimens (413) from Puerto Max, are probably the young of this species. Length 18 mm.

Depth 3; head 3. Body with 8 transverse bands, the last on the caudal peduncle. Some of these near the middle of the body have a tendency to split at the top, Y-shaped. Head with a diamond-shaped, dark blotch on top, enclosing an oblong, lighter portion, and with a line from eye, around lower lip, and a dark opercular blotch.

Form somewhat different from that of the adult, especially as to the head. Lower jaw more prominent, dorsal profile of head not concave but forming part of an even line from dorsal fin to snout.

Teeth strap-shaped, a pair of stronger ones set slightly behind the others in the mandible.

54. *Characidium fasciatum* Reinhardt.

Two specimens, one (471) from Villa Rica and the other (448) from a tributary of the Pilcomayo. The latter specimen is very pale, having a faint lateral band, a black spot at base of middle caudal rays and the lateral bands faint, most distinct on the back. The Villa Rica specimen, on the contrary, is highly colored, the lateral band wide and the vertical bands distinct. The dorsal with horizontal bands and the caudal with cross-bands.

D. 11; A. 8; lat. l. 37. The pectoral in the Pilcomayo specimen is feeble, not reaching the ventrals; that in the Villa Rica specimen is strong and reaches a little beyond origin of ventrals. The Villa Rica specimen has the general habit and coloration of a darter (*Etheostoma*).

55. *Odontostilbe paraguayensis* Eigenmann & Kennedy.

Five specimens, Corumba (329).

56. *Odontostilbe trementina* Eigenmann & Kennedy.

One specimen, Puerto Max (part of 388).

57. *Cheirodon interruptus* (Jenyns).

Puerto Max (part of 388).

Seven specimens (473), Colonia Gonzales.

58. *Aphiocharax dentatus* Eigenmann & Kennedy (Plate XXXIX., Fig. 3).

Nine specimens from Corumba (272, 282, 274, 367) one from Puerto Max (386), and ten from a small tributary of the Rio Negro, a tributary of the Rio Pilcomayo (443).

Back deep yellow, opercle golden.

In the original account of this species three typographical errors occur. For type No. "10030" read 10032, and under cotypes for "10030 and 10031" read 10034 and 10,035.

59. *Hemigrammus luetkeni* Boulenger.

(Part of 388), Puerto Max.

Three specimens from a pond at Colonia Gonzales, at Villa Rica (470).

60. *Hemigrammus kennedyi* Eigenmann.

Two specimens from Corumba (327), and several from Puerto Max (389).

61. *Hemigrammus ulreyi* (Boulenger).

Specimens 34–40 mm. long, Corumba (328).

62. *Tetragonopterus argenteus* Cuvier. Lambari. (Plate XL., Fig. 1.) *Tetragonopterus chalceus* Eigenmann & Kennedy, l. c., 523.

Eight specimens from Porto Murtinho (287).

Five specimens from Bahia Negra (383).

63. *Tetragonopterus alleni*[8] Eigenmann & McAtee sp. nov. (Plate XL., Fig. 2).

Mojarra Lambari. Type No. 10158, a specimen 110 mm., Corumba (363).

Cotype, No. 10159, a specimen 85 mm. Corumba (363); Cotype, No. 10160, a specimen 95 mm., Rio Otuquis (372); Cotypes, No. 10161, two specimens, 60 and 95 mm., Ascuncion (280).

This species agrees very closely with specimens of *Astyanax multiradiatus* from Ascuncion, Rio Paraguay, but differs notably in the greater depth, and the sharp up-turn of the nape making the profile distinctly a *Tetragonopterus* profile. It is very probable that Steindachner's *Tetragonopterus multiradiatus* is a true *Tetragonopterus*, inasmuch as his largest specimens were but two inches long and yet had

[8] For J. A. Allen, of the American Museum of Natural History.

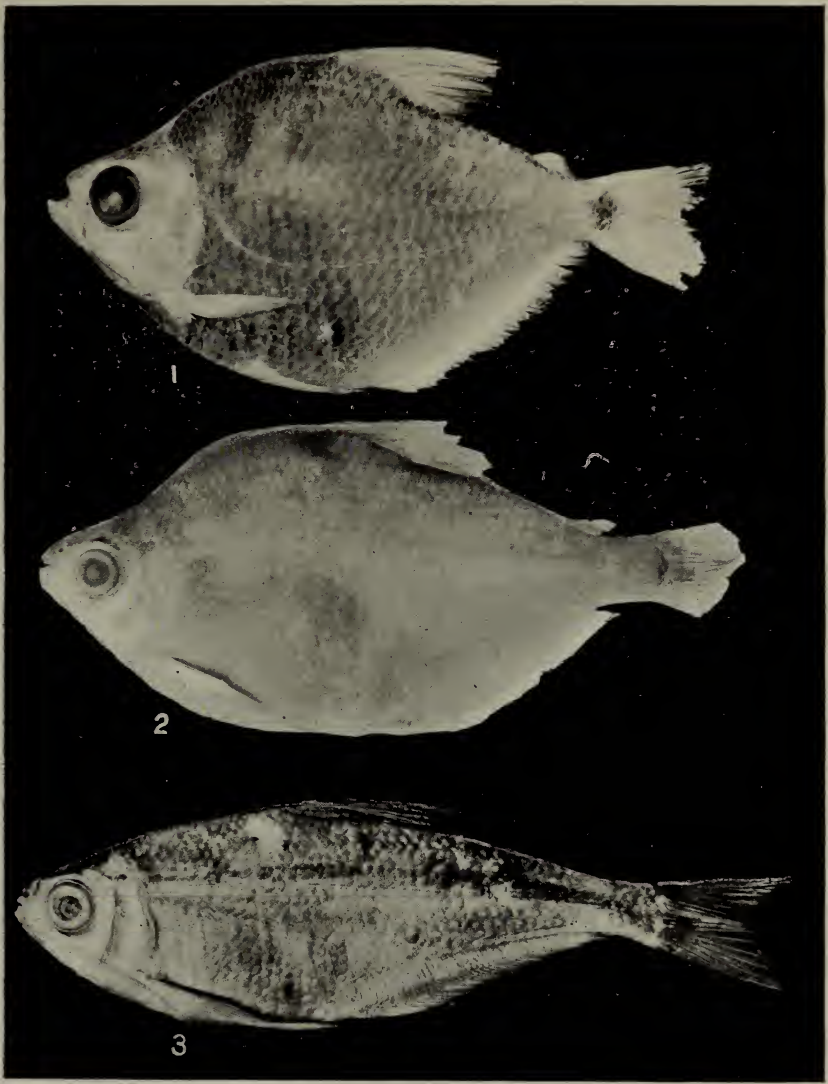


Fig. 1. *Tetragonopterus argenteus* Cuvier.
Fig. 2. *Tetragonopterus alleni* Eigenmann and McAtee.
Fig. 3. *Astyanax pelegrini* Eigenmann.

a depth equal to half the length. It is more than probable that the *Astyanax multiradiatus* of Eigenmann and Kennedy is a species distinct from Steindachner's.

Head 4; depth 2; D. 11; A. 40–41; scales 11–50–8.

Compressed, more elongate than in *argenteus*; anterior profile concave. Snout blunt, interorbital convex. Eye 2¾ in head, not equal to the interorbital, ¼ longer than snout. Maxillary small, not reaching to below eye; no teeth on maxillary.

Origin of dorsal equidistant from tip of snout and base of middle caudal rays or nearer the former, inserted distinctly behind the ventrals, not falcate, the longest ray not nearly reaching adipose; anal not falcate, the rays of nearly the same height its entire length; ventrals about reaching anal; pectoral a little beyond origin of ventrals.

A faint humeral and caudal spot, an indistinct silvery lateral band, fins gray, outer pectoral ray dark.

ASTYANAX Baird and Girard.

ASTYANAX Baird and Girard, Proc. Acad. Nat. Sci., Phila., Vol. VII., p. 27, 1854 (*argentatus*).

Pœcilurichthys Gill, Ann. N. Y. Lyc. Nat. Hist., 1858, p. 54, (*brevoortii* = *bimaculatus*).

The genus *Astyanax* is one of the oldest and most widely distributed genera of South American Characins. It is now one of the dominant South American genera, being found from the Rio Negro on the borders of Patagonia to the United States, and on both slopes from Peru north to Mexico. Its counterpart is found in Africa as *Petersius*. It has hitherto been associated with a number of other genera under the name *Tetragonopterus* with the following characters:

Premaxillaries with two series of multicuspid teeth, none of them enlarged; maxillary with or without teeth; mandible with a single series, those in front very strong, graduated and multicuspid, those of the side abruptly minute and usually conical; gill-rakers setiform; no predorsal spine; maxillary short; the snout and maxillary together less than half the length of the head.

The species with the characters just noted represent several genera which may be divided as follows:

a. Caudal and anal both naked.

  b. Lateral line interrupted.

c. Maxillary with usually conical teeth along its entire edge.
Holopristis Eigenmann.

cc. Maxillary with 0–5 conical or multicuspid teeth at its anterior upper end...*Hemigrammus* Gill.

bb. Lateral line complete.

c. Maxillary with 0–10 teeth.

d. Nape rather abruptly elevated, profile very concave, depth less than half the length, preventral region flat, with lateral keels.
Tetragonopterus Cuvier.

dd. Profile little if at all concave, depth usually less than half the length, preventral region rounded. *Astyanax* Baird and Girard.

cc. Maxillary with teeth along its entire edge.........*Hemibrycon* Günther.

aa. Caudal scaled.

e. Anal scaled, long, rounded, with over 40 rays.........*Markiana* Eigenmann.

ee. Anal naked, with 23–28 rays.

f. Premaxillary teeth parallel..........................*Mœnkhausia* Eigenmann.

ff. Anterior series of premaxillary teeth in a wavy line.
Bryconamericus Eigenmann.

KEY TO THE SPECIES OF ASTYANAX BAIRD AND GIRARD.

a. Anal rays 30 to 49.

b. Lateral line 55; anal 45; head 3.6; depth 2.63; lateral line 55. Eye greater than snout by one third of its diameter, greater than interorbital by $\frac{1}{5}$–$\frac{1}{6}$ of its diameter.................................*erythropterus* (Holmberg) 1.

bb. Lateral line with 50 scales or fewer.

c. Anal 40–48.

d. Scales 42–50.

e. Anal 47–48; scales small, 47 in lateral line.

f. A few rudimentary teeth on the maxillary; a silvery lateral band; ventral profile much arched; snout pointed; A. 48...............*spilurus* (Cuvier & Valenciennes) 2.

ff. No teeth on the maxillary; a very distinct silvery lateral band; an indistinct caudal and humeral spot; maxillary reaching anterior margin of orbit; depth 2.3; eye 3 in. the head; scales 9 or 10–47–10 or 11; A.47.
hauxwellianus (Cope) 3

ee. Anal 41–45.

g. Scales 8–46–8; two teeth on maxillary; lateral band not conspicuous; humeral spot bordered with silvery in front and behind; caudal spot large, continued to end of middle caudal rays; depth 3; eye 2½; A. 41.
riveti Pelegrin 4.

gg. Scales 10–45 to 50–8 or 9; a small silvery lateral band; a dark spot on shoulder and one on base of caudal [9]

[9] These spots are very obscure in alcoholic specimens, while in specimens first preserved in formalin they are conspicuous and a black band replaces the silvery band of the alcoholic specimens.

depth 2⅛–2⅔; A. 41–45; maxillary with a single, rather large caducous tooth; eye 2.4 in the head, about equal to interorbital; head 4.1–4.5.

pelegrini Eigenmann 5.

ggg. Scales 8–42–7 or 8; A. 42; eye 3.7 in the head, 1.7 in the interorbital; head 3.7 in the length; a caudal spot.................... ....*correntinus* (Holmberg) 6.

dd. Scales 37–38.

h. Several small teeth on the maxillary; head 3⅗; depth 3 or somewhat more than 3; snout 4 in the head; a silvery lateral band bordered above by blue-green; a round humeral spot; caudal spot, when present, extends to the end of some of the caudal rays. A. 43; scales 6–37 or 38–4.

bairdii (Steindachner) 7.

hh. Maxillary with a single small tooth. Scales in lateral line 37 or 38; caudal and humeral spots round, both very distinct; middle of caudal fin thickly dotted with black; maxillary not reaching orbit; head nearly 4; depth about 2¾; A. 40–42........ ....*tabatingæ* (Steindachner) 8.

cc. Anal 30–41.

j. A silvery lateral band ending in a black caudal spot, sometimes two lateral spots in front; maxillary very short, 2 in the eye; depth 2½–3; head 4–4⅓; eye 2½–2⅔ in head; D. 11, posterior to ventrals; A. 35–40. Lat. line 44–47.

festæ (Boulenger) 9.

jj. A black band extends from base of caudal fin along its middle rays; maxillary extending to eye; eye 2⅖–3 in head; depth 2⅔–2¾; head 4; A. 34–40; scales 8 or 9–40 to 50–8 or 9; last dorsal over first anal ray........*brevirostris* (Günther) 10.

ii. Scales in the lateral line less than 40 (except in *abramis*, sometimes in *brevoorti* and *bimaculatus*).

k. Anal rays 36 or fewer, rarely as many as 39 in *bimaculatus*; maxillary with a few teeth or none.

l. Depth more than three in the length, the form long and slender; maxillary without teeth.

m. No caudal or humeral spots; a silvery lateral band, most distinct posteriorly; head 3½; eye 2½ in the head. A. 30; scales 5–35–3..*astictus* (Ulrey) 11.

ll. Depth less than 3 in the length; a distinct caudal spot.

n. No humeral spot; depth 2½–2⅗; eye 3⅔–4 in the head; maxillary with 0–3 teeth, extending considerably beyond anterior margin of eye; a conspicuous black band on the caudal peduncle, becoming wedge-shaped on the caudal. A. 29–31. Scales 7 or 8–37 or 38–6......*maximus* (Steindachner) 12.

nn. A distinct humeral spot. (See *abramis*.)

o. Maxillary long, extending to below center of eye;

eye 3 in the head; maxillary without teeth; a black humeral spot, a silvery lateral band, becoming black on the tail and extending up on the caudal. A.30; scales 8–37 or 38–7; depth 2¾ ....*moorii* (Boulenger) 13.

oo. Maxillary extending little, if any, beyond origin of eye.

p. Dorsal plain.

q. Body deep; humeral spot usually horizontally elongate.

r. Scales in 19 or 20 rows, 10–43 to 47–8 or 9. Anal 28–32. Caudal plain or with an indistinct spot; humeral spot indistinct or wanting. Dorsal distinctly behind the ventral, the pectoral reaching the ventral. Depth 2½; head less than 4; scales in 18 or 19 rows, 10-43 to 47–8 or 9. *abramis* (Jenyns) 14.

rr. Scales in fewer than 17 rows.

s. Moderately compressed.

t. Teeth of the inner series of the premaxillary with their posterior surface convex, the denticles corresponding to the convexity, arranged in a U-shaped line.

v. Scales 6 to 8–30 to 40–5 to 8; maxillary with 0–4 teeth, extending somewhat beyond the front margin of the eye. Depth 2–2.1; head 4–4⅕; eye 3 in the head. A. 27–39. *bimaculatus* (Linnæus) 15.

tt. Teeth of the inner series of the premaxillary alike in front and behind, the denticles arranged in a nearly straight line; scales 6–

40–6; maxillary with a single tooth, extending to below origin of pupil; depth 2.4; head 4; eye a little more than 3 in head. A. 33.
orthodus Eigenmann 16.

ss. Greatly compressed. Scales 7 or 8–39 or 40–6 or 7; a humeral and a caudal spot; the pectorals extend beyond origin of ventrals; maxillary toothless, extending somewhat beyond front margin of orbit; head $3\frac{1}{4}$–$3\frac{2}{5}$; depth $2\frac{1}{3}$–$2\frac{1}{4}$; A. 38–41.
caucanus (Steindachner). 17.

qq. Humeral spot circular or vertically elongate.

u. Depth 2–2.2; scales 8 or 9–36 to 40–8 or 9; a humeral and a caudal spot; maxillary with one tooth; head 3.66; A. 38–39; dorsal and ventral outlines equally curved.
atratoensis Eigenmann 18.

uu. Body more elongate; humeral spot circular. Anal rays 38. A silvery lateral band. Dorsal a little behind the origin of the ventrals, the anterior anal rays elongate. Maxillary extending to near the anterior margin of the eye. Depth 2.4; head 3.5; scales 8–39–10.
stilbe (Cope) 19.

pp. Dorsal plain or with a broad, oblique, dark band across the middle. Scales 8–39–7; maxillary extends a little beyond the origin of the eye; D. 11; A. 31; depth $2\frac{3}{4}$; head $3\frac{2}{3}$...*bartlettii* (Günther) 20.

aa. Anal rays 26–29. (Sometimes as many as 36 in *cordovæ.*)

v. A series of seven, deep brown, longitudinal bands. Maxillary extending little, if any, beyond anterior margin of eye, with one tooth. Head $3\frac{3}{5}$;

depth a little more than 2 in the length. A. 27; scales 5–31–4. (See also under *bimaculatus*.)........................*steindachneri* (Eigenmann) 21.

vv. A single lateral band or none.

w. Caudal without vertical band.

x. Scales 28–35.

y. A caudal spot.

z. Humeral spot horizontally oval.

A. Lateral band black. (See also *bimaculatus*.) Scales in 14 rows. Dorsal fin behind the base of the ventrals. Maxillary with one tooth extending a little beyond the anterior border of the eye; interorbital space much greater than the eye. Head 3⅔; depth 3; A. 28; scales 7–34–6.

wappi (Cuvier & Valenciennes) 22.

zz. Shoulder spot if present vertically elongate, sometimes faint.

B. Caudal spot band-like, continued on the middle caudal rays; scales in less than 15 rows.

C. A humeral spot.

D. Dorsal behind the ventrals.

E. Maxillary with 2–7 teeth; anal 27–32; depth 2½–3; head about 4; maxillary equal to eye; eye 3 in head, equal to interorbital. Scales 7–37–6. *rutilus nicaraguensis* Eigenmann 23.

EE. Maxillary with 0–2 teeth.

F. Head 4, or more than 4, in the length. A band-like caudal spot sometimes extending forward to the indistinct humeral spot. Maxillary extending distinctly beyond the anterior margin of the eye. Head 4–4½; depth 2.25–3; A. 25–30; scales 6 or 7–30 to 39–4½ to 6.

rutilus[10] (Jenyns) 24.

FF. Caudal bordered above and below by yellow; a silvery lateral band; a humeral spot; head not 4 in the length. A. 27–35. Scales 7–38–7. Maxillary with a single tooth.

tæniurus (Gill) 25.

FFF. A. 24–32; origin of the dorsal behind the base of the ventrals; maxillary reaching an-

[10] *Rutilus jequitinhonhæ* has depth 3.

terior border of the orbit; head 4; depth 2.25–2.75; scales 7 to 9–35 to 39–6 or 7.
rutilus æneus (Günther) 26.

FFFF. Depth 3.33; head 3.66; A. 29; scales 7–37–5; maxillary long, equal to eye; eye 2.5 in head; interorbital 3.66...*cuvieri* (Lütken) 27.

DD. Dorsal over ventrals; snout less than 4 in the head; interorbital flattish. A. 27, beginning behind the dorsal. Depth 3; head 4; lateral line 37.
petenensis (Günther) 28.

CC. No humeral spot.

G. Dorsal behind ventrals; snout about 4 in the head; interorbital convex. A. 26–30, beginning under last ray of dorsal; depth 3–3½; head 3⅔–4. Lateral line 36–40; no maxillary teeth; a silvery lateral band which may become black on caudal.
simus (Boulenger) 29.

GG. Head 3½–4⅓; depth 2¾–3; interorbital much more than diameter of the eye. Maxillary terminates below the anterior margin of the eye; origin of dorsal behind the ventrals. A. 26–30; scales 6–35 to 37–6 to 8.
peruanus[11] (Müller & Troschel) 30.

BB. Caudal spot not continued on the middle rays.

H. Scales in 15 rows, 7–36–7. Humeral and caudal spots present, anal and ventral with broad red margins; eye 3⅔ in the head, much smaller than the convex interorbital. Maxillary extending to anterior margin of eye. A. 27–31................*humilis* (Günther) 31.

HH. Scales in 10–14 rows; lateral line 34–38.

I. Head 4, or less than 4, in the length.

J. A humeral spot. Maxillary reaching anterior border of eye, not to end of first suborbital. Head 3¾–4; depth 2.4–2.7; A. 23–28; scales 6½ or 7½–34 to 37–5½ to 6½. Two or three maxillary teeth.
fischeri (Steindachner) 32.

JJ. Maxillary ceases in front of the verti-

[11] See also *æneus*.

cal from the pupil and end of first suborbital. Dorsal considerably behind origin of ventrals; pectorals reaching beyond ventrals. Eye about equal to the slightly convex interorbital, 3 in the length of the head. Depth 2¾; head 3⅔; A. 26; scales 6½–37 or 38–5; a humeral spot.....*carolinæ* (Gill) 33.

II. Head 4 or more in the length; scales 5½–35–4. Anal, dorsal and caudal fins with red markings; scales in 9½ rows. Caudal and humeral spots indistinct. Head 4.2; depth 3.3; A. 26–27; scales 5½–35–4......*phœnicopterus* (Cope) 34.

yy. No caudal spot; a humeral spot.

K. Maxillary with 3 small teeth; eye 2.3 in the head; snout 4.5, the flattish interorbital 3; depth 2.66; head 3.6. A. 28; scales 5–35–4; a silvery lateral band, a vertical humeral spot......................*megalops* Eigenmann 35.

KK. Maxillary, with numerous minute teeth, extending beyond the front of the orbit. Snout shorter than eye; eye 2.8–3. A. 29–30; scales 5 or 6–32 or 33–4 to 5. Head $3\frac{3}{5}$; depth 2¼–2½; humeral spot elongate horizontally................*bahiensis* (Steindachner) 36.

KKK. Maxillary without teeth. Silvery band not edged with green above; origin of dorsal between ventral and anal; pectorals to origin of ventrals, ventrals nearly to anal. Head 4¾; depth 3½; eye $2\frac{3}{11}$ in head; D. 10; A. 27; scales 5–37–3. *alburnus* (Hensel) 37.

xx. Scales 9–40 to 46–10. Longitudinal series of scales 20. Caudal and humeral spots generally absent; origin of dorsal over root of ventrals. Width of interorbital greater than the diameter of the eye. Head 4; depth 3; A. 26–31. Interorbital very convex, 2⅔ in head; eye equals snout, 3⅔ in head; depth of caudal peduncle about ⅓ of the depth...*cordovæ* (Günther) 38.

xxx. Scales in 15 or 16 rows, 8–39 to 45–7; A. 28 or 29; head 3.6 or 3.5; depth 2.7–3; eye large, 2.6–2.8; interorbital 3.25 in head; maxillary as long as eye, with two narrow teeth; dorsal behind origin of ventrals; humeral spot faint, caudal spot distinct, not continued on middle rays. *emperador* Eigenmann & Ogle 39.

aaa. Anal rays 16–25, rarely 26 or 27 in *fasciatus* and *æneus;* 3 to 5 series of scales below the lateral line in all but *æneus* (6 or 7) and *fasciatus* (4½ to 7½).

L. Maxillary without teeth; two or three scales below the lateral line.

M. No caudal spot.

N. Depth 4.7. Longitudinal series of scales 12. A broad silvery lateral stripe; no caudal spot. Maxillary toothless, rather wide, extends little beyond anterior border of the orbit. Head 4.2; depth 4.7; A. 25...... .... *longior* (Cope) 40.

NN. Depth 2.5–3.5 in the length.

O. A silvery lateral band sharply edged above with a dark band. Dorsal fin a little behind the ventrals. The pectorals not entirely reaching the ventrals, the ventrals reaching the anal. Head $3\frac{4}{5}$; depth 3–3¾; scales 5–32–3. A. 21–22.
copei (Steindachner) 41.

OO. The broad silvery lateral band not edged above with dark. Maxillary extending nearly to the front margin of the eye; anterior dorsal and anal rays elongate. Head $4\frac{2}{5}$; depth $3\frac{1}{7}$; scales 4–35–3; A. 19 ....*diaphanus* (Cope) 42.

OOO. The narrow silvery band edged with greenish above; humeral spots distinct. Origin of the dorsal just behind the ventral; the pectoral reaches to the middle of the base of the ventral. Head $3\frac{2}{5}$–3¾; depth $2\frac{1}{5}$–$2\frac{6}{7}$; A. 24–25; scales 5–32 or 33–3...*colletti* (Steindachner) 43.

MM. Caudal and humeral spots present. Anal 24; scales 5–28–3. Head 4; depth 2½. Origin of the dorsal fin behind the ventral. Maxillary extending to the front margin of the eye.
oligolepis (Günther) 44.

LL. Maxillary with teeth.

P. Middle caudal rays black.

Q. One to three teeth in the maxillary.

R. A. 18–25. Lateral line with 37–40 scales; a silvery-gray lateral band; a dark caudal spot fading out forward. Usually a humeral spot. Maxillary with two small teeth. Head 4; depth 2¾–3; scales 7 or 8–37 to 40–3; eye 3 in head.. *mexicanus* Filippi 45.

RR. A. 24–27. Origin of the dorsal behind the base of the ventrals; maxillary toothless, reaching anterior border of the orbit. Head 4; depth 2¼–2¾; A. 24–27; scales 7–9–35 to 39–6 or 7 ....*æneus* (Günther) 26.

RRR. A. 18–25, rarely as many as 27. A dark caudal spot extending to the end of some of the rays and fading out anteriorly; a silvery lateral band; an indistinct humeral spot; ventral and pectoral fins with red. Head 4, longer than its depth at the occiput; depth 2½–3; scales 5 or 6–33 to 40–4½ to 7................*fasciatus* (Cuvier) 46.

RRRR. A. 19–21; three or four scales below the lateral line; head 4–4⅓; depth 2½–3; scales 5–35 to 37–3 or 4; eye 3 in head........*fasciatus iheringi* (Boulenger) 47.

QQ. Numerous minute teeth on the maxillary, which extends either a little or distinctly behind the front margin of the orbit. Eye small, 3.5–4 in the head. A vertically elongate humeral spot and a longitudinal caudal stripe extending to the end of the rays and fading out anteriorly. Head 3¼–3¾ ; depth 3–3⅓ ; scales 5–33–4. A. 16–18............*jenynsi* (Steindachner) 48.

PP. Middle caudal rays not black.

S. Scales in lateral line 34–38.

T. A. 19 or 20.[12] Almost colorless ; caudal rays sometimes dusky, a grayish lateral band. Pectorals reaching ⅔ to ventrals, ventrals ⅔ to anal. Maxillary, with 2 teeth, reaching to eye. Head 4, depth 3⅕–3¾ ; scales 4 or 5–35 to 38–4. *mœnkhausi* (Eigenmann & Kennedy) 49.

TT. Anal 17–18. Yellowish above, white on the sides; lateral band plumbeous above, silvery below; a plumbeous humeral spot. Head 4¼ to 4⅓; eye 2½ in head; depth 3⅕–3⅗. Lateral line 34–36. Dorsal band, large part of anal, the body near it and the median spot of the caudal more or less red..............*rubropictus* (Berg) 50.

TTT. Anal 18; scales 37 or 38; depth 3⅕; head 4⅕; plumbeous, fins dusky; pectorals reaching ventrals; ventrals nearly to anal; caudal lobes rounded; snout blunt, lower jaw distinctly shorter than upper; a faint humeral spot. mouth very small, maxillary not reaching eye; eye 3½ in head; interorbital very convex, less than 3 in head; depth of caudal peduncle little less than half the greatest depth................ *eigenmanni* Evermann & Kendall 51.

SS. Scales 5–31–3. Silvery lateral band; a diffuse caudal spot; no humeral spot. Head 3½; depth 2¾. A. 19. *paucidens* (Ulrey) 52.

64. *Astyanax pelegrini* Eigenmann (Plate XL, Fig. 3).

Pœcilurichthys multiradiatus Eigenmann, Proc. Phila. Acad. Sci., 1903, 521. (Not *Tetragonopterus multiradiatus* Steindachner.)

Steindachner describes his *multiradiatus* as having depth 2; head 3.6; eye 3 in head = interorbital; A. 40–41; scales 10–41 to 42–9.

Inasmuch as Steindachner's specimens were 2 inches long and their depth cannot be ascribed to old age, they should very probably be classed with typical *Tetragonopterus*.

Several specimens from the basin of the Paraguay, mentioned in the paper quoted above, and an additional one (380) from Bahia Negra, have the following formula: Depth 2–2.5; head 4–4.5; A. 41–45; scales 9 to 11–45 to 52–7 to 8.

These represent a species certainly distinct from the *multiradiatus* of Steindachner. It may be identical with Cope's *hauxewellianus* from Peru, from which it differs in the number of anal rays, there being 47 in *hauxewellianus*.

[12] 26 in one specimen.

65. *Astyanax bimaculatus lineatus* Perugia.

Many specimens, Ascuncion (281); Corumba (344, 368); Bahia Negra (380); Puerto Max (388, 389, 393) Sapucay (456).

Steindachner states that *bimaculatus* (*maculatus*) varies in the shape of the body, with age and sex, and with the habitat in rapid clear waters or in stagnant water.

Variation in depth, anal rays and scales of *bimaculatus* recorded by:

	Length	Depth	A.	Scales
1. Günther			31–34	7–39–7.5.
2. Steindachner,				
Southeastern Brazil	2½–3 inches	2.4–2.5	32–33	7.5 or 8.5–35 or 36–6 to 7.5.
	♀ 4½–5 "	2.25–2		
	♂ 4½ "	2.33–2.4		
3. Steindachner,				
Cauca & Magdalena		2.1–2.5	32–39	7.5 or 8–35 to 36–7.
4. Lütken (*lacustris*)		2	24–32	5 to 7–34 to 36–4½.
Rio Grande do Sul			27	7–39–5.

Sixty-five specimens from the basin of the Paraguay have the following rays, counting the rudimentary ones:

Two have 27, one has 28, four have 29, thirty-two have 30, eighteen have 31, five have 32 and three have 33.

The specimens from the Paraguay system have usually a small accumulation of pigment cells at the tips of the scales which form horizontal series. It is probable that such a specimen has served Perugia for his type of *lineatus*. Perugia's specimen had 28 anal rays with nothing said as to whether or not the rudimentary rays were counted. It is seen above that some specimens have 28, not counting the rudimentary rays, so that his specimens fall within the limits of *bimaculatus* whether he counted these rays or not. The most important difference is in the number of scales in the lateral line, which, according to Perugia, is 34, whereas the specimens examined by us from the basin of the Paraguay have the scales 36–40 in the following ratio: twelve have 36, twenty have 37, seventeen have 38, eight have 39 and one has 40.

There are no other differences and I have little doubt that Perugia's *lineatus* is identical with *bimaculatus*. If it is desirable to distinguish the differences which the Paraguayan specimens show they may be termed *Astyanax bimaculatus lineatus*.

66. *Astyanax fasciatus* (Cuvier).

P. scabripinnis Eigenmann & Kennedy, l. c., 521.

(With 281), Rio Paraguay, at Ascuncion; four specimens from Villa Rica (part 470).

67. *Astyanax iheringi* (Boulenger).

Seventeen specimens (455, 456), from mountain streams of Sapucay.

68. *Mœnkhausia dichrourus* (Kner). (Plate XLI., Fig. 1).

A single beautiful specimen 57 mm. long (299) from the Rio Paraguay at Tuyuyu, Matto Grosso, probably belongs to this species. The proportion and measurements differ somewhat, and are as follows: D. 9; A. 26; depth 3.5 (the type has depth 2½); head 4.5; scales 5–35–3. Maxillary without teeth, much curved. Middle caudal rays and the tips of all the rays dusky or black, the tips of the lobes beyond the scales black. A well-defined lateral band extending from caudal to below front of dorsal where it is rapidly contracted and tends to disappear before reaching the faint humeral spot.

A low adipose ridge extending from the adipose fin half way to the dorsal. We have other specimens from Corumba and Asuncion.

69. *Mœnkhausia agassizi* (Steindachner) (Plate XLI, Fig. 2).

Two small specimens Nos. 10164, 40 mm. and 10165, 33 mm. from Corumba (305) agree very closely with this species but differ in having the lateral line incomplete. If this is a constant character and not the condition of the age of the specimens, these specimens must be held as species distinct from *agassizi*. Until further specimens are available this question may be left in abeyance.

The great similarity of the specimens with a complete lateral line and an incomplete one is in itself not proof that the two sets of specimens belong to the same species. There are remarkable cases of parallelism between other species concerning whose generic difference there cannot be the slightest doubt.

Head 3.5; depth 2.5; D. 10; A. 23; scales 5–24–3½; pores on 7 or 8 scales.

Maxillary without teeth; eye 2.5 in the head; snout 4½; body deep, robust but moderately compressed; dorsal and ventral outlines equal; caudal peduncle short and deep.

Dorsal behind ventrals, the highest ray about equal to the length of the head; caudal lobes about 1½ times as long as the middle rays; highest anal ray about twice the height of the lowest, the fin not distinctly falcate; ventrals reaching the anal; pectorals reaching beyond origin of ventrals.

Top of head and tip of lower jaw minutely but densely punctate; large

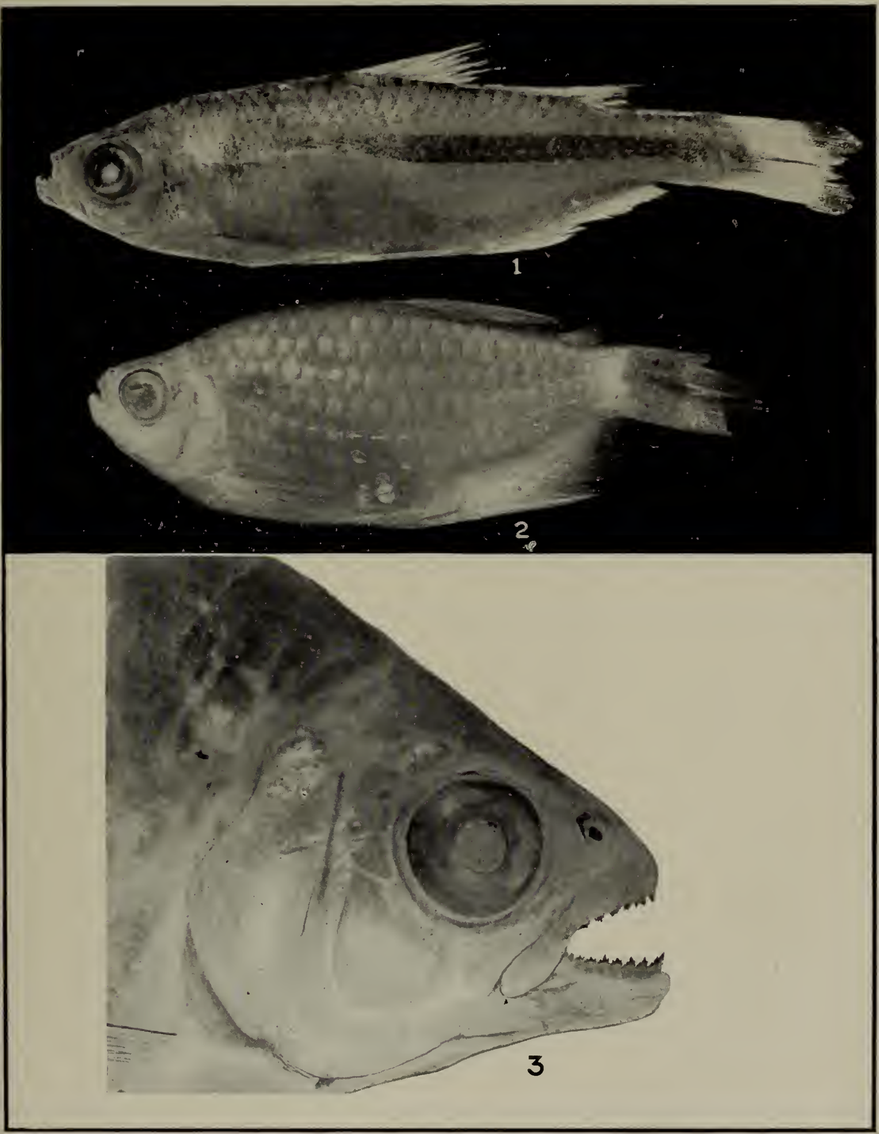


Fig. 1. *Mœnkhausia dichrourus* (Kner).
Fig. 2. *Mœnkhausia agassizi* Steindachner.
Fig. 3. *Deuterodon iguape* Eigenmann. (Type.)

color cells on upper part of cheek and opercle; back and sides above the lateral streak densely punctate, the margins of the cells blackish; a row of cells along the margin of the scales below the lateral streak; belly and breast colorless; region above anal peppered; a vertical shoulder spot and a dark lateral streak; back of caudal peduncle punctate, the peduncle otherwise without pigment except a narrow posterior margin, which, together with the basal part of the caudal is jet black, the band being about as wide as the eye and slightly oblique; caudal immediately behind the band without pigment; tip of caudal and all the other fins punctate.

70. *Bryconamericus exodon* Eigenmann gen. et sp. nov.

Pœcilurichthys dichrourus Eigenmann & Kennedy, in part, Proc. Acad. Nat. Sci. Phila., 1903, 522 (Ascuncion).

Type: No. 10298*a*, Indiana University Museum, a specimen 45 mm. long, over all. Puerto Max, J. D. Anisits.

Cotypes: 10298, Indiana University Museum, 5 specimens. Puerto Max.

Cotypes: 10297, Indiana University Museum, 3 specimens, Ascuncion.

Cotypes: 11264, Indiana University Museum, 2 specimens, Ascuncion.

The specimens differ from all other astyanaciform species I have been able to examine in the position of the anterior teeth of the premaxillary. I have both males and females and there are no apparent secondary sexual differences.

Head 4.4–4.33; depth 3.66–4; D. 9 or 10; A. 23–25; scales 5–39 or 40–4. Slender, tapering regularly from near the middle of the pectorals to the caudal; head blunt, mouth moderate, terminal; maxillary extending beyond origin of eye; snout and maxillary not quite 2.5 in head; maxillary not slipping under preorbital; cheeks covered by suborbitals; interorbitals slightly convex, very little greater than eye; eye not quite 3 in head.

Maxillary with two, three, or more pointed teeth; premaxillary with four, five, or more pointed teeth of the usual sort in the inner series; outer series consisting sometimes of five teeth in each premaxillary, the second and fourth teeth withdrawn from the line of the first and fifth and alternating with the space between the first and second and third teeth of the inner series; the anterior series thus form two imperfect series. The first, third, and fifth teeth directed forward slightly; sometimes there are but four or three teeth, in which case the first and last are directed forward and the other one or ones are withdrawn from the line connecting them. Dentary with four large, many-pointed teeth and several small, mostly conical ones on the side. Dorsal considerably behind the ventrals; adipose well developed; anal margin oblique, but little concave; ventrals small, not reaching anal; pectorals not ventrals. A small humeral spot; a well-defined silvery lateral band from in front of dorsal to caudal; middle caudal rays, margin and tips of caudal lobes black.

DEUTERODON[13] Eigenmann gen. nov.

A genus of Tetragonopterinæ distinguished as most of the genera of Caracidæ by its dentition.

Teeth in the premaxillary in two series, those of the outer series few (2 on each side), and separated from each other, expanded at the tip, each with a large median and two small lateral cusps; teeth of the second row very broadly expanded at the tip, each with a long, pointed median cusp and three graduated cusps on the sides; the teeth becoming smaller, but not notably so toward the sides, 5 on each side; maxillary with a few (2 on one side, 3 on the other), similar teeth; mandible with a single series of teeth, 10 on each side, regularly graduated from in front back; the teeth little expanded at the tip, each with a large and strong median cusp and two or three much smaller lateral cusps; the teeth and jaws so arranged that their action is shear-like, in contrast to *Astyanax* and related genera where the lower jaw is apparently thrown forward when opened and its anterior teeth point up and back when it is closed, the arrangement being similar to that in the Mylinæ, the second series of teeth in *Astyanax* being further back than in the present genus. Gill-rakers setiform as in *Astyanax*; no precumbent dorsal spine; nares close together; gill-membranes free from the isthmus and from each other; lateral line complete. Eats plants. Its teeth enable it to cut out pieces of aquatic plants with great neatness.

71. *Deuterodon iguape* Eigenmann sp. nov. (Plate XLI, Fig. 3).

Type No. 9265, a specimen 110 mm. long from Iguape collected by Dr. H. von Ihering.

Tetragonopterus fasciatus Eigenmann & Norris (not Cuvier). Revista Museu Paulista, IV, 357.

[13] δεύτερος repeated, ὀδούς tooth; in allusion to the simi rity of the mandibular eeth.

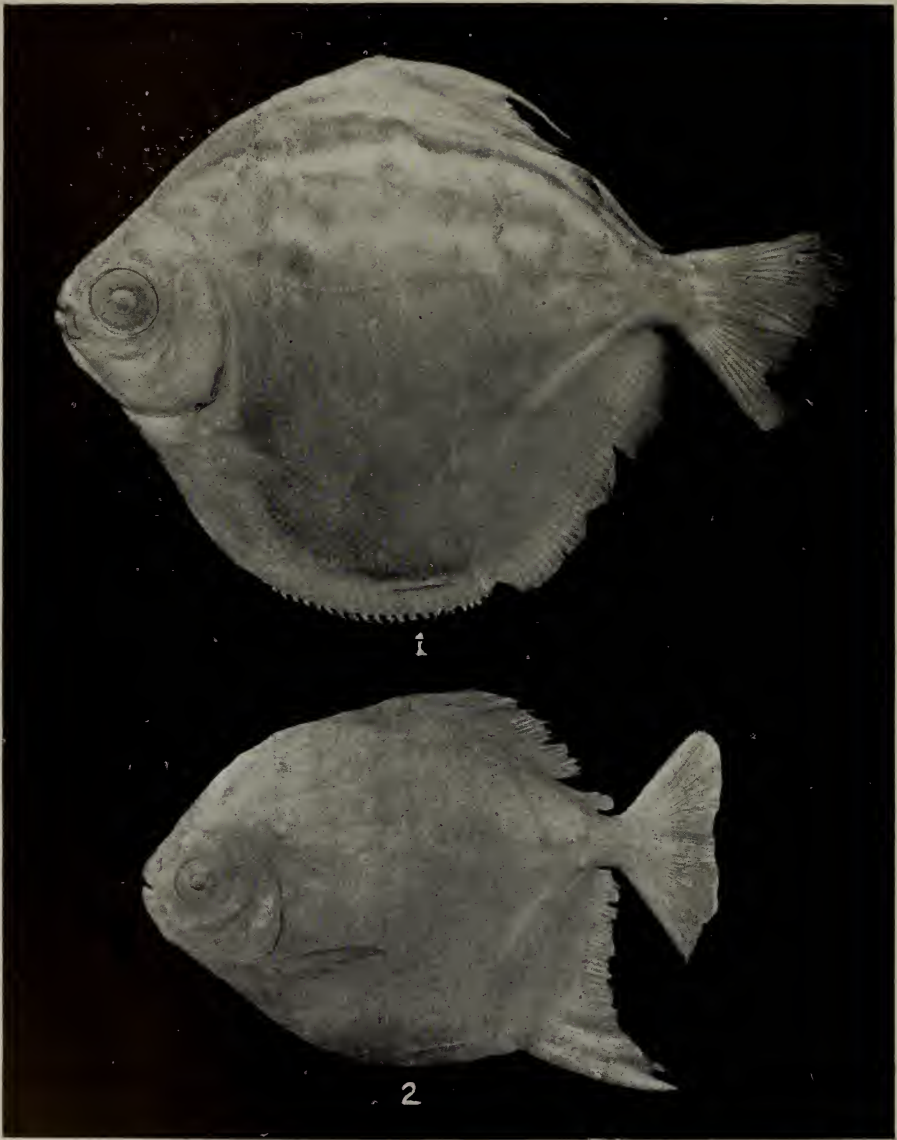


Fig. 1. *Metynnis mola* (Eigenmann and Kennedy).
Fig. 2. *Myleus levis* Eigenmann and McAtee.

This species is the image of *Astyanax fasciatus* Cuvier, but differs generically from the species in the character of the teeth.

Head 3.75; depth 2.6; D. 11; A. 2,22; scales 6–34–5.

Dorsal and ventral profiles nearly equally curved in front of the dorsal and ventrals; head somewhat pointed, the snout rather long; mouth nearly horizontal, the maxillary oblique, reaching at least to front of pupil; eye large, equal to snout in length, 3⅓ in head, less than interorbital width.

Origin of dorsal slightly behind origin of ventrals, a little nearer tip of snout than base of middle caudal rays, its height less than length of head; anal moderate, its margin slightly concave; ventrals not reaching anal; pectorals not to ventrals.

Free margins of the scales with a series of non-converging sub-parallel lines.

In alcohol, straw color; a silvery lateral band overlying a dark band; a well-marked round humeral spot smaller than eye; a well-defined caudal spot continued to the end of the middle rays; no other marks on the fins.

72. *Chalcinus angulatus* Agassiz.

Chalcinus angulatus curtus E. & K., l. c., 24.

Bahia Negra (384), Corumba (360).

73. *Thoracocharax stellatus* (Kner).

Bahia Negra (385) and Corumba (357).

74. *Pygocentrus nattereri* (Kner) Piranha.

Rio Paraguay at Porto Murtinho, and Corumba (285 and 342).

75. *Serrasalmo spilopleura* Kner. Piray, Pirambé.

Rio Otuquis; Rio Paraguay at Ascuncion, and Porto Murtinho (278, 284, 377, 378, 395).

76. *Serrasalmo humeralis* Cuvier and Valenciennes, Pirambéva. (Plate XXXIII, Fig. 2).

Porto Murtinho (384), Bahia Negra (410).

77. *Metynnis mola* (Eigenmann & Kennedy) (Plate XLII, Fig. 1).

A specimen somewhat larger (No. 376) than any of those recorded before, may be different. It is from the Rio Otuquis. A. 37; D. 18; ventral serræ 29–2, none of them two-pointed; back under dorsal without cross-bands, cross shades behind the dorsal. Sides below the lateral line and along the lateral line spotted.

In two small specimens (No. 361) from Puerto Murtinho, Matto Grosso, there are no cross-bands on back.

78. *Mylossoma albiscopus* (Cope) Piranha.

Bahia Negra (394).

79. *Myleus levis* Eigenmann & McAtee, sp. nov. (Plate XLII, Fig. 2).

Type No. 10156, Bahia Negra, Dec., 1901 (296) 143 mm.

Head 3.5; depth 1.5; D. 27; A. 36; abdominal serræ 45; lat. line about 112.

Form rather polygonal; nearly straight or slightly concave from snout to end of occipital crest, thence to within 2 cm. of the dorsal fin the anterior margin is strongly arched, thence is straight to the dorsal. From the front of the dorsal to the caudal the back is evenly curved. Caudal peduncle slender, about equal to eye, 2.8 in head. The basis of the anal is straight and meets the ventral profile at a large angle (about 60 degrees). The ventral surface is bounded by a straight, horizontal outline from anal to a point slightly in advance of the ventrals, thence evenly arching to in front of the pectoral, where it is slightly concave.

Lateral line complete, decurved from above middle of pectoral to below end of dorsal.

Opercle rounded; maxillary small, strap-shaped, partly sheathed in first suborbital, not reaching eye. Mandible with 5 strong teeth on each side, the inner 3 large and with slightly wavy edges, the outer two quite small. There are 2 hooked, conical teeth in the middle behind the anterior row; premaxillaries with two series of teeth, the outer composed of 10 teeth similar to those of the mandible and the inner with 4 broad, concave-topped teeth in a straight row across the jaw. Jaws equal; snout .8 in eye.

Dorsal fin rounded, highest in front. Caudal broad, subtruncate; pectorals 1.2 in head; ventrals narrow, 2 in head, not reached by the pectorals, nor reaching vent. Anal strongly falcate, the third ray very long and heavy, 1.2 times head.

Color plain dark brown, lighter below lateral line. Fins clear, except a wide basal portion of the dorsal dusky and a heavy black blotch on the margin of the anal from the longest to the 13th ray, widest on the 4th and 6th rays.

80. *Charax caliurus* Eigenmann & Kennedy, sp. nov. (Plate XLIII, Fig. 1.)

In Proc. Acad. Sci. Phila., Eigenmann & Kennedy describe a specimen, No. 9969 of the I. U. Collection. It was supposed to be the young of *squamosus*. The present collection contains specimens of

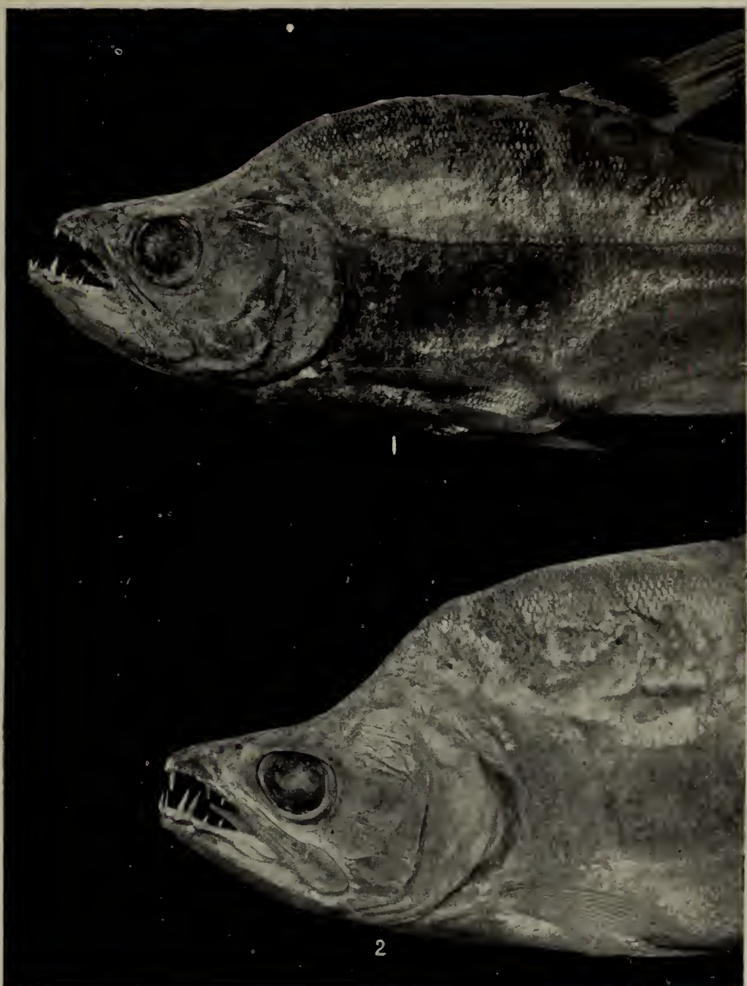


Fig. 1. *Charax calinrus* Eigenmann and Kennedy.
Fig. 2. *Charax squamosus* Eigenmann and Kennedy.

squamosus ranging from 70 to 280 mm. These leave no doubt that the specimen (No. 9969) under consideration represents a distinct and most strikingly marked species of the genus.

81. *Charax squamosus* (Eigenmann & Kennedy) (Plate XLIII, Fig. 2).

Of this species we have a specimen from Bahia Negra (404) 230 mm. to base of caudal. The profile becomes more and more concave with age, as the result of the humping of the nape, so that in the largest specimen the depression is 6 mm. below the line joining the tip of the snout and the nape. Formalin specimens all show a distinct humeral spot, a larger caudal spot and a well-defined black band uniting the two. In alcoholic specimens the humeral spot is not apparent and the black lateral band is hidden by the silvery band overlying it.

82. *Cynopotamus knerii* Steindachner.

Specimens from Bahia Negra (373) and Corumba (341).

83. *Rœboides bonariensis* Steindachner, Soirú pintada.

Corumba (356). It is very probable that this specimen, as well as those mentioned as *microlepsis* by Eigenmann & Kennedy, are *R. bonariensis*.

84. *Rœboides prognathus* Boulenger.

Rio Otuquis (371).

85. *Acestrorhynchus ferox* Günther. Pez de Cachorro.

Corumba (332).

GYMNOTIDÆ.

86. *Eigenmannia virescens* (Val.) Cubiha.

Corumba (293, 346).

87. *Sternopygus macrurus* Bloch & Schneider.

Corumba (294).

88. *Gymnotus carapus* Linnæus.

Corumba (295).

PŒCILIIDÆ.

89. *Girardinus caudomaculatus* Hensel.

Numerous specimens; exceedingly abundant in a mountain brook, Arroyo Itoroto at Sapucay (458).

BELONIDÆ.

90. *Potamoraphis guianensis* (Schomburgk). Pez d'Aquelha.

Tuyuyu (298).

SCIÆNIDÆ.

91. *Pachyurus bonariensis* Steindachner.

Corumba (250).

CICHLIDÆ.

92. *Chætobranchopsis australe* Eigenmann & Ward, sp. nov. (Plate XLIV, Fig. 1).

Type No. 10157, one specimen 110 mm. to base of caudal.

Bahia Negra.

Profile from tip of snout to occipital region straight, thence evenly curved to base of caudal. Depth 1⅔, head 1½; eye 3½ in head, 1 in snout, 1⅔ in interorbital. Cleft of mouth oblique, not reaching to the vertical from the orbit; cheek scaled; upper part of operculum scaled; 14 scales in front of dorsal; 10 scales in front of ventrals. Dorsal spines of medium strength, increasing in height posteriorly, the highest being 1½ times orbital diameter; pectoral long, some of the rays in the upper half much produced, longer than head, reaching to origin of second half of anal; ventrals produced in a filament which reaches to 3d anal ray. Anal and caudal fins densely scaled; soft dorsal with a very few, indistinct scales at base. Color light brown; a dark blotch on cheek and a dark spot on sides below lateral line; ventral and anal fins margined with black.

D. XIV, 13; A. V, 16; lat. l. 19 + 10; depth, 1⅔.

C. orbicularis from the Amazon has fifteen dorsal and six anal spines.

93. *Æquidens tetramerus* (Heckel). Cará.

Ascuncion; tributary of Paraguay in Chaco Paraguayo; Corumba; Bahia Negra; Puerto Max and Villa Rica (288, 343, 381, 391, 415, 468). An examination of 9 specimens gives D. XV, 10 in all specimens; A. III, 9 in seven; III, 10 in two; lat.l. 16 + 10 in one; 17 + 8 in three, and 17 + 9 in five specimens.

94. *Æquidens paraguayensis* Eigenmann & Kennedy (Plate XLIV, Fig. 2).

Ascuncion; Corumba; Rio Otuquis; Puerto Max (414, 417, 418, 282, 284, 326, 369, 379, 391).

An examination of 29 specimens gave the formulas; D. XIII, 10 in one specimen; XIV, 9 in 21; XIV, 10 in 3 and XV, 9 in 4 specimens. A. III, 7 in one, III, 8 in 18 and III, 9 in 10; lat. l. constant, 16 + 10. Of the specimens with A. III, 9, six came from a mountain brook at Sapucay (454).

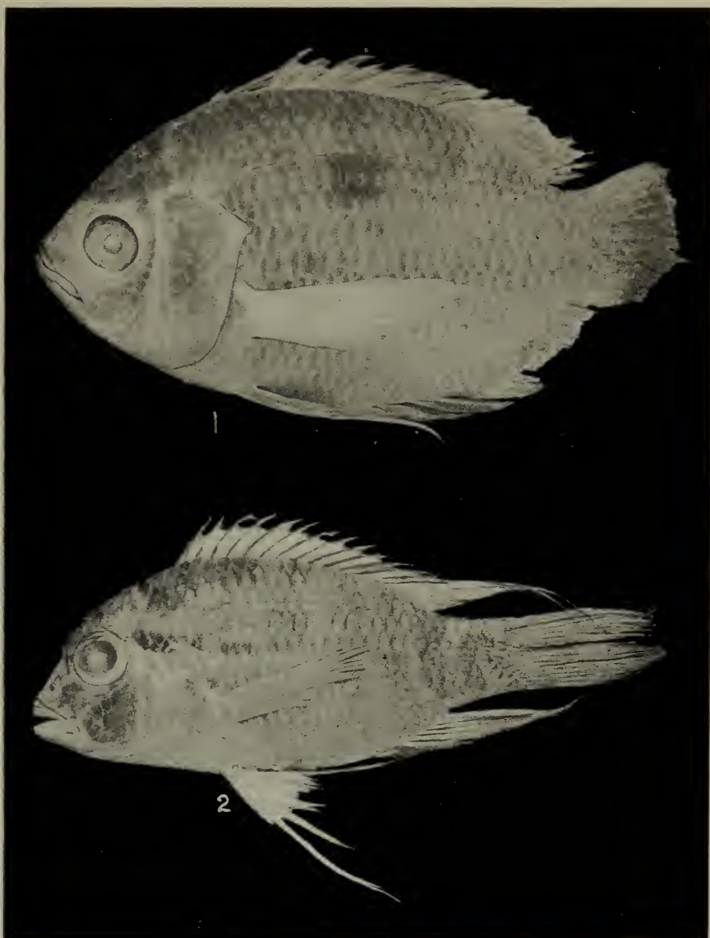


Fig. 1. *Chætobranchopsis australe* Eigenmann and Ward.
Fig. 2. *Æquidens paraguayensis* Eigenmann and Kennedy.

95. *Mesonauta festivus* (Heckel) (Plate XLV, Fig. 1).

Corumba (334).

96. *Batrachops semifasciatus* Heckel.

Crenicichla saxatilis Eigenmann & Kennedy, Proc. Phila. Acad. Sci., 1903, 535.

The specimen mentioned by E. and K. is in bad condition. It was collected in a laguna near the Paraguay. It should probably stand as *semifasciata* instead of *saxatilis*: D. XXII, 11; A. III, 8; scales 55.

97. *Crenicichla lepidota* Heckel. Juan Agenza.

Ascuncion (416, 277); Tributary of the Paraguay in Chaco, Paraguayo (289); Corumba (325); lat. l. 40–42.

98. *Crenicichla brasiliensis adspersa* Heckel. Juan Agenza.

Corumba (337). This specimen is most nearly like *adspersa* Heckel, from which it differs in having no spots on the body in front.

99. *Geophagus jurupari* Heckel.

Geophagus pappaterra Eigenmann & Kennedy (not Heckel), Proc. Acad. Sci. Phila., 1903, 536. Laguna near Arroyo, Trementina, Corumba (370).

100. *Heterogramma trifasciatum* Eigenmann & Kennedy (Plate XLV, Fig. 2).

Five additional specimens of this species enable us to revise the diagnosis. We take the opportunity to correct a typographical error. The "D. X, 6" should read D. XVI, 6. "Type No. 10066" should read "Type No. 10155."

The specimens of this species at hand are: 1. The Type No. 10-155, 34 mm. from the Arroyo Chagalalina. 2. Five specimens, 20, 24, 25 and 50 mm. long (parts of 315, 318, 324), from Corumba.

All these specimens agree in color pattern underscored. *There is a well-defined black line from the lower margin of the pectoral to the origin of the anal*, and continued more or less distinctly to the tip of the first ray; anal behind this uniformly dusky or alternately light and dusky; *a dark streak from eye down and back to the angle of sub- and interopercle; a dark band from tip of snout to the distinct caudal spot*, the band narrowest on head and showing no indications of breaking up on the sides or enlarging into a lateral spot; base of dorsal more or less dusky; in one of the specimens there are indications of cross shades on the tail; first two membranes of the spinous dorsal black in most of the specimens; ventrals with a large black spot; caudal uniform, dusky.

D. XVI, 6–XV, 7; A. III, 6–III, 7; head 3; depth 2¾.

The lateral line ascends rapidly; tubes are variously developed, ranging from 5–10 on the anterior part of the lateral line; behind the tubes the scales contain inconspicuous pores only, which are on the row of scales next to the dorsal for a distance, but further back they shift down on the sides to the next row of scales. On the posterior section of the lateral line tubes are variously developed from none at all to 3 next to the caudal, the remainder of the line being represented by pores.

101. *Heterogramma corumbæ* Eigenmann & Ward sp. nov. (Plate XLV, Fig. 3).

Type No. 10166, one specimen, 30 mm., Corumba (303).

Cotypes No. 10167, nine specimens, 22–35 mm., Corumba. (312, part of 315, part of 318, part of 324.)

Two specimens, 27 and 37 mm. from a forest laguna (392), near Puerto Max in water saturated with calcium (gypsum?).

The cotypes were evidently associated with *Biotodoma fasciatus*, inasmuch as they were mixed with specimens of the latter under the same collector's number. The species which they represent, if different from *trifasciatus*, is in shape and fin-formula very similar to that species. In color, in which they all agree, they differ very strikingly from *trifasciatus*. There is the same streak from the eye down and back, a similar dusky area along the base of the dorsal and the same lateral band, but the edges of the latter tend much more frequently to become jagged than in *trifasciatus* and the caudal spot is much larger and more intense than in the latter species; the most striking difference comes below the lateral band. *Here there are two or three more or less interrupted lines following the series of scales and parallel with the lateral band;* faint cross bands extend along the entire sides; ventrals as in *trifasciatus* with a large black spot or streak; anal and soft dorsal more or less barred; caudal distinctly crossbarred.

Head 3; depth 2⅔; D. XVI, 6; A. III, 6–7; lat. l. 9–11 + 0–8; 22 scales along median line.

Eye large, ¾ in snout, 3 in head; scales large; the lateral line very poorly developed, the number of developed tubes varying greatly, both in the anterior and posterior portions. Pectorals reaching to vent; ventral to anal; anal and dorsal to caudal.

102. *Heterogramma borelli* Regan.

Six specimens from Corumba (part of 312 and 324).

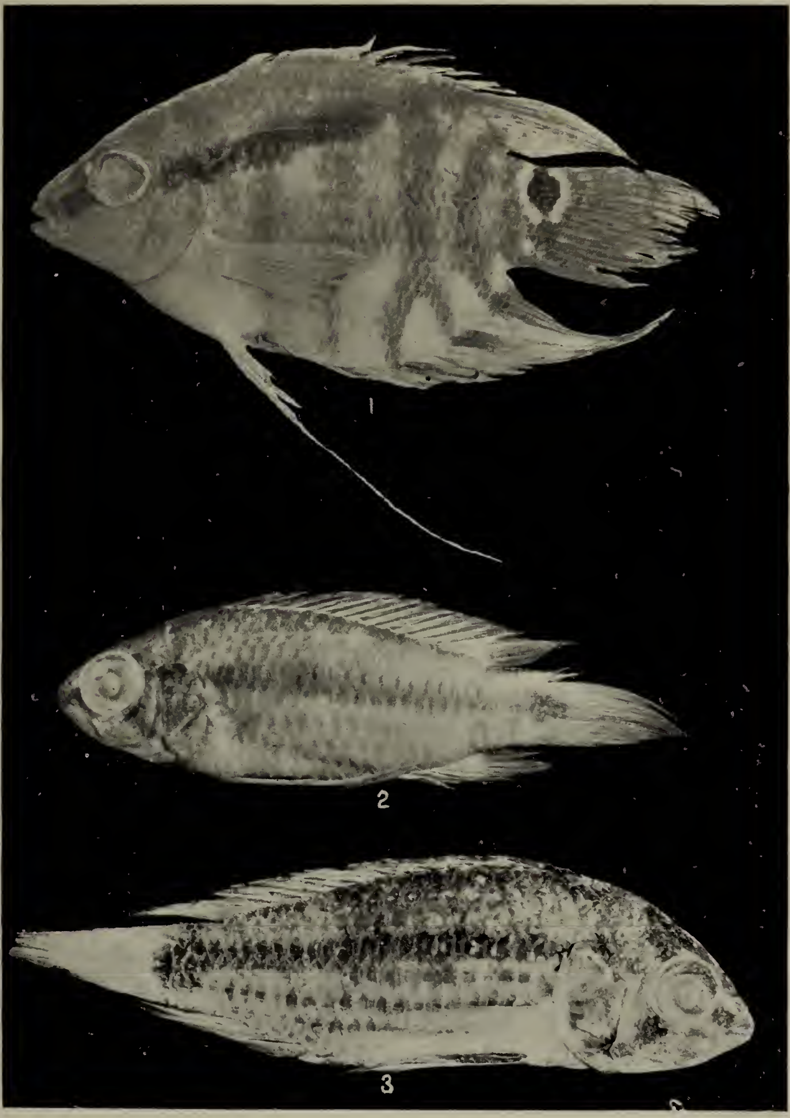


Fig. 1. *Mesonauta festivus* (Heckel).
Fig. 2. *Heterogramma trifasciatum* Eigenmann and Kennedy.
Fig. 3. *Heterogramma corumbæ* Eigenmann and Ward.

These specimens differ but slightly from Günther's and Steindachner's descriptions of *tæniatum*, hitherto known only from the Amazon. Dorsal XIV–XVI, 5½; A.III, 5½ to 6½. Depth 2⅔–(3); head 3 (3); head as long as high (longer); eye 3 in the head, longer than snout, equals interorbital; preorbital 2 in eye; highest dorsal spine equals length of eye or a little longer; soft dorsal and anal reaching middle of caudal when laid back; caudal rounded; pectorals about reaching anal, the threads of the ventrals beyond origin of anal.

Lateral line with 4–7 canals, 21–23 scales in the lateral series. A dark streak from eye forward, another downward and backward; a black band broken into spots along the middle of the sides to the end of the caudal; a series of dark spots along the base of the dorsal; anterior margin of anal and outer pectoral ray sometimes black.

ACHIRIDÆ.

103. *Achirus jenynsii* (Günther).
Corumba (347).

LIST OF FISHES SO FAR RECORDED FROM THE BASIN OF THE PARAGUAY.

In the following list one star (*) indicates that the species is peculiar to the basin of the Paraguay; two stars (**) that both the genus and species are peculiar to it; A indicates that the *species* is also found in the basin of the Amazon; B, that the *genus* is found in the basin of the Amazon; P, that the species is peculiar to the basin of the La Plata; C, that the species is also found in the coast streams of eastern Brazil, and S, that it is found in the Rio San Francisco.

TRYGONIDÆ.

1. A. *Potamotrygon hystrix* Müller & Troschel.
2. A. *Potamotrygon dumerili* Castlenau.

ASPREDINIDÆ.

3. B.* *Dysichthys australe* Eigenmann & Ward.
4. B.* *Bunocephalus rugosus* Eigenmann & Kennedy.
5. B. P. *Bunocephalus iheringi* Boulenger.
6. B.* *Bunocephalus doriæ* Boulenger.

SILURIDÆ.

PIMELODINÆ.

7. A. *Pinarampus pirinampu* (Spix).
8. B. A. *Luciopimelodus platanus* Günther.
9. A. S. *Pseudopimelodus zungaro* (Humboldt).
10. * *Pseudopimelodus cottoides* Boulenger.
11. A. C. *Rhamdia quelen* (Quoy & Gaimard).
12. P. *Heptapterus mustelinus* Valenciennes.
13. A. *Rhamdia sebæ kneri* Steindachner.
14. A. *Pimelodus ornata* Kner.
15. * *Pimelodus albicans* (Cuvier & Valenciennes).
16. A. S. *Pimelodus clarias* (Bloch).
17. S. *Pimelodus valenciennis* (Kröyer).
18. A. S. *Pimelodus fur* Reinhardt.
19. ** *Iheringichthys labrosus* (Lütken).
20. ** *Iheringichthys megalops* Eigenmann & Ward.
21. A. *Pimelodella gracilis* (Valenciennes).
22. * *Pimelodella tæniophorus* Regan.
23. A. C. S. *Pimelodella lateristriga* (Müller & Troschel).
24. * *Pimelodella mucosa* Eigenmann & Ward.
25. A. *Sciades pictus* (Müller & Troschel).
26. A. *Hemisorubim platyrhynchus* (Cuvier & Valenciennes).
27. B. S. *Pseudoplatystomus coruscans* (Agassiz).
28. A. *Sorubim lima* (Bloch & Schneider).

DORADINÆ.

29. A. *Doras granulosus* Valenciennes.
30. A. S. *Doras costatus* (Linnæus).
31. * *Doras maculatus* Valenciennes.
32. * *Doras nebulosus* Eigenmann & Kennedy.
33. A. *Doras weddeli* Castelnau.
34. B.* *Oxydoras kneri* (Bloch).
35. * *Oxydoras eigenmanni* (Boulenger).
36. * *Hemidoras paraguayensis* Eigenmann & Ward.

AUCHENIPTERINÆ.

37. B. A. *Tracheliopterus coriaceus* (Cuvier & Valenciennes).
38. * *Auchenipterus nigripinnis* (Boulenger).

39. A. S. *Trachycorystes galeatus* (Linnæus).
40. A. C. *Trachycorystes striatulus* (Steindachner).

AGENIOSINÆ.

41. A. *Ageneiosus valenciennes* Bleeker.
42. A. *Ageneiosus brevifilis* (Cuvier & Valenciennes).

HYPOPHTHALMIDÆ.

43. A. *Hypophthalmus edentatus* Spix.

PYGIDIIDÆ.

44. * *Pygidium borelli* Boulenger.
45. * *Pygidium brasiliense* (Reinhardt).
46. P. *Pygidium cordovensis* (Weyenberg).
47. ** *Homodiætus anisitsi* Eigenmann & Ward.

LORICARIIDÆ.

PLECOSTOMINÆ.

48. A. *Plecostomus plecostomus* (Linnæus).
49. C. *Plecostomus johni* Steindachner.
50. C. *Plecostomus commersoni* (Valenciennes).
51. C. *Plecostomus vaillanti* Steindachner.
52. * *Plecostomus borelli* Boulenger.
53. A. C. *Plecostomus robini* Cuvier & Valenciennes.
54. C. S. *Plecostomus wuchereri* Günther.
55. A. *Hemiancistrus vittatus* (Steindachner).
56. A. *Cochliodon cochliodon* Kner.
57. * *Pterygoplichthys multiradiatus* (Bloch).
58. * *Pterygoplichthys anisitsi* Eigenmann & Kennedy.
59. * *Pterygoplichthys juvens* Eigenmann & Kennedy.
60. * *Pterygoplichthys gigas* Boulenger.
61. A. *Pseudancistrus barbatus* (Cuvier & Valenciennes).
62. A. *Xenocara gymnorhynchus* (Kner).
63. B. A. *Ancistrus cirrhosus* Valenciennes.
64. A. *Ancistrus cirrhosus dubius* Eigenmann & Eigenmann.
65. A. *Ancistrus hoplogenys* (Günther).
66. * *Oxyropsis inexpectatum* Holmberg.
67. * *Otocinclus vittatus* Regan.

LORICARIINÆ.

68. A. *Hemiodontichthys acipenserinus* (Kner).
69. B.* *Sturisoma robusta* Regan.
70. * *Sturisoma barbata* Kner.
71. * *Loricaria parva* Boulenger.
72. P. *Loricaria catamarensis* Berg.
73. A. *Loricaria phoxocephala* Eigenmann & Eigenmann.
74. * *Loricaria maculata* Bloch.
75. A. *Loricaria typus* Bleeker.
76. * *Loricaria labialis* Boulenger.
77. P. *Loricaria anus* Valenciennes.
78. A. *Loricaria cataphracta* Linnæus.
79. A. *Loricaria carinata* Castelnau.
80. * *Loricaria apeltogaster* Boulenger.
81. * *Loricaria macrodon* Kner.
82. * *Loricaria laticeps* Regan.
83. * *Loricaria platycephala* Kner.

CALLICHTHYIDÆ.

84. B.* *Corydoras microps* Eigenmann & Kennedy.
85. * *Corydoras paleatus* (Jenyns).
86. * *Corydoras aurofrenatus* Eigenmann & Kennedy.
87. * *Corydoras australe* Eigenmann & Ward.
88. A. C. *Callichthys callichthys* (Linnæus).
89. * *Callichthys callichthys asper* Quoy & Gaimard.
90. * *Callichthys callichthys hæmiphractus* Hensel.
91. * *Hoplosternum pectoralis* (Boulenger).
92. A. *Hoplosternum littorale* (Hancock).

CHARACIDÆ.

ERYTHRININÆ.

93. A. C. S. *Hoplias malabaricus* (Bloch).
94. A. C. *Hoplerythrinus unitæniatus* (Spix).

PYRRHULININÆ.

95. * *Pyrrhulina australe* Eigenmann & Kennedy.
96. A. *Pyrrhulina brevis* Steindachner.

CURIMATINÆ.

97. B.* *Psectrogaster curviventris* Eigenmann & Kennedy.
98. A. *Curimatella alburnus* (Müller & Troschel).
99. * *Curimatella alburnus australe* Eigenmann & Kennedy.
100. A. *Curimatus spilurus* Günther.
101. * *Curimatus gilli* Eigenmann & Kennedy.
102. A. *Curimatus nasus* Steindachner.
103. * *Curimatus nigrotænia* Boulenger.
104. * *Curimatus elegans nitens* Holmberg.
105. A. *Curimatus bimaculatus* Steindachner.
106. A. *Curimatus rutiloides* Kner.
107. C. *Curimatus gilberti* Quoy & Gaimard.
108. B. A. *Anodus latior* Spix.

CHILODINÆ.

109. B. S. *Prochilodus argenteus* Agassiz.
110. C. *Prochilodus scrofa* Steindachner.
111. P. *Prochilodus lineatus* (Valenciennes).

HEMIODONTINÆ.

112. * *Anisitsia othonops* Eigenmann & Kennedy.
113. A. *Hemiodus unimaculatus* (Bloch).
114. * *Hemiodus semitæniatus* Kner.
115. A. *Hemiodus microlepis* Kner.
116. A. *Parodon suborbitalis* Cuvier & Valenciennes.
117. * *Parodon gestri* Boulenger.
118. * *Parodon paraguensis* Steindachner.
119. * *Parodon tortuosus* Eigenmann & Norris.

ANOSTOMATINÆ.

120. ** *Schizodon borelli* (Boulenger).
121. S. *Schizodon isognathus* Kner.
122. A. *Schizodon dissimilis* (Garman).
123. A. *Schizodon fasciatus* (Spix).
124. A. *Lahilliella nasutus* (Kner).
125. A. *Leporinus striatus* Kner.
126. A. C. *Leporinus frederici* (Bloch).
127. A. *Leporinus obtusidens* (Valenciennes).

128. A. *Leporinus trifasciatus* Steindachner.
129. A. *Leporinus eques* Steindachner.
130. A. *Leporinus affinis* Günther.
131. A. *Leporinus hypselonotus* Günther.
132. A. C. *Leporinus conirostris* Steindachner.
133. A. *Leporinus fasciatus* (Bloch).
134. A. C. *Characidium fasciatum* Reinhardt.
135. B. * *Characidium lateralis* (Boulenger).

TETRAGONOPTERINA.

136. B.* *Odontostilbe paraguayensis* Eigenmann & Kennedy.
137. * *Odontostilbe trementinæ* Eigenmann & Kennedy.
138. * *Cheirodon ribeiroi* Eigenmann.
139. B. * *Cheirodon interruptus* (Jenyns).
140. * *Cheirodon calliurus* Boulenger.
141. A. *Cheirodon insignis* Steindachner.
142. A. *Cheirodon nattereri* Steindachner.
143. A. *Holoshesthes pequira* (Steindachner).
144. * *Aphyocharax dentatus* Eigenmann & Kennedy.
145. A. *Aphyocharax alburnus* Günther.
146. * *Aphyocharax stramineus* Eigenmann.
147. A. *Aphyocharax anisitsi* Eigenmann & Kennedy.
148. * *Aphiocharax rathbuni* Eigenmann.
149. A. S. *Hemigrammus gracilis* Reinhardt.
150. ? *Hemigrammus callistus* (Boulenger).
151. * *Hemigrammus anisitsi* Eigenmann.
152. C. *Hemigrammus lütkeni* (Boulenger)
153. C. *Hemigrammus ulreyi* (Boulenger).
154. * *Hemigrammus tridens* Eigenmann.
155. ** *Hemigrammus kennedyi* Eigenmann.
156. A. *Tetragonopterus argenteus* Cuvier.
157. A. C. *Tetragonopterus orbicularis* Cuvier & Valenciennes.
158. * *Tetragonopterus alleni* Eigenmann & McAtee.
159. * *Tetragonopterus ternetzi* Boulenger.
160. A. *Astyanax fasciatus* (Cuvier).
161. P. *Astyanax iheringi* (Boulenger).
162. A. *Astyanax hauxwellianus* (Cope).
163. * *Astyanax pelegrini* Eigenmann & Kennedy.
164. A. *Astyanax abramis* (Jenyns).

165. * *Astyanax moorii* (Boulenger).
166. A. *Astyanax bimaculatus* (Linnæus).
167. * *Astyanax bimaculatus lineatus* (Holmberg).
168. A. B. *Astyanax rutilus* (Jenyns).
169. * *Astyanax moenkhausi* Eigenmann & Kennedy.
170. A. *Moenkhausia agassizi* (Steindachner).
171. * *Moenkhausia dichrourus* (Kner).
172. A. *Moenkhausia lepidurus* (Kner).
173. ** *Bryconamericus exodon* Eigenmann.
174. B. *Brachychalcinus retrospina* Boulenger.[15]
175. * *Brycon hilari* (Cuvier & Valenciennes).
176. * *Brycon microlepis* Perugia.
177. A. *Creatochanus melanurus* (Bloch).
178. P. *Bryconodon orbignianus* (Cuvier & Valenciennes).

GASTEROPELICINÆ.

179. A. *Thoracocharax stellatus* (Kner).
180. * *Chalcinus paranensis* Günther.
181. A. *Chalcinus angulatus* Spix.
182. *Chalcinus angulatus curtus* Garman.

SERRASALMONIÆ.

183. A. S. *Pygocentrus piraya* (Cuvier).
184. A. *Pygocentrus nattereri* (Kner).
185. A. *Pygopristis serrulatus* Cuvier & Valenciennes.
186. A. S. *Serrasalmo marginatus* Valenciennes.
187. A. *Serrasalmo spilopleura* Kner.
188. A. *Serrasalmo gymnogenys* Gunther.
189. A. *Serrasalmo humeralis* Cuvier & Valenciennes.
190. A. *Serrasalmo rhombeus* (Linnæus).

[15] *Fowlerina paraguayensis* Eigenmann should be added here. *Fowlerina* is a new genus for *Tetragonopterus compressus* Günther. It is allied to *Brachychalcinus* and *Stethaprion*, differing from the former by having a leaf-like or scale-like predorsal spine, and from the latter in having less than 40 scales in the lateral line. *Tetragonopterus compressus* has anal II, 31½. The Paraguayan specimens in the British Museum have:

2 specimens from Santa Cruz. A. II, 34½.
3 specimens from San Luis. A. III, 34½.
5 specimens from Descalvados. A. II, 35; I, 36½, and III, 34½.

These having uniformly a larger number of anal rays may be termed *Fowlerina paraguayensis*.

MYLINÆ.

191. * *Metynnis mola* Eigenmann & Kennedy.
192. A. *Metynnis hypsauchen* (Müller & Troschel).
193. A. *Myleus asterias* (Müller & Troschel).
194. * *Myleus levis* Eigenmann & McAtee.
195. A. *Mylossoma aureus* (Agassiz).
196. A. *Mylossoma albiscopus* (Cope).
197. A. *Piaractus brachypomus* (Cuvier).

CHARACINÆ.

198. A. *Charax gibbosus* (Linnæus).
199. * *Charax squamosus* Eigenmann & Kennedy.
200. * *Charax calliurus* Eigenmann.
201. A. *Rœstes molossus* (Kner).
202. A. *Rœboides microlepis* (Reinhardt).
203. P. *Rœboides bonariensis* Steindachner.
204. * *Rœboides prognathus* (Boulenger).
205. A. *Cynopotamus humeralis* (Valenciennes).
206. A. *Cynopotamus kneri* Steindachner.
207. ? *Cynopotamus magdalenæ* (Steindachner).[16]
208. A. *Salminus brevidens* Cuvier.

ACESTRORHAMPHINÆ.

209. A. *Acestrorhynchus ferox* (Günther).
210. C. *Acestrorhamphus hepsetus* (Cuvier).

CYNODONTINÆ.

211. A. *Raphiodon vulpinus* Spix.

STERNOPYGIDÆ.

212. A. *Sternarchus albifrons* Linnæus.
213. A. *Rhamphichthys reinhardti* Kaup.
214. A. *Rhamphicthys marmoratus* Castlenau.
215. A. *Hypopomus brevirostris* Steindachner.
216. A. S. *Sternopygus macrurus* (Bloch and Schneider).
217. A. S. *Eigenmannia virescens* (Valenciennes).
218. A. S. *Gymnotus carapo* Linnæus.

[16] The record of this species for the Paraguay is on the authority of Perugia. It probably should be eliminated.

SYNBRANCHIDÆ.

219. B. A. *Synbranchus marmoratus* Bloch.

STOLEPHORIDÆ.

220. A. *Stolephorus olidus* Günther.

PŒCILIIDÆ.

221. A. *Rivulus punctatus* Boulenger.
222. A. *Girardinus caudomaculatus* Hensel.
223. C. *Cnesterodon decemmaculatus* (Jenyns).
224. B. * *Fundulus paraguayensis* Eigenmann & Kennedy.
225. B. * *Fundulus balzanii* (Perugia).
226. * * *Ilyodon paraguayense* Eigenmann.

BELONIDÆ.

227. A. *Potamorrhaphis guianensis* (Schomburgk).
228. A. *Tylosurus amazonicus* (Steindachner).

SCIÆNIDÆ.

229. P. *Pachyurus bonariensis* Steindachner.
230. A. *Pachyurus schomburgkii* Günther.
231. B. * *Plagioscion ternetzi* Boulenger.

CICHLIDÆ.

232. B. * *Chætobranchopsis australe* Eigenmann & Ward.
233. A. *Astronotus ocellatus* (Agassiz).
234. A. *Æquidens tetramerus* (Heckel).
235. C. *Æquidens portalagrensis* (Heckel).
236. A. *Æquidens dorsigera* (Heckel).
237. * *Æquidens paraguayensis* Eigenmann & Kennedy.
238. A. *Æquidens vittata* (Heckel).
239. A. *Cichlasoma bimaculata* (Linnæus).
240. B. * *Heterogramma corumbæ* Eigenmann & Ward.
241. ** *Heterogramma borelli* Regan.
242. ** *Heterogramma trifasciatum* Eigenmann & Kennedy.
243. A. *Mesonauta festivus* (Heckel).
244. A. *Crenicichla lepidota* Heckel.
245. A. *Crenicichla adspersa* Heckel.
246. A. *Crenicichla vittata* Heckel.

247. A. *Crenicichla saxatilis* (Linnæus).
248. B. * *Batrachops ocellata* Perugia.
249. P. *Batrachops semifasciatus* Heckel.
250. * *Batrachops ocellatus* Perugia.
251. A. *Satanoperca pappaterra* Heckel.
252. B. * *Geophagus balzanii* Perugia.
253. A. *Geophagus jurupari* Heckel.

PLEURONECTIDÆ

254. P. *Achirus jenynsii* (Günther).

Total, two hundred and fifty-four species. Of these ninety-five are, as far as known, peculiar to the basin of the Paraguay; one hundred and thirty-two, or over half, are common to the basins of the Amazon and the Paraguay. Only twenty-one are also found in the coast streams north of Rio de Janeiro, while eighteen are also fouud in the Rio San Francisco.

EXPLANATION OF PLATES.

PLATE XXXI.

Figs. 1–2. *Dysichthys australe* Eigenmann & Ward. Type and cotype.

PLATE XXXII.

Fig. 1. *Pimelodella mucosa* Eigenmann & Ward. Type.
Fig. 2. *Pimelodella gracilis* Valenciennes.
Fig. 3–4. *Iheringichthys megalops* Eigenmann & Ward. Type.

PLATE XXXIII.

Fig. 1. *Iheringichthys labrosus* (Kröyer).
Fig. 2. Dentition of *Serrasalmo humeralis* Cuv. & Val.

PLATE XXXIV.

Fig. 1. *Hemidoras paraguayensis* Eigenmann & Ward. Type.
Figs. 2–3. *Homodiætus anisitsi* Eigenmann & Ward. Type.

PLATE XXXV.

Fig. 1. *Hemiodontichthys acipenserinus* Eigenmann & Eigenmann.
Fig. 2–3. *Loricaria typus* (Bleeker).

PLATE XXXVI.

Figs. 1–3. *Sturisoma robusta* (Regan).

PLATE XXXVII.

Figs. 1–2. *Loricaria carinata* Castelnau.
Figs. 3–4. *Loricaria labialis* Boulenger.

PLATE XXXVIII.

Fig. 1. *Otocinclus vittatus* Regan.
Fig. 2–3. *Corydoras microps* Eigenmann & Kennedy.
Fig. 4. *Corydoras aurofrenatus* Eigenmann & Kennedy.

PLATE XXXIX.

Fig. 1. *Parodon paraguayensis* Eigenmann.
Fig. 2. *Schizodon borelli* Boulenger.
Fig. 3. *Aphiocharax dentatus* Eigenmann & Kennedy.

PLATE XL.

Fig. 1. *Tetragonopterus argenteus* Cuvier.
Fig. 2. *Tetragonopterus alleni* Eigenmann & McAtee. Type.
Fig. 3. *Astyanax pelegrini* Eigenmann & Kennedy.

PLATE XLI.

Fig. 1. *Moenkhausia dichrourus* (Kner).
Fig. 2. *Moenkhausia agassizi* Steindachner.
Fig. 3. *Deuterodon iguape* Eigenmann. Type.

PLATE XLII.

Fig. 1. *Metynnis mola* (Eigenmann & Kennedy).
Fig. 2. *Myleus levis* Eigenmann & McAtee. Type.

PLATE XLIII.

Fig. 1. *Charax caliurus* Eigenmann & Kennedy. Type.
Fig. 2. *Charax squamosus* (Eigenmann & Kennedy).

PLATE XLIV.

Fig. 1. *Chætobranchopsis australe* Eigenmann & Ward. Type.
Fig. 2. *Æquidens paraguayensis* Eigenmann & Kennedy.

PLATE XLV.

Fig. 1. *Mesonauta festivus* (Heckel).
Fig. 2. *Heterogramma trifasciatum* Eigenmann & Kennedy.
Fig. 3. *Heterogramma corumbæ* Eigenmann & Ward. Type.

CONTENTS.

Publications of the Carnegie Museum Serial No. 50

ANNALS

OF THE

CARNEGIE MUSEUM

Vol. IV. Nos. III and IV

April, 1908

For sale by Messrs. Wm. Wesley & Sons, 28 Essex St. Strand, London, England, Messrs. R. Friedlaender u. Sohn, 11 Carlstrasse, Berlin, N. W. 6., Germany, and at the Carnegie Museum, Schenley Park, Pittsburgh, Pa., U. S. A.

LIST OF FIGURES IN TEXT.

ERRATA AND CORRIGENDA.

Page 21, line 1, for "Dec., 1906," read "March 21, 1907."
Page 23, footnote, for "Lepiauchenia," read "Leptauchenia."
Page 24, line 12 from below, for "melagodon," read "megalodon."
Page 41, line 3 from below, for "oss," read "Foss."
Page 51, line 4 from below, for "second and third premolars," read "second and third upper premolars."
Page 95, line 13, for "Harrison or Upper Monroe Creek beds," read "Harrison beds."
Page 96, lines 35 and 36, for "Upper Monroe Creek or Harrison beds," read "Harrison beds."
Page 126, No. 58, read "Aphyocharax" for "Aphiocharax." Ditto p. 152, No. 148.
Page 169, 3d line from bottom, for "Canaa" read "Canada."
Page 172, line 12, for "Te" read "The."
Page 177, line 12, for "umbiculated" read "umbilicated."
Page 184, 3d line from bottom, for "Scalits" read "Scalites."
Page 250, line 17, for "Ways" read "Way."
Plate XII, legend, for "½" read "⅔."

Publications of the Carnegie Museum Serial No. 50

ANNALS

OF THE

CARNEGIE MUSEUM

Vol. IV. Nos. III and IV

W. J. HOLLAND, *Editor*

Published by the Authority of the
Board of Trustees of the Carnegie Institute
April, 1908

ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME IV. NOS. III AND IV.

Editorial Notes.

The Second Annual Meeting of the American Association of Museums, which was held in the Carnegie Museum June 4–6, was well attended, and many who were present have since written expressing their appreciation of the hospitality shown them by the Trustees of the Institute and the citizens of Pittsburgh. The papers which were read and the discussions which took place were interesting and instructive. The American Association of Museums may be regarded as having been fairly launched upon a career of usefulness, and takes its place as one of the important associations of scientific men in the western hemisphere. The proceedings of the meeting held in June will shortly be published.

Dr. A. E. Ortmann, Dr. Percy E. Raymond, Mr. O. A. Peterson, and the Director of the Carnegie Museum attended the sessions of the Seventh International Zoölogical Congress which were held in Boston at the end of August. Papers were read by all of the gentlemen who represented the Carnegie Institute.

A large number of men distinguished in the walks of science have recently visited the Carnegie Museum. Among those from abroad whom we have had the pleasure of welcoming were Mr. S. F. Harmar, of King's College, Cambridge, and Mr. Arthur E. Shipley, of Christ's College, Cambridge, who are associated in the editorship of the Cambridge Natural History, and hold very high rank among British zoölogists. Other visitors have been Sir John Murray, famous by reason of his connection with the "Challenger Expedition," Dr. Charles W. Andrews, of the British Museum, best known by his exploration of Christmas Island and his remarkable paleontological discoveries in the Fayûm; Dr. G. Severin, Director of the Royal Museum in Brussels; Dr. David von Hansemann and Dr. Richard Heymons, of the University of Berlin; Dr. Lühe, of the University of Koenigsberg; Dr. H. Schauinsland, Director of the Museum in Bremen; Dr. Versluys, of Amsterdam, well known through his work in connection with the "Siboga Expedition," and Dr. J. E. Hoyle, Director of the Manchester Museum. A constant stream of American men of science passing through "The Gateway of the West," as Bancroft styles Pittsburgh, have made it a point to interrupt their journeys going and coming in order to spend a day at the Museum of the Institute. We have also enjoyed the honor of visits from many, both from home and abroad, distinguished in other than the walks of science. One of the most famous of these was General Kuroki, the illustrious Japanese commander.

THE expedition of Mr. W. H. Utterback to the fossil fields of the west was suddenly terminated by the summons which came to him to return to the bedside of his father, who was dying at his home in Franklin, Indiana, and who has since passed away at a ripe age, greatly honored and respected by all who knew him. The results of Mr. Utterback's labors were somewhat lessened by the bad weather which he encountered, but he sent in twelve large cases containing a great deal of valuable and important material illustrating the osteology of the Ceratopsia. In October Mr. Utterback returned to the Museum.

WORK upon the replicas of the skeleton of *Diplodocus carnegiei* intended as a gift, one for His Imperial Majesty, the German Emperor, the other as a gift to the President of the French Republic, has been carried on vigorously during the past summer and fall, and it is expected that these two reproductions will have been put in place by the end of June of the coming year. A rearrangement of the exhibits in the Hall of Paleontology at the National Museum in Paris is taking place in order to accommodate the skeleton of the western monster, and Dr. Brauer, the Director of the Royal Museum of Natural History in Berlin, writes that with sorrowful heart he is taking down the skeletons of some fine whales which have hitherto adorned the light-court (Lichthof) of the great Museum in Berlin in order to make room for the Diplodocus. He adds in his letter the remark that "when such monsters of the past are resurrected from their tombs the living fauna is compelled to take a back seat." It is certain that the Diplodocus during its long life in Jurassic times did not give as much trouble to thoughtful minds as it is now doing.

WE sincerely hope before another twelve months has rolled its course to be able to place alongside of the Diplodocus now standing in the Hall of Paleontology in the Carnegie Museum the skeleton of a Brontosaurus which we possess, and also if possible the skeleton of a Mosasaurus, of which we have a fine example.

SUPERB work in the way of mounting several groups of recent mammals is being accomplished by the Messrs. Santens, and at the next celebration of Founder's Day, 1908, the Gallery of Mammals will present an even more attractive appearance than it does now.

THE generosity of Mr. H. J. Heinz in sending to the Museum from London, where he acquired them, some thirty-three beautiful examples of ancient watches made two or three hundred years ago, is most certainly appreciated. Mr. Heinz is laying the foundation for a fine horological collection which will be of great interest not only to the historian, but also to the student of an interesting branch of mechanics.

MR. JOHN D. HASEMAN, who went to Brazil at the beginning of October in order to carry on explorations in some hitherto little known portions of that vast country, was very kindly received by Professor J. C. Branner, upon his arrival in the province of Bahia, and reports himself as having addressed himself to his task with great hope of much success.

VIII. AN UNDETERMINED ELEMENT IN THE OSTEOLOGY OF THE MOSASAURIDÆ.

By W. J. Holland.

In the collection of Baron Ernest Bayet, purchased in 1903 by Mr. Andrew Carnegie for the Museum of the Institute in Pittsburgh, was a skeleton of *Mosasaurus lemonnieri* Dollo, discovered at Cuesmes, Belgium. It is mounted free, and though lacking the phalanges of the paddles, is otherwise one of the best specimens representing the genus and species in existence. Associated with the skeleton was a bone which had evidently been identified as a portion of the sternum, for it was placed on the floor of the case in which the skeleton was displayed in such a position as to indicate that the preparator supposed that it might be properly assigned to the sternum. Dr. A. Smith Woodward, who reported upon the Bayet Collection to the Trustees of the British Museum with a view to its purchase, and who kindly allowed me to make a copy of his report preserved in the files of the National Museum in London, in speaking of the skeleton of *Mosasaurus* says that it includes a "sternum?" The reference of the bone to the sternum was evidently a matter of doubt in the mind of Dr. Woodward. Last summer, when freeing from the matrix and mounting the bones of a fine specimen of *Clidastes tortor* Cope, now displayed as a slab mount in the Carnegie Museum, a portion of a similar bone was found associated with the remains and lying very near the lower margin of the inferior maxillary bones. In the summer of 1906 I called the attention of Dr. S. W. Williston, who was visiting me, and who has devoted more time and attention to the osteology of the Mosasauridæ than any other American student, to the bone belonging to the specimen found at Cuesmes. I suggested to him that the bone might be possibly regarded as a glossohyal bone, or that it might be the xiphisternum, stating that I was inclined to prefer the first hypothesis. At that time the specimen found associated with the remains of *Clidastes tortor* had not turned up. Subsequently, having found the latter specimen, I wrote to Dr. Williston, enclosing sketches of both bones, and asking him to again give me the benefit of his great knowledge of the osteology of the group and to indicate to me where the bones, in his judgment, ought to be placed. In a letter written by him on January 13, 1907, he says:

"It is rather a humiliating confession to make, after thirty years' acquaintance with the Mosasaurs, to say that your bone 'stumps' me, but it is a fact. The lingual bone has been figured by Marsh for *Tylosaurus*, a copy of whose figure you will find in Volume IV of the University Geological Survey of Kansas, Plate XXXI, Figures 1–3, there wrongly ascribed to *Platecarpus*. Somewhere else I make mention of the hyoid bones of *Platecarpus* being very much like the figures, having found specimens at a later date. *Mosasaurus* and *Clidastes* are scarcely distinct generically, and they differ in so many ways from *Platecarpus* and *Tylosaurus* that one would expect to find some differences in the hyoids, but scarcely so great differences as your bone would indicate.

"The sternum of no Mosasaur is ever really ossified; the bones of the sternum are frequently preserved as calcified cartilage, quite of the consistency and structure of the sternal ribs. As your bone is really ossified, I mean, having the true bone structure, it cannot be a sternal element. The interclavicle, or episternum, whichever one chooses to call it, has so far been found in *Plioplatecarpus*, *Platecarpus*, and *Holosaurus*, that is, in Mosasaurs of the Platecarpus type. I have suspected in the past that its retention was rather characteristic of this group, but there are really no good reasons why it should not be preserved as a vestige in the Mosasaurus type also, though it has never been found in that genus or in *Clidastes*.

"The bone has never been figured for any genus. One of my students[1] has prepared a paper on the girdles and limbs of *Holosaurus*, which is very doubtfully distinct from *Platecarpus*, and has included the figure of an interclavicle from a specimen in which there can be no doubt of its identity, having been found in position between the coracoids. I have made a photograph of his figure for you and enclose it herewith. You see that it is a mere vestige, a slender flattened rod of bone, almost 'without form and void.' In *Platecarpus* I have found the bone rather better developed, and apparently with facets for vestigial clavicles. Your bones show material differences from

[1] S. R. Capps, Jr., "The Girdles and Hind Limb of *Holosaurus abruptus* Marsh," *Journal of Geology*, Vol. XV, No. 4, pp. 350–356, May, 1907. (See Fig. 1.)

these, and I am not at all confident that they are interclavicles, but where else will they go? One thing is very evident, they are not penis bones, and I do not see how they can be hyoids, unless they are very different from the Platecarpus type. It looks almost as though there may have been articular facets towards the roughened end, and that would point perhaps toward the possession of clavicles. Of course the ancestors of all the Mosasaurs had both clavicles and interclavicles, and their loss was the result of aquatic adaptation. I regard *Mosasaurus* as one of the least specialized genera of the group, and should expect therefore clavicles and interclavicles to possibly occur.

"In any event I certainly, if I were you, would publish a figure and description of each bone, for they have a bearing on the phylogeny and classification of the creatures."

Acting upon the suggestion of Dr. Williston I herewith give a brief description of the two specimens.

I. Bone Found Associated with the Skeleton of Mosasaurus Lemonnieri Dollo.

The bone is long, thin, flattened, bifid at one extremity, and at the opposite extremity, which is manifestly not well preserved, but some-

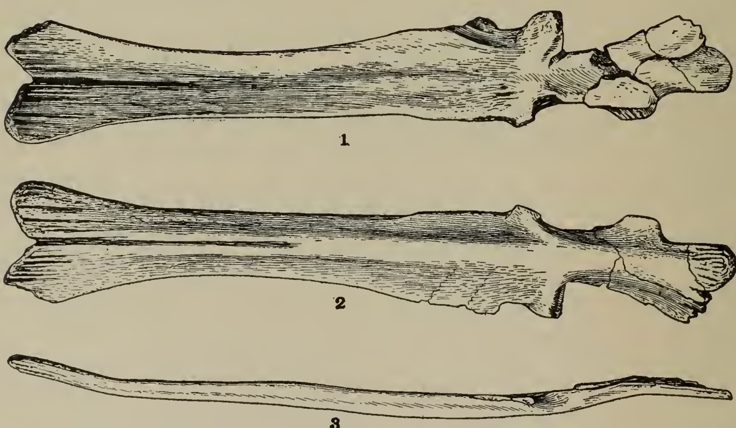


FIG. 1–3. Bone belonging to *Mosasaurus lemonnieri* Dollo. 1. View of that surface which is both longitudinally and laterally concave. 2. View of that surface which is longitudinally and laterally convex. 3. View of the bone from the side, showing its curvature, the lower edge of the figure corresponding to the surface shown in Fig. 2, and the upper edge of the figure corresponding to the surface shown in Fig. 1. ⅓ natural size.

what defective, irregular in outline, the surfaces suggesting that it may have been imbedded in fibrous or cartilaginous tissues. The bifid extremity is broader than the part of the shaft immediately behind it. Viewed from the side the bone is seen to be gently curved, the curvature increasing at the bifid end. It is trough-shaped on the surface which shows longitudinal concavity, and on the surface which shows longitudinal convexity has through the middle a raised ridge of greater convexity than the sides adjacent. A deep groove runs from the middle of the convex surface, increasing in width and depth until it terminates in the notch at the bifurcating end; and a similar groove, but much shallower and not so long, though broader, reveals itself on the opposite or concave side of the bone. Numerous short ridges, with relatively deep striæ, or shallow grooves between them, appear at the end of the bone in the neighborhood of the deep bifurcation. These do not run back far on the surface, though the entire half of the bone on both flat surfaces toward the bifurcated end shows faint traces of longitudinal lines of elevation and depression. The raised central longitudinal ridge, which appears prominently upon the convex side of the bone is joined a little more than two thirds of the length of the bone from its notched end by ridges, which represent thickenings of the bony mass on either side. This is shown in Figure 2. That portion of the bone which lies at the extremity opposite the bifurcated end is in the specimen before us somewhat broken and parts of it appear to be missing. No facets or surfaces distinctly indicating articulation with other bones can be made out with certainty, though they are suggested. The breaks in the bone at this point show that the two flat surfaces are composed of thin laminæ of dense osseous tissue, between which there is looser cancellous tissue.

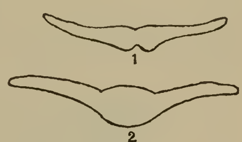


FIG. 4. Sections across the bone. 1. Section taken at the narrowest part of the shaft back of the bifurcated extremity. 2. Section taken at a point about two-thirds the length of the bone from the bifurcating end.

DIMENSIONS.

	mm.
Extreme length	290
Extreme breadth at notched end	50
Least breadth of shaft back of notched end	26
Thickness of bone along edges	2–4

Extreme thickness of bone at the middle of the shaft	8
Depth of notch at end of bone	15
Length of linear median groove on convex surface	110
Length of groove on concave surface	65

II. Bone found associated with the skeleton of Clidastes tortor Cope.

This specimen shows at one end a deep notch somewhat similar to the one observed in the specimen found with the skeleton of *Mosasaurus lemonnieri.* Only one of the projections forming the sides of the notch (the upper one as represented in Fig. 5) is complete; the

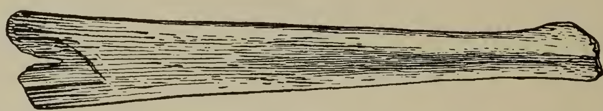


FIG. 5. Bone belonging to *Clidastes tortor* Cope. ⅔ nat. size.

other has been mutilated. The bone is thin. Both longitudinally and laterally one surface is concave and the other is convex. A trace of the rib-like longitudinal thickening of the middle of the shaft, so well marked in the bone of *M. lemonnieri*, appears. The striæ at the bifurcated end are very distinct. The median grooves appearing on both sides of the bone terminating in the notch in *M. lemonnieri* are not found in this specimen. In spite of differences and imperfections the close resemblance in form and structure to the better preserved specimen from Belgium is manifest at a glance.

DIMENSIONS.

	mm.
Extreme length of specimen	120
Extreme breadth at the notched end	20
Least breadth of shaft back of notched end	10
Thickness of bone along edges	1–2
Extreme thickness of bone at the middle of the shaft	5
Depth of notch at the end of the bone	11

The function of these singular bones in the skeleton must remain more or less problematical until future discoveries shall clear up the question. The suggestion that they are interclavicles does not appear to the writer at the present time as satisfactory. It is very hard to conceive how such bones should have functioned as interclavicles.

It seems to be far more likely that they might have been a portion of the sternum, located at the posterior extremity of the central axis of that element, in other words constituting the *xiphisternum*. In that case the concave surface may be supposed to have looked upward, the notched end to have marked the posterior termination of the sternum, and the somewhat unshapen and irregular mass of bone at the opposite extremity, as shown in the Belgian specimen, to have been the sternum itself. Against this view is, as has been pointed out by Professor Williston, the histological character of the bone itself, so wholly unlike what we know of the sternal bones as found in other animals of this class, some of the remnants of the sterna of which have been found in a fossil state. The bone suggests a formation in membrane, rather than in cartilage.

The other view suggested by the writer is that these bones were truly lingual (glosso-hyal). The discovery of the smaller specimen lying near the lower margin of the lower jaw of a specimen of *Clidastes tortor*, in which there has been very little displacement of the bones of the head, is suggestive. A comparison with the basi-hyoid in the crocodile shows that the latter is distinctly bifurcated at its anterior extremity and besides has minor lateral subdivisions, to which the ridges and the intercalated depressions in the specimens we are considering might perhaps be regarded as morphologically analogous. The bones figured by Marsh and Williston as the hyoid bones of *Tylosaurus* (*Platecarpus* in error) appear to the writer to be more likely to be thyro-hyals than basi-hyals. There appears to be nothing improbable in the view that these great marine saurians may have had tongues supported internally by an osseous framework and that the posterior portion of the bones we are considering may have functioned as the basi-hyoid, and the anterior bifurcated end may have functioned as a glosso-hyal, while the bones figured by Marsh and Williston may have been thyro-hyals.

IX. THE GASTROPODA OF THE CHAZY FORMATION.

By Percy E. Raymond.

Plates XLVI–LV.

Introduction.

The Gastropoda of the Chazy Limestone seem to have been among the first Paleozoic fossils to attract the attention of naturalists in this country. As early as the year 1818 C. A. Lesueur described and figured the most conspicuous of the gastropods of the Chazy under the name *Maclurite magna*. From 1818 until 1842 no species of Chazy fossils were described, but in the latter year Ebenezer Emmons named and figured several fossils from his Calciferous and Chazy groups, at Chazy, New York. Five of these, and all to which he gave specified names, were gastropods. They were: *Maclurea magna* Lesueur, *Maclurea striata* Emmons, *Maclurea labiata* Emmons, *Bellerophon sulcatinus* Emmons, and *Scalites angulatus* Emmons.

Since Lesueur's generic name *Maclurite* had the ending *ite*, Emmons corrected the spelling to *Maclurea*, the name which has come into general use. To be strictly accurate, however, we must return to Lesueur's original name for the genus, adding a terminal "s." This name is hardly more objectionable than *Dalmanites*, *Ceratites*, *Cyrtolites*, *Agoniatites*, *Trocholites*, or a host of other similar generic names.

In 1847 James Hall recognized fourteen species of gastropods in this formation. He described as new: *Metoptoma? dubia*, *Raphistoma staminea*, *Raphistoma planistria*, and its variety *parva*, *Pleurotomaria biangulata*, *Pleurotomaria antiquata*, *Capulus auriformis*, *Murchisonia abbreviata*, and *Bucania rotundata*. He referred *Maclurea striata* Emmons to the new genus *Raphistoma*, and placed *Bellerophon sulcatinus* Emmons as the first species under the genus *Bucania*. To one fragmentary specimen referred by him to the genus *Pleurotomaria* a specific name was not given.

Of Hall's species *Metoptoma? dubia* is the same as *Orbicula?* (*Archinacella*) *deformata* Hall. *Raphistoma planistria* and variety *parva* are the same as *Raphistoma stamineum* Hall, and *Pleurotomaria biangulata* is a *Trochonema*. *Pleurotomaria antiquata* is indeterminable, *Capulus auriformis* was not from the Chazy, and *Bucania rotundata* is the same as *Bucania sulcatina.*

The revised list of gastropods up to the year 1847 includes *Maclurites magnus* Lesueur, *Scalites angulatus* Emmons, *Raphistoma striatum* (Emmons), *Raphistoma stamineum* Hall, *Bucania sulcatina* (Emmons), *Archinacella deformata* (Hall), and *Trochonema biangulatum* (Hall).

In the "Prodrome de Paleontologie," 1850, d'Orbigny substituted the name *Murchisonia subabbreviata* for Hall's specific name *abbreviata*, the latter name having been previously used for a species of *Murchisonia* by de Koninck.

In the "American Geology," 1855, Emmons added one species, *Straparollus angulatus.* No figure was given, but there is little doubt from the description, that the name is a synonym for *Raphistoma stamineum.*

In 1859 Billings recognized twenty-one species of gastropods in the Chazy of Canada, but described only nine of them. These were: *Pleurotomaria docens*, *Pleurotomaria calyx*, *Pleurotomaria immatura*, *Pleurotomaria crevieri*, *Pleurotomaria pauper*, *Murchisonia infrequens*, *Murchisonia asper*, and *Maclurea atlantica*, all new species, and *Murchisonia perangulata ?* Hall. Of the eight new species only three, *Pleurotomaria docens*, *Pleurotomaria calyx*, and *Pleurotomaria crevieri*, were figured. As will be shown in the following pages, *Pleurotomaria docens* is probably *Liospira. Pleurotomaria calyx*, *Pleurotomaria crevieri*, and *Pleurotomaria pauper* seem to be the same as *Raphistoma stamineum. Murchisonia infrequens* and *Murchisonia asper* are known only from the types, which are figured for the first time in this article. The list is thus reduced to six species, making a total of thirteen species of gastropods described from the Chazy up to the year 1860.

In the "Paleozoic Fossils of Canada," Volume 1, 1865, Billings described two species of gastropods from the "Chazy or Black River" at the Mingan Islands, and two from a similar formation at Phillipsburgh, Canada. None of these species have been found in the typical deposits in the Champlain Valley, and their exact horizon is still uncertain.

Metoptoma montrealensis was described in the same volume from specimens obtained at Montreal, Canada. This species, which belongs to the genus *Scenella*, occurs in the Champlain Valley, and is the fourteenth of the described species now recognizable.

In a "Bulletin of the American Museum of Natural History," 1897, Whitfield described a gastropod from the Chazy formation at Valcour Island under the name *Bucania champlainensis*. As will be shown on a later page, this shell is probably the same as that described earlier as *Bucania sulcatina* (Emmons).

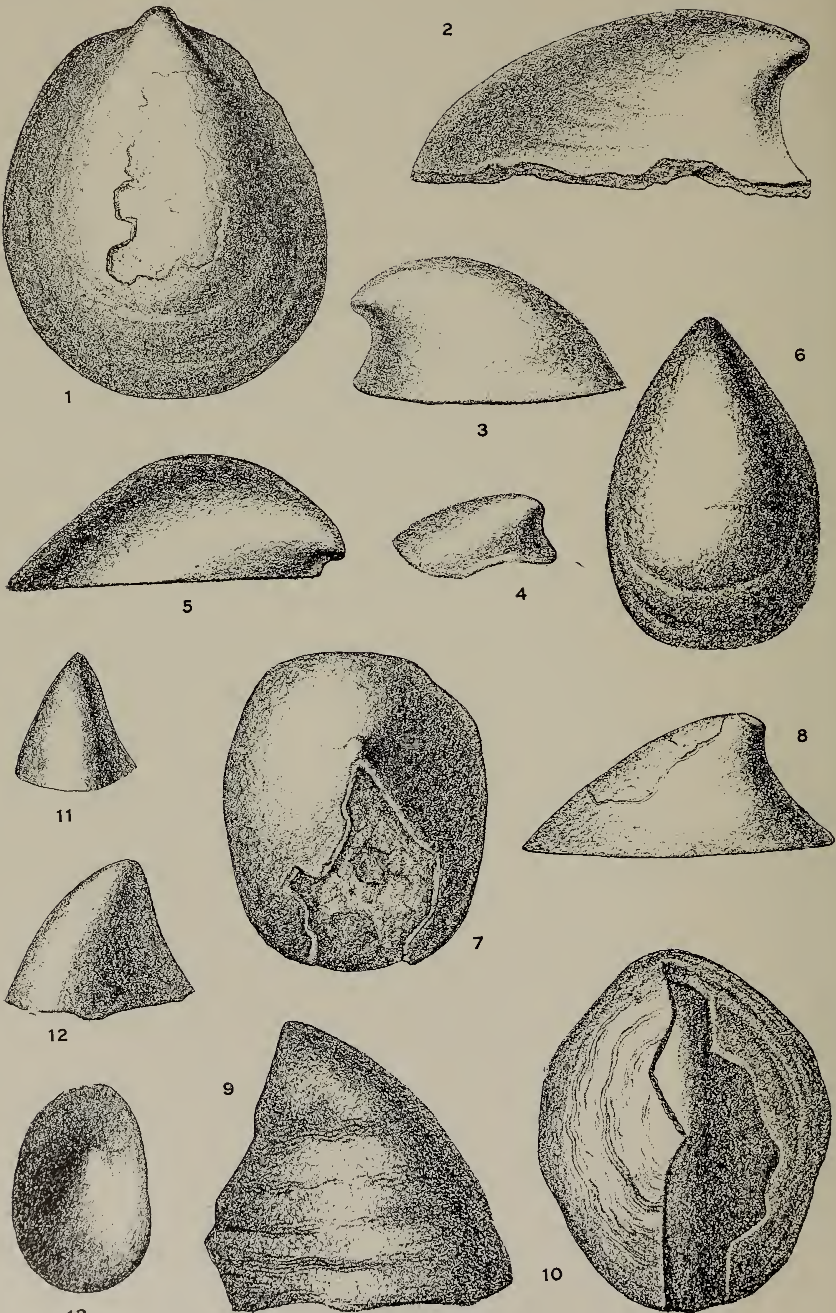
In 1902 Raymond described and figured a *Bucania* as *Bucania champlainensis* Whitfield, but this also is *Bucania sulcatina*. At the same time he described a new gastropod from the Chazy at Crown Point, New York, as *Eccyliomphalus fredericus*.

In the "Report of the New York State Paleontologist for 1903" (1905), Hudson described six species of gastropods, making a total list of twenty-one species in the Chazy.

In two papers, one in November, 1905, and the other in July, 1906, the present writer has published preliminary descriptions of twenty species, which are more fully described and figured in the present paper. With the five species now described for the first time, the total list of named gastropods in the Chazy formation includes forty-seven species.

To the gentlemen who have assisted me in the following review of the Gastropoda of the Chazy, I wish to express my thanks. For the loan of the types and interesting specimens I am particularly indebted to Dr. J. F. Whiteaves and to Dr. H. M. Ami, paleontologists to the Geological Survey of Canada; Professor R. P. Whitfield and Dr. E. O. Hovey, of the American Museum of Natural History; Dr. Ray S. Bassler, of the United States National Museum, and Dr. H. F. Cleland, of Williams College.

To Professor Charles Schuchert, of Yale University, and to Dr. E. O. Ulrich, of the United States Geological Survey, I am indebted for kind criticisms and assistance in the identification of the material.



Sydney Prentice del.

Gastropods from the Chazy Formation.

Class **GASTROPODA.**

Order *ASPIDOBRANCHIA* Schweigger.

Sub-Order DOCOGLOSSA Troschel.

Family PATELLIDÆ Carpenter.

Genus **Archinacella** Ulrich and Scofield.

Archinacella deformata (Hall).

(PLATE XLVI, FIGURES 1-6.)

Orbicula ? deformata Hall, 1847, Paleontology of New York, Vol. I, p. 23, Pl. 4, figs. 10*a*, 10*b*. (*Orbicula deformis*, in explanation of plate.)

Metoptoma ? dubia Hall, 1847, *ibidem*, figs. 11*a*, 11*b*.

Metoptoma deformis Billings, 1863, Geology Canada, p. 937.

Stenotheca dubia Whitfield and Hovey, 1898, Bulletin American Museum Natural History, Vol. XI, p. 58.

Archinacella ? deformata Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 875.

An examination of the types shows that Whitfield and Hovey were correct in referring the specimen named *Orbicula ? deformata* by Hall to the species *Metoptoma ? dubia*, which Hall described on the same page of Vol. I, New York State Paleontology. The species should, however, take the first specific name applied to it.

It is evident that Billings saw the true nature of *Orbicula ? deformata*, for as early as 1863 he referred it to the genus *Metoptoma*. (See the paper cited above.)

As no specimens have been found which show either muscle scars or pronounced surface markings, the generic reference is somewhat uncertain. It does not seem possible either to leave it in the genus *Metoptoma*, where Hall doubtfully put it, or in the genus *Stenotheca*, where it was placed by Whitfield and Hovey. In general form it most resembles the shells of some of the species of *Archinacella* described by Ulrich and Scofield, and until better specimens are obtained it may be placed in that genus. The specimens of this shell are abundant, and the characters are quite constant. It is easily recognized by the low form and by the anterior position of the apex.

DESCRIPTION.

Shell small, patelliform, depressed conical. The highest point is at the apex, which always reaches to, or overhangs the anterior margin. Outline elliptical, broadest posteriorly. Beak small, slightly incurved. The slope to the anterior margin is concave, the posterior slope gently convex. All the specimens so far seen are casts and show no surface markings other than fine concentric lines of growth. The greater diameter of the aperture of an average shell is 11 millimeters; the lesser 8 millimeters.

Locality. — Common in the Chazy Limestone at Crown Point, Valcour Island, and Chazy, New York, and in the Aylmer Sandstone at Aylmer, Canada. The specimen figured on Plate XLVI, figures 1 and 2 is a typical form, and with it should be compared the specimen from the Aylmer beds, figure 3 of the same plate. Figures 5 and 6 illustrate a specimen which is partially buried in the matrix.

Archinacella ? propria Raymond.

(PLATE XLVI, FIGURES 7–8.)

Metoptoma montrealensis Raymond (non Billings), 1902, Bulletin American Paleontology, Number 14, p. 34.

Archinacella ? propria Raymond, 1906, Annals Carnegie Museum, Vol. III, p. 575.

This is another rather common species of the same type as *Archinacella deformata* (Hall) but differs from that species in the more broadly elliptical outline and the position of the apex, which is nearly half way between the center and the anterior margin of the shell.

DESCRIPTION.

Shell of medium size, almost circular in outline, depressed conical, rising to an acute apex which is half way between the center and the anterior margin. Beak small, scarcely incurved, directed forward. Anterior slope concave directly under the beak but straight for the greater part of the slope. Posterior slope long and slightly convex. The surface shows a few very fine concentric lines.

The greater diameter of the aperture of one specimen is 18.5 millimeters; the lesser is 17.5 millimeters.

Locality. — This species is fairly common in the Chazy at Crown Point, Valcour Island, and Chazy, New York. The type is in the Yale University Museum.

Genus **Scenella** Billings.

Scenella montrealensis (Billings).

(PLATE XLVI, FIGURES 9, 10; PLATE LV, FIGURE 1.)

Metoptoma montrealensis Billings, 1865, Paleozoic Fossils of Canada, Vol. I, p. 394, fig. 371.

Scenella montrealensis Ulrich and Scofield, 1897, Paleontology of Minnesota, Vol. III, part II, p. 838.

Billings' original description is as follows: "Acutely conical; apex a little in advance of the center; base obtusely elliptical, the antero-posterior diameter a little the longest. On a side view the outline is gently convex from the apex to the posterior, and concave to the anterior margin. Surface, when perfect, with fine vertical striæ running from the apex to the margin, and with both fine engirdling striæ and obscure undulations of growth parallel to the base. In most specimens the fine striæ are not perceptible."

The specimens from Chazy, New York, the locality in which this species has been found by the writer[1] very rarely show radiating striæ, although the shell is preserved. On these specimens, especially near the aperture, the "obscure undulations of growth" are very prominent. A specimen in the United States National Museum which is here figured (Plate LV, figure 1) through the courtesy of Dr. Bassler, shows the vertical striæ, which are often interrupted by the concentric undulations and give the shell much the appearance of a worn coral. This specimen is from Isle La Motte, Vermont, where this fossil is common in association with *Raphistoma stamineum*, *Bucania sulcatina*, *Pliomerops canadensis*, and other characteristic fossils.

Scenella pretensa Raymond.

(PLATE XLVI, FIGURES 11–13.)

Scenella pretensa Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 375.

A rare species found with the last differs from it principally in its narrowly elliptical aperture and generally compressed form.

[1] The specimens from the Crown Point section which were identified as *Metoptoma montrealensis*, did not belong to that species but to *Archinacella? propria*. Bulletin American Paleontology, No. 14, 1902.

Description.

Shell small, aperture narrowly elliptical in outline. Height about equal to the greater diameter of the aperture. Beak small, pointed forward but not incurved. Anterior slope nearly straight. Posterior slope convex above, becoming straight below. Surface smooth, except for a few low concentric undulations near the base. Beak a little in in front of the middle.

The greater diameter of the aperture is 11 millimeters, the lesser is 6.5 millimeters, height 11.5 millimeters.

Locality. — This shell occurs rarely in the Lower Chazy south of the lime kilns at Chazy, New York. The specimen selected as the type is from the Middle Chazy at Lenoirs, Tennessee, and is in the Yale University Museum.

Scenella robusta Raymond.

(Plate XLVII, figures 1–2.)

Scenella robusta Raymond, 1905, American Journal of Science, Series 4, Vol. XX, 376.

Description.

Shell large, aperture nearly circular. Beak obtuse, rather high, a little in front of the center. All slopes about equal and all convex. The whole shell is somewhat hemispheric. The specimens are all casts, showing no surface markings of any sort. This species somewhat resembles *Scenella superba* (Billings), but has a more depressed form, and a blunter apex.

The only perfect specimen is 17 millimeters in greater and 16 millimeters in lesser diameter. A much larger specimen is represented by a fragment 27 millimeters long, but, when complete, it was evidently considerably larger.

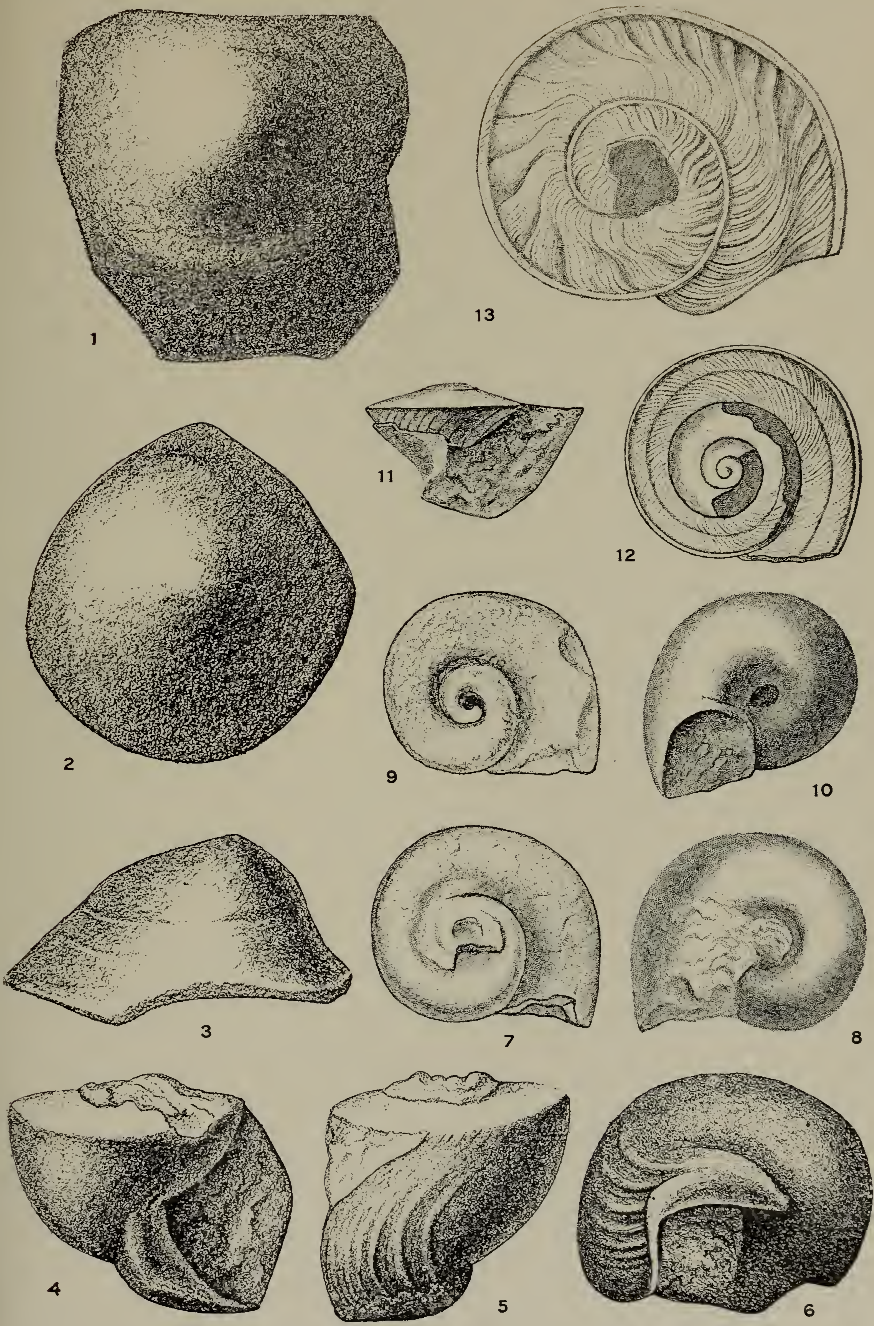
Locality. — Valcour Island in the Middle Chazy beds. Rare. Type in the Carnegie Museum. It occurs also at Lenoirs, Tennessee, and figure 1, Plate XLVII, is from a specimen obtained at that locality.

Genus **Palæacmæa** Hall and Whitfield.

Palæacmæa irregularis Raymond.

(Plate LIV, figures 10–12.)

Palæacmæa irregularis Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 376.



Sydney Prentice del.

Gastropods from the Chazy Formation.

DESCRIPTION.

Shell simple, depressed conical, rather large, irregular in outline, generally subcircular, but never smoothly curved. Apex obtuse, almost central, sometimes a little back of the center. All slopes about equal, generally almost straight, but occasionally a little convex. Surface marked by fine lines of growth which follow the irregular form of the aperture. Usually there are a few obliquely radial folds and various irregular depressions and pits which do not follow any symmetrical arrangement. Some of the specimens show obscure evidences of coiling.

The greater diameter of one specimen is 26 millimeters, lesser diameter 25 millimeters, height 10 millimeters. The aperture of another specimen is 19 millimeters in greater diameter, 18 millimeters in lesser diameter, and 9 millimeters in height.

Locality. — *Palæacmæa irregularis* is a common fossil in one zone at Chazy, New York, where it is found associated with *Raphistoma stamineum*, *Lophospira rectistriata*, and *Scenella montrealensis*. The cotypes are in the Yale University Museum.

Sub-Order RHIPIDOGLOSSA Troschel.

Family RAPHISTOMIDÆ Ulrich and Scofield.

Genus **Raphistoma** Hall.

Hall, Paleontology of New York, 1847, Vol. I, p. 28.

Ulrich and Scofield, Paleontology of Minnesota, 1897, Vol. III, part II, pp. 931, 940.

Under the generic name *Raphistoma*, Hall described three species and one variety from shells collected in the Chazy Limestone at Chazy, New York. On the basis of similar specimens, which, however, showed a band on the outer margin of the upper surface of the whorls, Billings referred all of Hall's species to the genus *Pleurotomaria*, and described five new species from the Chazy of Canada. Reviewing their work at the present time, with several hundred specimens gathered from the Canadian and New York localities, it becomes evident that Hall and Billings referred to the same shell under different specific names. The imperfections of the material studied by each led them to take different views of the characters of the shells. Before stating just what synonymy has arisen from the study of this imperfect material, a brief survey of the principal characters of the species of *Raphistoma* previously described from the Chazy will be presented.

Raphistoma striatum (Emmons).

Spire nearly flat, slightly elevated toward the apex; ventricose below; outer margin obtusely angular. Aperture subtriangular, nearly straight above and rounded below. Umbilicus moderately large. Striæ rather coarse.

Raphistoma stamineum Hall.

Depressed toward the margin, with the central portion of the spire raised somewhat above the outer volution. Sharply angulated on the outer side, nearly flat above and sub-ventricose beneath.

The surface is marked by strongly elevated, rounded striæ, which, bending back from the suture, are interrupted along the center of the upper part of the whorl by a concentric elevated line. Passing the sharp angle of the volution, the striæ bend abruptly forward, and, curving gently, pass into the umbilicus. The cast of the inner volutions is rounded.

Raphistoma planistrium Hall.

Spire depressed. Apex a little elevated. Surface marked by broad, flat, imbricating striæ, which are bent backwards and interrupted along a line near the middle of the whorl. Umbilicus small.

This shell differs from the last in the greater proportional height, the narrow trigonal aperture and the small umbilicus, as well as in the flat, plain striæ.

Raphistoma planistrium variety *parvum* Hall.

This differs from the last only in size and a lack of distinct imbricating striæ.

Pleurotomaria docens Billings.

Spire nearly flat. Umbilicus closed. On the lower side the whorls are ventricose. At the aperture the outer lip is at right angles to the upper lip or upper surface of the whorl, but this angle decreases as the whorl is followed backward.

The surface is covered by coarse, slightly elevated undulations of growth.

When the shell is destroyed, a cast of the interior exhibits an umbilicus one eighth the whole width of the spire.

Some of the specimens are two and a half inches wide.

Pleurotomaria immatura Billings.

Spire nearly flat. In specimens an inch and a half wide the apex is elevated four or five lines above the margin. Owing to the depression of the outer whorl, the spire is semi-turreted.

Surface marked by rather fine backward-curving striæ.

Pleurotomaria calyx Billings.

Spire nearly flat, acute, or sharply rounded on the outer edge. No umbilicus. Apex slightly higher than the margin. This species closely resembles the *Raphistoma stamineum* Hall, but is not umbiculated, and therefore Billings believed it to be distinct from *Raphistoma stamineum*.

Pleurotomaria crevieri Billings.

Spire nearly flat. No umbilicus. The anterior margin is acutely rounded, not beveled, as in specimens of *Pleurotomaria calyx* of the same size. Surface marked by fine striæ of equal size as in all the other species of the same group.

Pleurotomaria pauper Billings.

Shell small, flat above, ventricose below and obtusely angulated at the edge of the umbilicus. Surface markings unknown. This shell is about the size and shape of *Pleurotomaria crevieri*, but with a perfectly flat spire and an umbilicus.

OBSERVATIONS ON THE PREVIOUS SPECIES.

A large number of well-preserved specimens from Chazy, New York, which appear to represent one species, show a great range of variation. These variations are: first, in the relative height and width of the shells; second, when the shell substance is removed all specimens show a wide umbilicus, but when the test is complete the umbilicus is nearly or quite concealed; third, the spire may vary from almost perfectly flat to one which rises several millimeters above the level of the outer whorl; fourth, the surface markings of young shells consist of fine impressed lines, while adults of the same species have coarse striæ or undulations of the shell. With these facts in mind, an examination of the above descriptions will decrease the list of species.

Pleurotomaria pauper Billings differs from *Pleurotomaria crevieri* Billings only in that it has a flat spire and open umbilicus. The specimen on which the former was founded is a cast, so its characters really are what we would expect to find in a cast of *Pleurotomaria crevieri*.

Pleurotomaria crevieri differs from *Pleurotomaria calyx* in its smaller size and its rounded instead of beveled outer margin. Both of these characters are comparatively unimportant. An examination of the types shows that they belong to the same species.

Pleurotomaria calyx Billings differs from *Raphistoma stamineum* Hall only in the lack of the umbilicus. As above stated, this is due only to the removal of the lower part of the shell. Therefore, *Pleurotomaria pauper*, *Pleurotomaria crevieri*, *Pleurotomaria calyx*, and *Raphistoma stamineum* Hall, all agree in their essential characters, and probably represent but one species.

Raphistoma planistrium parvum Hall differs from *Raphistoma planistrium* only in size and in the distinctness of the striæ, which certainly are not important differences and cannot hold, even for a varietal name.

Raphistoma planistrium Hall differs from *Raphistoma stamineum* in the greater proportional height, the narrow trigonal aperture and the small umbilicus. Of these three differences, two, the height and the small umbilicus, may be disregarded. The size of the aperture is not indicated in the description of *Raphistoma stamineum* nor in the figure of *Raphistoma planistrium*, so they cannot be compared. In the writer's collection there are specimens which correspond exactly to the figures and description of *Raphistoma stamineum*, *Raphistoma planistrium* and *Raphistoma planistrium parvum*, and yet there can be found no distinction on which to base a separation of the specimens into species. It is true also that none of the descriptions apply to the really perfect shells which occur with the ones which fit the above names.

Raphistoma striatum (Emmons).

(PLATE XLVII, FIGURES 4–10.)

Maclurea striata Emmons, 1842, Final Report of the Second District of the New York State Survey, p. 312, fig. 3.

Raphistoma striata Hall, 1847, Paleontology of New York, Vol. I, p. 28, Pl. 6, figs. 2a, 2b.
Scalites striata Emmons, 1855, American Geology, Vol. I, Pl. 4, fig. 30.

DESCRIPTION.

Shell large, high, spire nearly flat, although the inner volutions are sometimes a little elevated. There are usually four or five volutions which expand gradually, but more rapidly than in *Raphistoma stamineum.* The angle between the upper side and the outer surface of the last volution is always large, varying from 75° to 90°, and the shoulder between the two is always quite sharp, while in *Raphistoma stamineum* it is apt to be considerably rounded. The umbilicus is small in the cast and completely closed in specimens retaining the shell. As in *Maclurites*, the angle in the cast, between the basal portion of the shell and the inner surface of the umbilicus, is sharp.

The surface, when perfect, is marked by numerous, rather coarse, rounded striæ, or rather undulations. Starting from the suture they run sharply backward until stopped by the low revolving line characteristic of the genus. Starting again on the other side of this line, they run back to the margin, which they meet at an acute angle. Below the margin they swing sharply forward, and a little below the middle of the slope they turn back again under the thickened inner lip which covers the columella. Around the margin of the upper surface of the whorl is the slit band similar to that described by Billings in *Pleurotomaria docens.* However, the striæ do not cross it in loops as indicated in his figures, but, on reaching it, turn more sharply backward, and turn forward again only after crossing the angle of the shell.

The specimens most commonly found are casts retaining little or none of the shell. In this condition they resemble specimens of *Maclurites magnus* but may readily be distinguished from that shell by the dextral instead of the sinistral coil. They differ from exfoliated specimens of *Raphistoma stamineum* in having the sides more nearly at right angles to the top, in the more rapid expansion of the whorls, the smaller umbilicus, and in the sharp angle of the lower surface of the whorls bordering the umbilicus. The cast of *Raphistoma stamineum* is rounded, while that of *Raphistoma striatum* is angular.

Locality. — Fairly common at Valcour Island. Rare at Chazy, New York, and at Aylmer, Province of Quebec, in the Aylmer Sandstone.

The specimen figured on Plate XLVII, figures 7 and 8, is in the Carnegie Museum. That represented by figures 9 and 10, of the same plate, is in the Cornell University Museum, and the originals of 4–6 are in the Yale University Museum.

Raphistoma stamineum Hall.

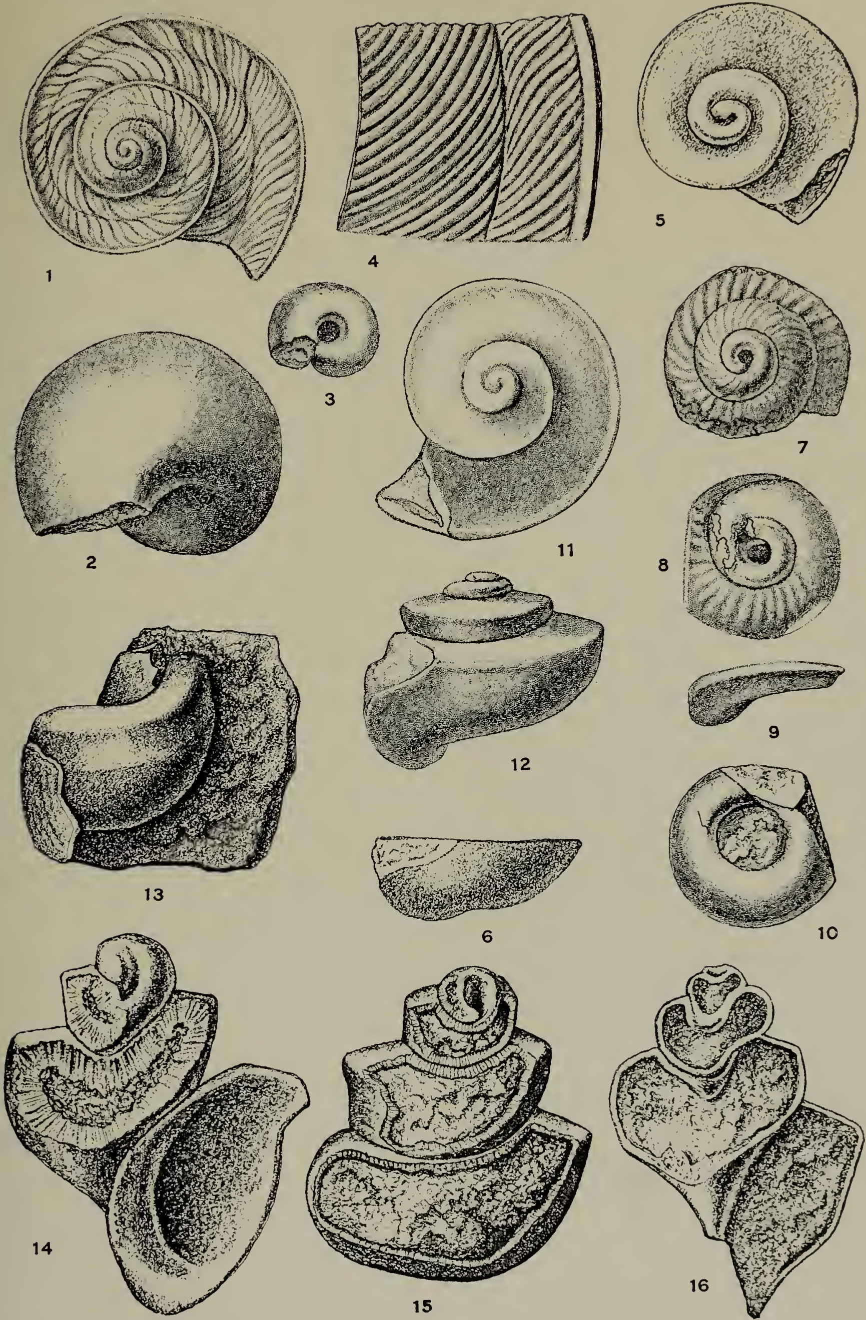
(PLATE XLVII, FIGURES 11–13; PLATE XLVIII, FIGURES 1–5; PLATE LV, FIGURES 5–8.)

Raphistoma staminea Hall, 1847, Paleontology of New York, Vol. 1, p. 29, Pl. 6, figs. 4, 5, 5*a*.
Raphistoma planistria Hall, 1847, *ibidem*, p. 29, figs. 1, 2, Pl. 6, figs. 3*a*, 3*b*.
Raphistoma planistria var. *parva* Hall, 1847, *ibidem*, figs. 3*c*, 3*d*, 3*e*.
Pleurotomaria sp. Hall, 1847, *ibidem*, p. 31, Pl. 6, fig. 8.
Scalites planistria Emmons, 1855, American Geology, Vol. 1, p. 159, Pl. 4, figs. 16, 17.
Straparollus planistria Emmons, 1855, American Geology, Vol. 1, p. 233.
Straparollus angulatus Emmons, 1855, American Geology, Vol. 1, p. 157.
Scalites staminea Emmons, 1855, American Geology, Vol. 1, p. 159.
Pleurotomaria calyx Billings, 1859, Canadian Naturalist and Geologist, Vol. 4, p. 455, figs. 30, 31, 32.
Pleurotomaria crevieri Billings, 1859, *ibidem*, p. 456, figs. 33, 34, 35.
Pleurotomaria pauper Billings, 1859, *ibidem*, p. 457.
Pleurotomaria calyx Billings, 1863, Geology Canada, p. 132, fig. 62.

This is a very common species in the lower layers at Chazy, New York, and on Isle La Motte, Vermont, where hundreds of well-preserved specimens may easily be obtained. A careful study of these specimens in comparison with the type of Billings' species, named above, fails to reveal any specific differences and all must be referred to Hall's species.

DESCRIPTION.

Shell of medium size, with five to seven whorls which enlarge gradually. Apex usually a little higher than the plane of the outer whorl, but this is a variable character. In some specimens the upper surface of the shell is flat or even concave, while in others the spire may be



Sydney Prentice del.

Gastropods from the Chazy Formation.

convex and the outer whorl concave, or the whole upper surface may be convex and the spire somewhat elevated. The lower part of the shell is usually rather long, the sides meeting the upper surface always at less than a right angle; in young shells, in rather an acute angle.

The umbilicus is large in the cast, but in perfect specimens it is filled by the shell.

The surface is marked by lines which make a double curvature in crossing the upper surface of the volution. They are interrupted at the middle by a raised line. At the edge of the shell, which is acute, there is a raised band on which the striæ curve sharply back. Beneath, the striæ curve sharply forward, then backward to the columella.

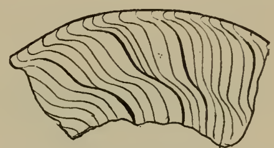


FIG. 1. An enlargement of the upper surface of a specimen of *Raphistoma stamineum* Hall, to show the band on the margin. The striæ turn back on the upper surface, and then cross the angle of the whorl before turning forward again, and thus do not make a true slit band, such as is seen among the Pleurotomariidæ.

In young shells the surface markings consist of fine impressed lines which are often more or less gathered into fascicles, as is shown in figure 13, Plate XLVII, and on Plate XLVII, figure 1. On mature shells the surface of the body is covered with coarse striæ or undulations, parallel to the successive positions of the outer lip. This character of the surface of the adult shell is shown in figures 5–8, Plate LV.

In fully adult shells the columella is somewhat drawn out, twisted to the right, and slightly excavated. (See figure 8, Plate LV.) Some shells show a hint of an umbilical perforation, as is seen in figure 7 on the same plate, but in almost all cases this is covered by the columellar lip. The outer lip seems always to be thin. Its form can be seen on Plate LV, figures 5 and 6.

For characters distinguishing this species from the last, see *Raphistoma striatum.*

Locality. — Shells of this species are common at Crown Point, Valcour Island, Valcour, and Chazy, New York, and Isle La Motte, Vermont. The specimen represented on Plate XLVIII, figure 1 is in the Carnegie Museum, figures 11–13, Plate XLVII, and figures 2–6, Plate XLVIII, are from shells in the Yale University Museum, and those on Plate LV, figures 5–8 are from specimens in the United States National Museum.

Raphistoma immaturum (Billings).

Pleurotomaria immatura Billings, 1859, Canadian Naturalist and Geologist, Vol. IV, p. 454.

Although this species has never before been figured, it may easily be recognized from Billings' description, as it is the only species of *Raphistoma* in the Chazy with step-like whorls. In *Raphistoma stamineum* and *Raphistoma striatum*, when the central whorls are elevated, the outer edge of the body whorl is also usually elevated so that the outer whorl gives the whole shell a somewhat concave border. In *Raphistoma immaturum*, each whorl is a little higher than the preceding, making steps up to the apex (figure 2) and at the same time the top of each whorl slopes up toward the apex, so that the surface is like that of *Liospira americana* (Billings) of the Black River. In all the specimens seen, the lower part of *Raphistoma immaturum* is less prolonged and ventricose than in *Raphistoma striatum* and *Raphistoma stamineum*, and the whole shell is more like the Black River and the Trenton forms of *Liospira*.

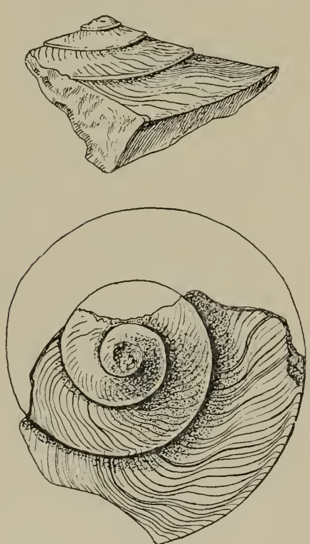


FIG. 2. *Raphistoma immaturum* Billings. Side and top views of an imperfect specimen. Enlarged 4 diameters.

DESCRIPTION (Figure 2).

Shell small, consisting of five or six whorls, each a little above the one outside it. The apex is always elevated and the slope is regular from the apex to the outer margin of the body whorl. The lower portion of the body whorl is rounded, but is not so conical as in *Raphistoma stamineum*. The angle at the margin is acute. The section of the outer whorl is almost a parallelogram, rather wide, gently convex in the outer lip and base, and straight on the top. The umbilicus is closed in adult testiferous shells, and small in young shells with test.

The surface markings show numerous fine growth lines which bend sharply backward from the suture, are interrupted by a raised line on the middle of the top of the whorl, curve a little forward, then back to the band, then turn more sharply backward in crossing the angle, which is a little rounded. On the under surface they turn sharply forward, then back again toward the columella.

Locality. — The best specimens have been found in the lower part of the Chazy at Plattsburgh, New York, with *Scalites angulatus* and *Bucania sulcatina.* It occurs also at Chazy, New York, and at Montreal, Canada.

The figured specimen is in the Yale University Museum.

Genus **Raphistomina** Ulrich and Scofield.

Raphistomina undulata Raymond.

(PLATE XLVIII, FIGURES 7–10.)

Raphistomina undulatum Raymond, 1906, Annals Carnegie Museum, Vol. III, p. 576.

In the locality at Sloop Bay there occurs a *Raphistoma*-like shell which cannot be referred to any of the preceding species. It differs from them, not only in surface markings but also in its much more lenticular form. It belongs, strictly speaking, with the group of shells for which Ulrich erected the genus *Raphistomina.* The corrugated surface of the body whorl serves to identify this species very readily.

DESCRIPTION.

Shell small, four or five whorls, lenticular, the spire rather high, the under portion rounded, depressed, not subconical as in *Raphistoma stamineum.* The first three or four volutions of the cast are smooth, but the surface of the body whorl is marked by numerous small folds which run from the suture diagonally across the volution. The margin is acute, rounded and just beneath it is a narrow concave space. Below this the shell is gently convex for a short distance, then flat to the umbilicus, which, in the cast, is open.

Locality. — This shell has so far been found only in the Middle Chazy at Sloop Bay, Valcour Island, New York. The type is in the Yale University Museum.

Genus **Scalites** Emmons.

Scalites angulatus Emmons.

(PLATE XLVIII, FIGURES 13–16.)

Scalites angulatus Emmons, 1842, Geological Survey of New York, p. 312, fig. 1.

Scalites angulatus Hall, 1847, Paleontology of New York, Vol. I, p. 27, Pl. 6, figs. 1*a*, 1*b*.

Scalites angulatus Emmons, 1855, American Geology, p. 159, Pl. 4, fig. 20.

Scalites angulatus Ulrich and Scofield, 1897, Paleontology of Minnesota, Vol. III, part 2, p. 933, fig. 4.

The genus *Scalites*, proposed in manuscript by Conrad, published by Emmons and described by Hall, has never been well known, owing to the poor state of preservation in which the specimens occur. In the few localities in which they are found, — only three are known, — they occur in a fine-grained, dense limestone matrix, which adheres so closely to the shell that the only examples ordinarily obtainable are the casts and the natural sections so abundant on the weathered surface of the rock, in which the species occurs.

Most writers have placed the genus close to *Raphistoma*, many, indeed making *Raphistoma* a synonym of *Scalites*. Ulrich and Scofield (*loc. cit.*) have made *Scalites* a genus in their family Raphistomidæ, a disposition of the genus which seems in accord with the characters of the shell as now known.

The only specimen seen by the writer in which any considerable portion of the original shell is retained in such a condition as to show surface markings, is a specimen preserved in the Hall collection at the American Museum of Natural History, New York City.

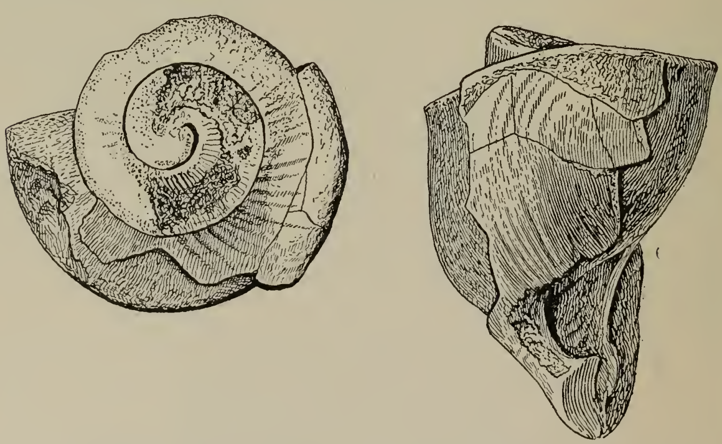


FIG. 3. *Scalites angulatus* Emmons. Top and side views of a specimen preserving a part of the shell. The side view shows a part of the inner lip, but both it and the columella have been injured and do not show their true form. Natural size.

This specimen was very kindly loaned for study by Dr. E. O. Hovey and Professor R. P. Whitfield of that Museum, and the accompanying text figures illustrate its characters. The spire has been almost entirely weathered off, but the body whorl retains a part of the shell. The specimen has been mutilated along the inner lip and columella, but enough of the shell is retained to show that the form of the aperture was essentially similar to that in *Raphistoma stamineum.* The striæ on the top of the whorls cross the surface in an uninterrupted sweep, thus differing from *Raphistoma.* The only other genus with which this shell could be compared is *Trochonema*, but the absence of a revolving flattened band and of the umbilicus, will readily distinguish it from that group of shells.

DESCRIPTION.

Shell large, robust, making about five volutions. Whorls strongly angulated, flattened on top. Spire rather high, frequently making up nearly half the height of the shell. The initial whorls are rounded in cross section, the succeeding whorls increasing rapidly in size to the body whorl, which always constitutes at least half the shell. In some individuals the slope from the suture to the periphery is rather steep, in others it is flat or slightly concave. Below the peripheral angle is a narrow concave band, best shown in the cast. The body whorl is drawn out below, somewhat cylindrical. Complete aperture not observed, but apparently the same as in *Raphistoma stamineum.* The inner lip is thickened, wide, turned back over the columella. In front the lip is thickened, rounded and entire, not canaliculate. The outer lip seems to be thin and the most perfect margin seen — that on the specimen in the American Museum — is approximately parallel to the lines of growth as in *Raphistoma.*

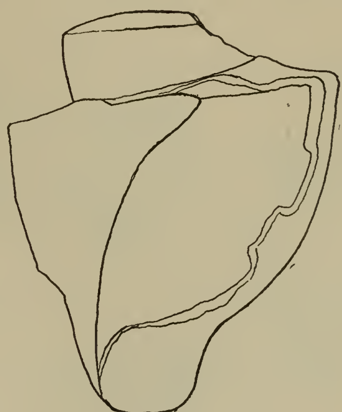


FIG. 4. Outline drawing of the same specimen illustrated by figure 3. The shell has been largely removed from this side of the specimen, but the former shape of the outer lip is indicated on the cast, as shown here. The irregular double line represents the broken edge of the shell, and the smooth line the margin of the lip. Natural size.

The surface markings consist of lines of growth and fine undulations parallel to them. On the upper surface of the whorl they sweep gently backward from the suture to the shoulder, then, after crossing the angle, turn abruptly forward, passing about one third the way down the side of the whorl, then turn back and run under the inner lip.

One specimen is 75 millimeters high, another 44, and a third 66.

Locality. — The species occurs in two localities south of the village at Chazy, New York, and near the Normal School at Plattsburgh, New York. The specimens shown on Plate XLVIII, figures 14–16, are in the Yale University Museum. The original of figure 13, of the same plate is in the Geological Museum of Williams College.

FAMILY PLEUROTOMARIIDÆ d'Orbigny.

Genus **Lophospira** Whitfield.

Lophospira subabbreviata (d'Orbigny).

Murchisonia abbreviata Hall, 1847, Paleontology New York, Vol. I, p. 32, Pl. 6, fig. 7 (not of de Koninck).

Murchisonia subabbreviata d'Orbigny, 1850, Prodrome de Paleontologie, Tome I, p. 8.

Murchisonia decurta Hall, 1877, American Paleozoic Fossils, S. A. Miller, p. 244.

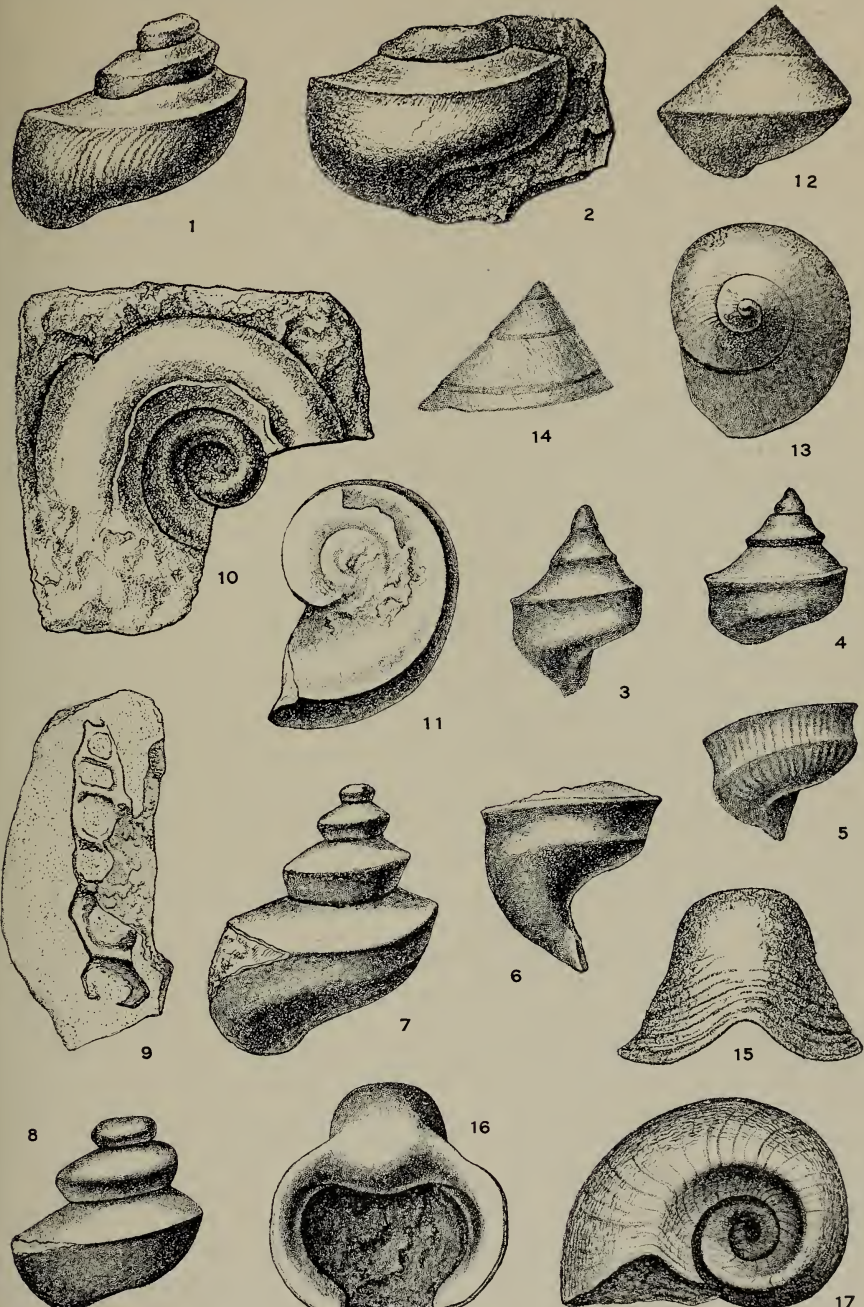
This species was described by Hall from a single specimen obtained at Chazy, New York. The specimen was lost before Volume I, Paleontology of New York, was issued, and as Hall's figure and description are inadequate to define a species, the name will have to be dropped.

Lophospira rectistriata is fairly common at the locality from which Hall's specimen was obtained, and, for that reason, the writer has identified it with Hall's species in previous papers. Dr. Ulrich has pointed out the impropriety of such a course, and it will probably be best to abandon the name *abbreviata* entirely.

Lophospira billingsi Raymond.

(PLATE XLIX, FIGURES 1, 2.)

Lophospira billingsi Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 377.



Sydney Prentice del.

Gastropods from the Chazy Formation.

DESCRIPTION.

Shell of four volutions, body whorl very large, spire low, whorl angular, sloping gently from the suture to the periphery, then sharply deflected and flattened below. The under side of the body whorl is rounded and strongly convex. In the section of the body whorl the inner and lower lips rounded, the upper lip straight from the suture to the periphery and nearly straight for a short distance below it. The surface is covered by rather coarse lines of growth, which cross the upper side of the volutions diagonally and backward, turning forward after crossing the carina. On the under surface of the whorl the striæ turn sharply backward.

Locality. — These shells occur in the Aylmer Sandstone at the Canadian Pacific Railroad cut east of Main Street, Aylmer, Canada. Named for W. R. Billings, of Ottawa, an enthusiastic student of the Chazy. The types are in the Yale University Museum.

Lophospira rectistriata sp. nov.

(PLATE XLIX, FIGURES 3–6)

Lophospira subabbreviata Raymond, 1906, Annals Carnegie Museum, Vol. III, p. 501 *et seq.* (not of d'Orbigny).

This species, which the writer has previously listed under the name *Lophospira subabbreviata*, differs considerably from the figure given by Hall, and should bear a distinct name.

DESCRIPTION.

Shell of medium size, with four or five sharply angulated whorls, the last of which is much larger than the next preceding, making up more than half the height of the shell. The first two whorls are rounded, the last two or three strongly angulated. On the body whorl below the periphery is a low carina, which is separated from the periphery by a concave space. On testiferous specimens the sutures are not sharp, but in casts of the interior they are deep. The section of the body whorl is rounded at the top, notched at the outer angle of the main carina and rounded below. The umbilicus is small, often covered by the inner lip. On the periphery of the body whorl is the somewhat rounded and prominent slit band.

The surface is marked by fine lines of growth, which run slightly backward from the suture to the band on the upper keel; below the angle they turn a little forward and continue across the concave space, then at the lower keel they turn backward again to the columella.

Locality. — Common in the Chazy at Crown Point, Valcour Island and Chazy, New York.

The specimens figured on Plate XLIX, figures 5 and 6, are in the Yale Museum. The originals of figures 3 and 4 are in the Carnegie Museum.

Lophospira perangulata (Hall).

(PLATE XLIX, FIGURES 7, 8.)

Murchisonia perangulata Hall, 1847, Paleontology of New York, Vol. I, p. 41, Pl. 10, fig. 4.

Not *Murchisonia perangulata* var. A, *ibidem*, p. 179, Pl. 38, figs. 7*a*, 7*b*.

Murchisonia perangulata? Billings, 1859, Canadian Naturalist and Geologist, Vol. IV, p. 458.

Murchisonia bicincta var. *perangulata* Salter, 1859, Canadian Organic Remains, Decade I, p. 19, Pl. IV, fig. 7.

Lophospira perangulata Ulrich and Scofield, 1897, Paleontology of Minnesota, Vol. III, part 2, p. 972, Pl. 63, figs. 1–7.

This species seems to have a rather extensive geographical distribution. It has been found in the Chazy at Mingan Islands and on Valcour Island. It was originally described from the Lowville Limestone at Watertown, New York, and was found by Ulrich in the Stones River Group of Tennessee and Kentucky, while Salter found it in the Black River at Pauquettes Rapids, on the Ottawa River.

DESCRIPTION.

Shell larger than *Lophospira subabbreviata*, consisting of four or five sharply angular whorls, the body whorl large and making up about half the height of the shell. The upper surface of the whorl slopes rather steeply from the suture to the periphery, and the lower surface makes an angle of less than 90° with the upper surface. On the body whorl there is below the periphery a second carina, which on some specimens is only faintly indicated. The slit band is faintly shown by one specimen, which is a natural cast of a mould of the exterior. The surface markings are roughly indicated and seem to be the same as those observed in this species when found in other formations.

Locality. — Fairly common at Valcour Island and in the upper beds at Chazy. This species is usually more common than *Lophospira rectistriata*. The figured specimens are in the Yale University Museum.

Lophospira aspera (Billings).

(PLATE LV, FIGURE 2.)

Murchisonia asper Billings, 1859, Canadian Naturalist and Geologist, Vol. IV, p. 458.

This species was well described by Billings, but not figured. Through the kindness of Professor Whiteaves and Dr. Ami, the writer was permitted to study two of the typical specimens and a figure of one of them was made. Billings' description is as follows:

DESCRIPTION.

"Obtusely conical; apical angle about 70°, spire of four or five whorls, the larger whorl large and ventricose, with a prominent band about the middle and a low angular carina at about two-thirds the distance between it and the suture above. The upper whorl small, rapidly tapering to an acute apex, and altogether forming only one-fourth or less, of the whole length. The band on the body whorl of a specimen an inch and a half long is two lines wide, and consists of a central rounded ridge one line wide and an obscurely angular carina on each side. The surface is ornamented with fine sharp lines of growth, about six to eight in the width of one line, which in descending, curve gently backward until they reach the band; below which they curve abruptly forward for about two lines, then become vertical, or nearly so, and again curve backward on approaching the aperture. They are thin, sharp, imbricated and very distinct. The aperture, as exhibited in a single specimen, is nearly circular, the lower part somewhat effuse, the inner lip entire and a little separated from the body whorl.

"In some fragments of other specimens there appears to be a wide but shallow concave band just below the principal band on the body whorl, and below this there is an obscure carina. The main band also varies a little in its proportional width and angularity. Owing to the thickness of the shell the sutures above the body whorl are not deep, and the upper whorls are, in consequence, not ventricose, but still encircled by the band, apparently also with the upper carina. In the cast the whorls are smooth, rounded, ventricose, and exhibit scarcely any trace of either band or carina. In some specimens the shell of the body whorl exhibits some deep, irregular undulations of growth.

"Resembles both *Murchisonia helicteres* Salter and *M. bicincta* Hall, but these species have a distinct carina below the band.

"*Locality.* — Mingan Islands, Canada."

The type is in the Museum of the Geological Survey of Canada.

Lophospira seelyi sp. nov.

(PLATE LV, FIGURE 3.)

A small specimen of a species of *Lophospira* from Isle La Motte, Vermont, differs considerably from all the preceding in its more trochiform shape, the flattened slopes of the spire and the unusual strength of the carina above the principal keel on the body whorl. In many respects it resembles *Lophospira quadrisulcata* Ulrich and Scofield, from the Richmond of Minnesota, but lacks the lowest carina of the body whorl.

DESCRIPTION.

Shell small, trochiform, consisting of about three whorls, the body whorl making up three fourths of the height. Spire rather low, the sides flattened. Body whorl large, angular, rounded below. The principal carina, about the middle of the body whorl, bears a narrow convex slit band. Below the principal carina is a wide, slightly concave space, bordered below by an indistinct carina, below which the shell is convex. On the body whorl, below the suture, there is a narrow concave band bounded below by a strong carina. Below this carina is a wider concave space which extends to the principal carina. On the first concave band below the suture the surface is marked by very coarse striæ which curve gently backward. Below this carina the striæ are very much finer and turn more directly backward to the slit band.[2]

[2] Professor Ulrich, who has examined the type since the above was written, writes me as follows: "This is a close ally of *Lophospira obliqua* Ulrich and Scofield, the differences being (1) that the subsutural keel is a little further removed from the suture in the Chazy species, (2) the band in the latter seems to be less distinctly trilineate though this feature varies somewhat in *L. obliqua*, and (3) the periphery is more prominent, so that in section the outline of the whorls is more sharply angular. *Lophospira bicincta* and *Lophospira helicteres* agree better in these respects with *Lophospira seelyi*, but in both the growth lines are sharper and much more regular, while in *L. helicteres* the later whorls become vagrant. *Lophospira aspera* also must be a close relative."

Height of shell 14 mm., greatest diameter, 11 mm.

Locality.— A very rare shell in the Chazy Limestone on Isle La Motte, Vermont, where it is associated with *Bucania sulcatina*, *Raphistoma stamineum*, *Scenella montrealensis*, *Clisospira bassleri*, and *Clionychia montrealensis*. Named for Professor H. M. Seely, of Middlebury College, to whom, with President Brainerd, we are indebted for our knowledge of the stratigraphy of the Calciferous and Chazy formations. The holotype is in the United States National Museum.

Genus **Hormotoma** Salter.

Hormotoma infrequens (Billings).

(PLATE LV, FIGURE 4.)

Murchisonia infrequens Billings, 1859, Canadian Naturalist and Geologist, Vol. IV, p. 457.

In Billings' article on the "Fossils of the Chazy Limestone" this species was described with other species of gastropods, but it has not been figured. Only one specimen has been found, so our knowledge of the species must be drawn from the type now figured for the first time.

DESCRIPTION.

Shell elongate, slender, consisting of five smooth, flattened whorls. The body whorl is large, making up about half the height. The sutures are wide and deep and the shell thick. The body whorl is somewhat flattened, abruptly deflected in a sort of carina near the lower part of the whorl. The aperture is apparently entire. There is no umbilicus. On the surface of the cast of the second whorl are several impressed revolving lines. The body whorl retains a fragment of the outer shell, but it is devoid of surface markings.

The height of this shell is 25 mm.; the diameter of the body whorl 8 mm.

Locality. — From the upper part of the Chazy at Grand Isle, near Cornwall, Canada.

The type is in the Museum of the Canadian Geological Survey.

Hormotoma sp.

(PLATE XLIX, FIGURE 9.)

While no good specimens of this species have been found, the sections of long shells of the type of *Murchisonia gracilis* Hall are common in outcrops of the Chazy along Lake Champlain south of Crown Point. That it was a high narrow shell consisting of more than seven short, rounded volutions, is all that is now known of this species. Attention is here directed to it merely to note the occurrence of large shells of this genus in the Chazy formation.

The figured specimen shows a section near the outer edge, some distance from the axis. This specimen is in the Carnegie Museum and was obtained at Maclurea Point, about ten miles north of Fort Ticonderoga, New York.

Genus **Eotomaria** Ulrich and Scofield.

Eotomaria obsoleta Raymond.

(PLATE XLIX, FIGURES 12–14.)

Eotomaria obsoletum Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 376.

DESCRIPTION.

Shell small, trochiform, with about four volutions. The spire is conical, the sides of the volutions flat, and the suture only slightly impressed. The lower part of the body whorl is convex, the umbilicus small. The holotype is an internal cast and shows no surface markings. Aperture large, angulated on the side, rounded below.

Another specimen, which probably belongs to the same species, shows a narrow concave band just above the suture on the penultimate whorl and above the periphery of the body whorl. The surface markings of this specimen consist of delicate striæ which cross the upper surface of the whorls in a nearly vertical direction, and turn backward very abruptly close to the slit band.

This species closely resembles *Clathrospira subconica* Hall, a species which ranges from the Stones River to the Loraine and is found from Canada and New York to Tennessee and Minnesota. The cast of *Eotomaria obsoleta*, however, shows a much less deeply impressed suture, the vertical striæ are much coarser and the revolving lines are not present, so that the shell surface is not cancellated. Moreover, the slit band is not vertical, but oblique.

One specimen is 13 mm. high and 14 mm. in diameter at the periphery of the body whorl.

Locality. — The holotype is from the Chazy formation at Crown

Point, New York, and the paratype is from the south end of Valcour Island, New York. Both specimens are in the Carnegie Museum.

Genus **Liospira** Ulrich and Scofield.

Liospira docens (Billings).

Pleurotomaria docens Billings, 1859, Canadian Naturalist and Geologist, Vol. IV, p. 452, figs. 27–29.

Pleurotomaria docens Billings, 1863, Geology Canada, p. 132, fig. 63.

Only one specimen of this shell is now known, and, though quite well preserved, it does not serve to define the characters of the species as fully as might be wished.

The shell has the form, and, according to Billings, the closed umbilicus of *Raphistoma*, but it lacks the sigmoidally curved and interrupted striæ which characterize that genus. It possesses a true slit band, and must therefore be placed in the Pleurotomariidæ.

In the absence of an umbilicus, and in the prolonged, conical shape of the lower portion of the body whorl, the shell differs markedly from the typical species of *Liospira*, yet there is no other genus in the family to which it is more closely allied. The essential part of Billings' description follows.

"Spire nearly flat; base sub-hemispherical; umbilicus closed; whorls about four, with a distinct spiral band all around the outer margin; width, usually a little more than an inch and a half; height about two-thirds of the width.

"On the upper side the whorls in the center are gently convex and elevated, so that the apex is about three lines higher than the outer margin. As the whorls enlarge, they gradually lose the slight convexity which they possess at the center, and become more and more flattened, until at the aperture the last is quite flat or even a little concave. The first whorl is very small, but the others somewhat rapidly enlarge so that at the aperture the last one is full six lines wide, where the whole width is eighteen lines.

"The band forms the outer margin of the upper surface. At the aperture it is one line wide, but it becomes gradually smaller, and at the apex is reduced to a mere line. It is crossed by strong, backward curving striæ, and has a fine elevated line-like ridge on each side.

"On the lower side the whorls are ventricose, and constitute a sub-hemispherical or depressed conical base. At the aperture the outer lip is at right angles to the upper lip or upper surface of the whorl, but this angle decreases as we follow the margin of the whorl backwards toward the apex, at such a rate that, at the commencement of the last whorl, it is not more than 75°.

"The surface is covered with coarse, but only slightly elevated undulations of growth, the width of which is from one-sixth to half a line. Besides these it is striated with fine lines of growth, of which there are about ten or twelve in the width of one line. On the upper surface the striæ and undulations turn backwards at an acute angle from inner to the outer edge of the whorl. On the lower surface they curve forward and then backwards.

"The shell in the spire is thin, but below very thick. When the shell has been totally destroyed, the cast of the interior exhibits an umbilicus one-eighth of the whole width of the spire."

Locality. — In the Chazy Limestone near L'Original, Canada.

Family BELLEROPHONTIDÆ McCoy.

Genus **Bucania** Hall.

Bucania sulcatina (Emmons).

(PLATE XLIX, FIGURES 15–17; PLATE L, FIGURES 3, 4; PLATE LV, FIGURES 13, 14.)

Bellerophon sulcatinus Emmons, 1842, Geology of New York, Report of the Second District, p. 312.

Bucania sulcatina Hall, 1847, Paleontology of New York, Vol. I, p. 32, Pl. 6, figs. 10, 10*a*; Pl. 33, fig. 4*d*.

Bucania rotundata Hall, 1847, Paleontology of New York, Vol. I, p. 33; Pl. 6, figs. 11*a–c*.

Bellerophon sulcatinus Emmons, 1855, American Geology, Vol. I, Pl. 4, fig. 4.

Bucania sulcatina Waagen, 1880, Paleontologica Indica, Series XIII, part 2, p. 131.

Bucania sulcatina Ulrich and Scofield, 1897, Paleontology of Minnesota, Vol. III, part 2, pp. 850, 883.

Bucania champlainensis Whitfield, 1897, Bulletin of the American Museum of Natural History, p. 181, Pl. 4, figs. 14–16.

Bucania champlainensis Raymond, 1902, Bulletin of American Paleontology, Vol. III, No. 14, p. 305, Pl. 18, figs. 7, 8.

A careful study of a large series of the common *Bucanias* of the

Sydney Prentice del.

Gastropods from the Chazy Formation.

Chazy Limestone has forced upon the writer the conviction that the three species heretofore described are all founded on more or less imperfect specimens of the same type.

The first to be described, *Bellerophon sulcatinus* Emmons, was, according to the figure, a large specimen retaining the shell, and showing the characteristic reticulate surface markings and the slit band. Under Emmons' name for this species, Hall figured a characteristic specimen which retained a part of the shell, and then, under the name *Bucania rotundata*, he figured an exfoliated specimen of the same species. This second species was distinguished from the preceding, first, because it was more rotund; second, the inner volutions were less angular; third, the surface was marked only by transverse striæ or lines of growth, with a few stronger wave-like lines; and fourth, there was no indication of a carina or of a depressed line along the back of the shell.

The first two statements are not upheld either by Hall's figures or by the types. The third and fourth characters mentioned can be seen on specimens of *Bucania sulcatina* from which the outer shell has been either partially or entirely split off. When partially exfoliated the shell shows transverse lines parallel to the margin of the lip. (See figure 15, Plate XLIX.)

Bucania champlainensis was described from shells from the upper part of the Chazy formation at Valcour Island. The ordinary specimens in that horizon do not show the surface characters well, as they usually occur in a limy clay that adheres too closely to be removed without destroying fine detail. A few specimens were, however, obtained from a purer layer which lies directly upon the one from which Whitfield's specimens were obtained, and these show exactly the same surface markings as *Bucania sulcatina*. Whitfield distinguished the species *Bucania champlainensis* from *Bucania rotundata* as having more rounded volutions and a very small umbilicus, but an examination of a series of sections shows that both the form of the umbilicus and the angularity of the volutions depends upon the plane of the section and the amount of distortion of the specimens. Therefore, this distinction cannot be relied upon to distinguish species. It would seem then that all these large *Bucanias* must be united under the one species, *Bucania sulcatina* (Emmons), which is the type of Hall's genus, *Bucania*.

This species is especially common at two horizons. One is in the lower part of the formation, where it is accompanied by *Scalites angulatus*, the other is just below the *Camarotœchia plena* beds, where it is accompanied by a variety of fossils, the most prominent of which is *Pliomerops canadensis*. It occurs most commonly as sections upon the rock surface.

DESCRIPTION.

Shell large, coiled in one plane, umbilicated on both surfaces, all the whorls visible. The whorls are broad, somewhat angular at the sides, the last whorl moderately expanded at the mouth. Shell on the whorls thin, but on the lip it becomes very thick and sometimes corrugated. The surface is ornamented by coarse wavy revolving striæ which are crossed by transverse lines of growth.

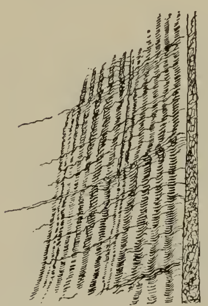


FIG. 5. An enlargement of a portion of the surface of a specimen of *Bucania sulcatina* (Emmons).

These lines turn backward in crossing the middle of the shell and then forward again on either side. Along the center of the shell runs a narrow carina or slit band which is open for a short distance on the last whorl. The lip shows a broad, deep notch on the outer edge, and at the base of this notch is a further prolongation in the shape of a narrow slit. On most specimens this carina is a flat or depressed band, but on a few, especially on young specimens and on the outer whorl of adults, the carina is elevated.

One locality has furnished a number of very small specimens of this species, varying 1.5 to 4 mm. in diameter. These young individuals always show more rotund whorls and a raised carina, but otherwise the same surface markings as the adult. (See figure 14, Pl. LV.) The adults are from 50 to 70 mm. in greatest diameter.

Locality. — Common in the Chazy at Crown Point, Valcour Island, Plattsburgh, and Chazy, New York; and Isle La Motte, Vermont.

Figures 3 and 4, Plate L, and figure 15, Plate XLIX, are from specimens in the Carnegie Museum. Figures 16 and 17, Plate XLIX, and figure 13, Plate LV, are from specimens in the United States National Museum. Figure 14, Plate LV, is from a young specimen in the Carnegie Museum.

Genus **Oxydiscus** Koken.

Oxydiscus catilloides Raymond.

(PLATE LV, FIGURES 9, 10.)

Bucania catilloides Raymond, 1906, Annals Carnegie Museum, Vol. III, p. 576.

DESCRIPTION.

Shell very small, compressed, with two or three whorls which expand gradually. The carina is narrow, but distinct and elevated. The form is much like that of *Oxydiscus acutus* (Sowerby), but the umbilicus is wide enough to expose all whorls. On none of the specimens are the surface markings preserved.

Locality.— A very rare fossil in the Chazy, found only on the west side of Valcour Island where it is associated with *Bucania sulcatina*, *Zygospira acutirostris*, and species of *Phylloporina*.

The type is in the Carnegie Museum.

Genus **Tetranota** Ulrich and Scofield.

Tetranota bidorsata? (Hall).

(PLATE L, FIGURE 5.)

Bucania bidorsata ? Raymond, 1906, Annals Carnegie Museum, Vol. III, part 4, p. 514 *et seq.* (In faunal lists.)

From a layer of decomposed limestone on the south end of Valcour Island, a considerable number of imperfect specimens of a species of *Tetranota* have been obtained. All are casts of the inner whorls, and are not sufficiently well preserved to permit of accurate identification, but they appear to be closely related to *Tetranota bidorsata*.

DESCRIPTION.

Shell small, closely coiled in one plane, umbilicated on both sides. Surface of the cast, which shows only the inner whorls, marked by four keels, two marginal and nearly obsolete, two central and connected by a flat or slightly concave band. The shells show no other surface markings and the form of the aperture is not shown.

These shells may be compared with either *Tetranota bidorsata* (Hall) or *Tetranota obsoleta* Ulrich and Scofield. It differs from the former species in having the revolving keels less strongly developed on the inner whorls, while it differs from *Tetranota obsoleta* in having the slit band of the cast flat instead of distinctly grooved.

Locality.— In the lowest beds of the *Maclurites* division of .the Chazy on Valcour Island, New York. The figured specimen is in the Carnegie Museum.

Family CYRTOLITIDÆ Ulrich and Scofield.

Genus **Trigyra** genus nov.

Trigyra ulrichi sp. nov.

(PLATE L, FIGURE 6.)

Trigyra genus nov. Cyrtolitidæ with two strongly developed medio-lateral carinæ on the body whorl. Type, *Trigyra ulrichi* sp. nov.

This genus is founded to receive a single species, and is based on a small testiferous specimen in the National Museum.

DESCRIPTION.

Shell small, closely coiled in one plane, umbilici rather narrow. Whorls angular at the boundaries of the umbilici, the back of the whorl broadly and gently convex. The body whorl is marked by five sharp revolving keels, two at the boundaries of the umbilici, two in the middle of the back of the whorl, placed about half way between the sharp V-shaped central keel and the keels at the umbilici. According to Dr. Ulrich, who has recently removed the shell from the matrix, the two medio-lateral keels are not developed on the inner whorls.

The surface markings consist of fine lines of growth which sweep gently back from the edges of the umbilici to the central keel. Beside these markings the surface is covered with fine wrinkles transverse to the lines of growth, and minute pits, producing the surface characteristic of the Cyrtolitidæ. This shell has somewhat the general appearance of a *Tetranota*, but differs in its reticulate surface, V-shaped central keel which does not carry a slit band, and in having an odd, rather than an even, number of keels.

Locality. — From the Chazy Limestone on Isle La Motte, Vermont. The holotype is in the United States National Museum.

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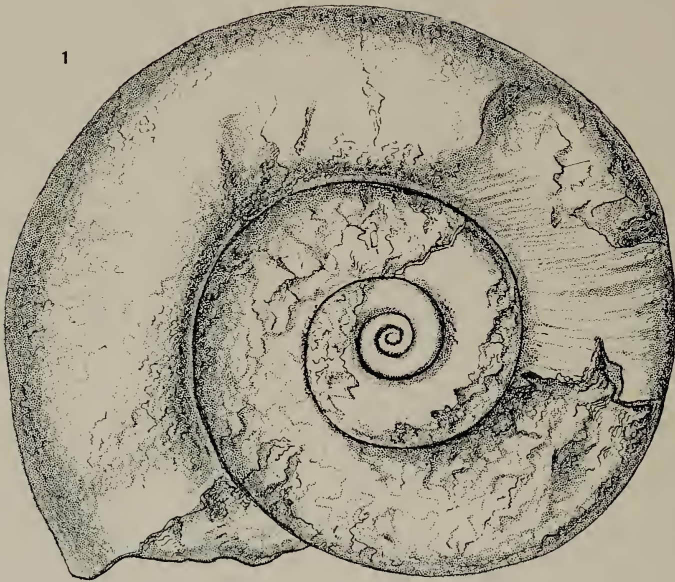

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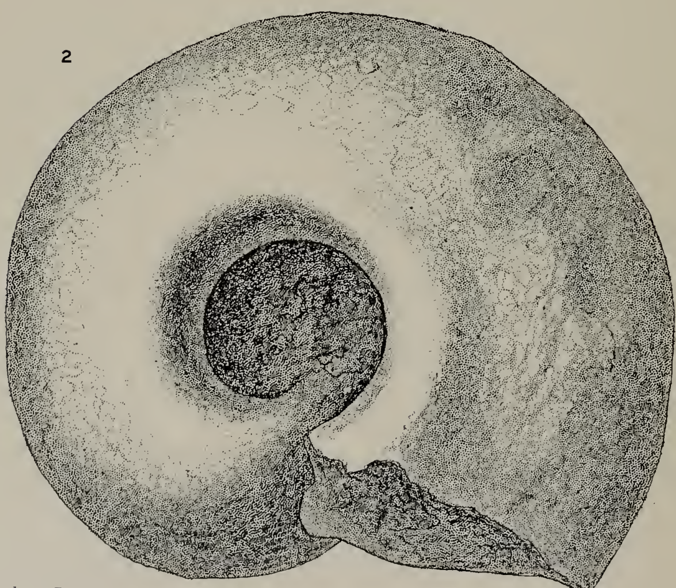

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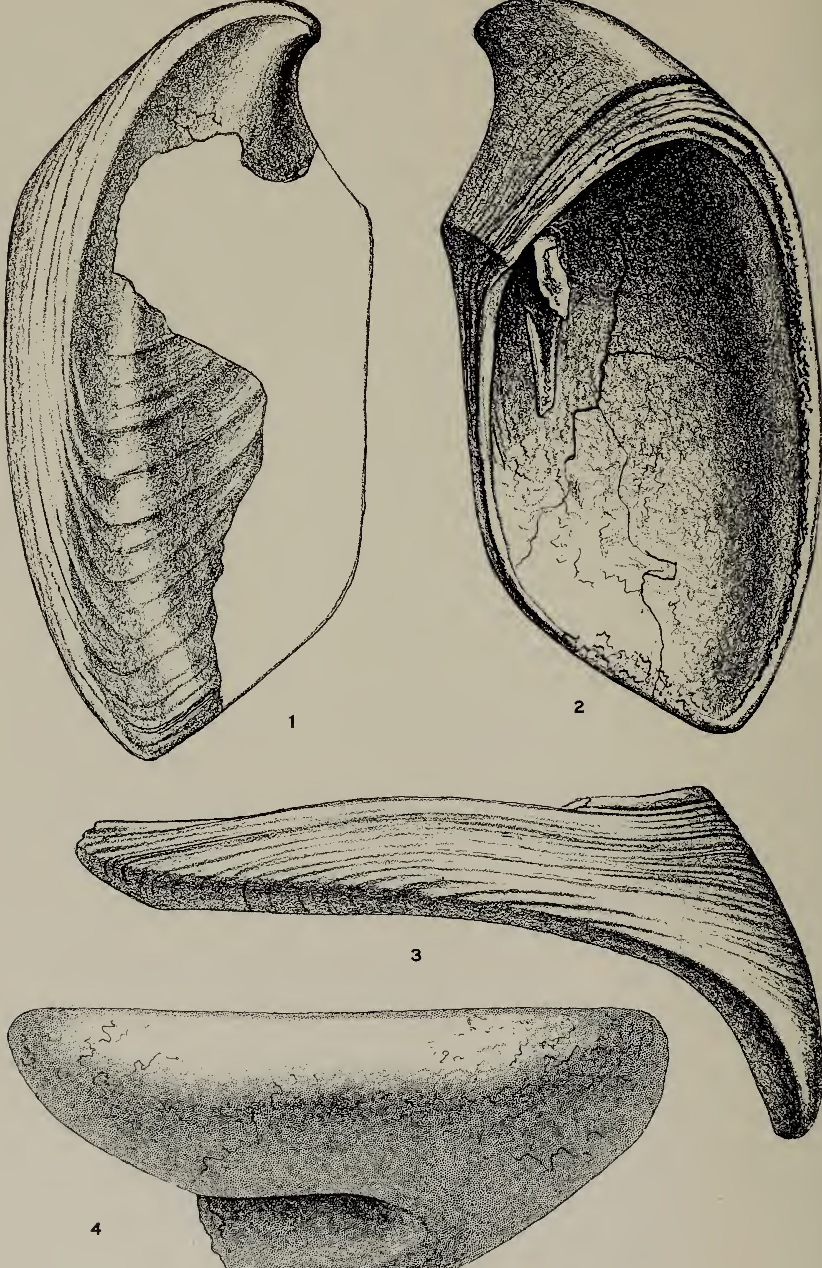
Gastropods from the Chazy Formation.



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Gastropods from the Chazy Formation.

Family EUOMPHALIDÆ de Koninck.

Genus **Maclurites** Lesueur.

Maclurites magnus Lesueur.

(PLATE L, FIGURES 1, 2; PLATE LI; PLATE LII.)

Maclurite magna Lesueur, 1818, Journal of the Academy of Natural Sciences, Philadelphia, Vol. I, p. 312, Pl. 13, figs. 1, 2, 3.

Maclurea magna Emmons, 1842, Final Report of the Second District of New York State Survey, p. 276, fig. 1.

Maclurea magna Hall, 1847, Paleontology of New York, Vol. I, p. 26, Pl. 5, figs. 1*a*–1*d*; Pl. 5*bis*, figs. 1*a*–1*c*.

Straparollus magnus Emmons, 1855, American Geology, p. 156, Pl. 4, fig. 15.

Maclurea magna Raymond, 1902, Bulletin of American Paleontology, Vol. III, p. 305, Pl. 18, fig. 10.

Maclurites magnus Clarke and Ruedemann, 1903, Bulletin of the New York State Museum, No. 65, p. 542.

This species was one of the first of American Paleozoic fossils to be described. It has always been considered the characteristic fossil of the Chazy, and as such has become widely known. It is not, however, by any means as widely distributed as it has been reported to be, and it has constantly been confused with *Maclurites logani* Salter, *Maclurites bigsbyi* Hall, and other species of the younger formations, not so much because of its similarity as because of the familiarity of the name *Maclurea magna*. From this fossil the Chazy has been called the *Maclurea Limestone*. *Maclurites magnus* is a very common fossil in the Chazy from Orwell, Vermont, north to Montreal, but it should be pointed out that the Beekmantown formation contains *more species* and probably as many individuals of this genus as the Chazy, and that the Stones River and Trenton also afford numerous shells of the same genus, with more or less modification of form.

Maclurites magnus is distinguished from *Maclurites logani* by the more gradual increase in the size of the whorls and by the operculum, which is horn-shaped in *Maclurites magnus* and oval in *Maclurites logani*. The various Beekmantown species described by Billings, have in general more numerous and more rounded whorls, although there are exceptions.

The following is Lesueur's description:

"Genus Maclurite.

"Generic Character. Shell discoidal, much depressed, unilocular; spire not elevated, flat; umbilicus very large, with a groove formed by the projection of the preceding whorls, not crenulated.

"Species *M. magna.* Shell obtusely carinated on the exterior upper edge; whorls rapidly increasing in size; aperture on the left, irregularly oval, horizontally depressed above, lips not reflected."

Lesueur's original specimens were from Basin Harbor, Vermont, and subsequently other specimens were obtained by him from Kentucky. The specimens actually described as *Maclurite magna* were undoubtedly from the Chazy formation, as is shown by the figures accompanying the description (Plate 13 of the article cited above).

Hall's description:

"Sinistrorsal, discoidal, depressed turbinate; breadth more than twice as great as the height; spire flat, a slightly depressed line at the sutures; whorls about six, gradually increasing from the apex,

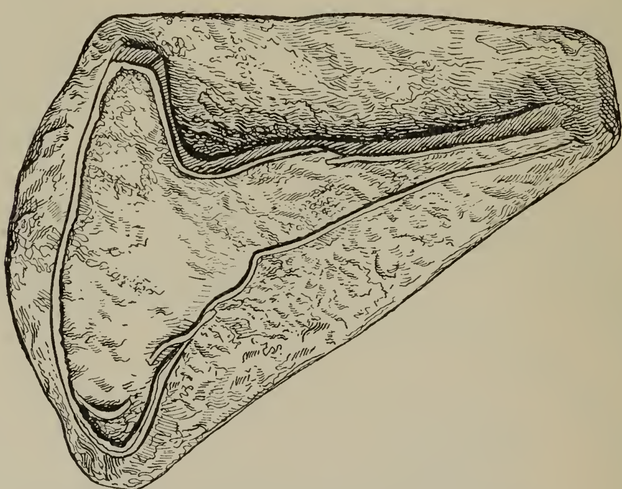


FIG. 6. A natural section of the operculum of *Maclurites magnus* Lesueur. These sections are very frequently seen on the surfaces of the layers in the middle portion of the formation.

ventricose, flattened above, obtusely angular on the outer edge; surface marked by fine striæ, which, upon close examination, are found to be produced by the imbricating edges of lamellæ; striæ undulating, bending backwards from the suture and forward in passing over the edge of the shell; aperture obtusely trigonal, depressed above, slightly expanded beyond the dimensions of the whorl just behind it; axis hollow, umbilicus broad and deep, extending to the top of the spire."

Operculum.— The operculum of *Maclurites magnus* has been referred to by Billings, Ulrich, and others, but does not appear to have been figured. As shown in the figures on Plate LII, the operculum is large, heavy, horn-shaped, with the nucleus twisted to the right. In the inner right hand corner of the operculum is a long process which projects downward into the shell and forms a place for the attachment of muscles. The specimen figured was silicified and was removed from the limestone matrix by etching. The inner side was exposed first, and the drawing for figure 2, Plate LII, was made before etching was complete, but the muscular process was imperfectly preserved. In an attempt to free the shell entirely from the matrix the inner edge of the shell was destroyed so that when figure 1 was made the specimen was imperfect, but the outline is restored from the figure previously made. Viewing the operculum from the outer side, the lines of growth are very prominent and there is a slight depression extending from the nucleus along the left margin to the lower left hand corner. Figure 1, Plate L, shows a view of the exterior of a calcified specimen from Crown Point. On the right the shell has been removed and the depression shown is the opening left by the removal of the basal portion of the muscle-process.

Locality. — This species is common in the Chazy Limestone from Orwell, Vermont, to Montreal, Canada. It occurs also in Eastern Tennessee. The figured specimens are in the Carnegie Museum.

Maclurites atlanticus Billings.

Maclurea atlantica Billings, 1859, Canadian Naturalist and Geologist, Vol. IV, p. 459.

This species was described from specimens obtained at the Mingan Islands and was separated from *Maclurites magnus* by the difference in form of the operculum. No specimens of this species have been found in the region of Lake Champlain. The following is Billings' original description :

"Maclurea atlantica.

"*Description.* — Whorls about four, flat or gently convex on the lower side, ventricose above, and obtusely angulated at the edge of the umbilicus. In a specimen with four whorls the diameter is three inches and seven lines; the width of the last whorl at the aperture, on the flat, lower side, is sixteen lines; at the termination of the third whorl six lines, and of the second whorl three lines. The first whorl occupies about two lines of the diameter in the center. In the same specimens, if on a line drawn from the aperture straight across the shell, the width from the outside of the aperture to the center is two inches and two lines, and from the center to the termination of the line on the posterior side one inch and three lines . . . .

"The operculum found associated with the specimens is elongated, flat or a little concave on one side, moderately convex on the other, curved like a short *Cyrtoceras*, but not in the same plane, — the apical half being gradually turned towards the flat side, so as to constitute a sub-spiral curve."

Genus **Eccyliomphalus** Portlock.

Eccyliomphalus fredericus Raymond.

(PLATE LIII, FIGURES 1–3.)

Eccyliomphalus fredericus Raymond, 1902, Bulletin of American Paleontology, p. 305, Pl. 18, fig. 4.

DESCRIPTION.

"Very loosely coiled, making but one volution; tapering rather abruptly at the apex; test thin, marked by distant lamellose lines of growth; cast rounded, smooth; section nearly circular.

"Diameter of largest specimen 3.5 centimeters; greatest diameter of outer coil, 1 centimeter."

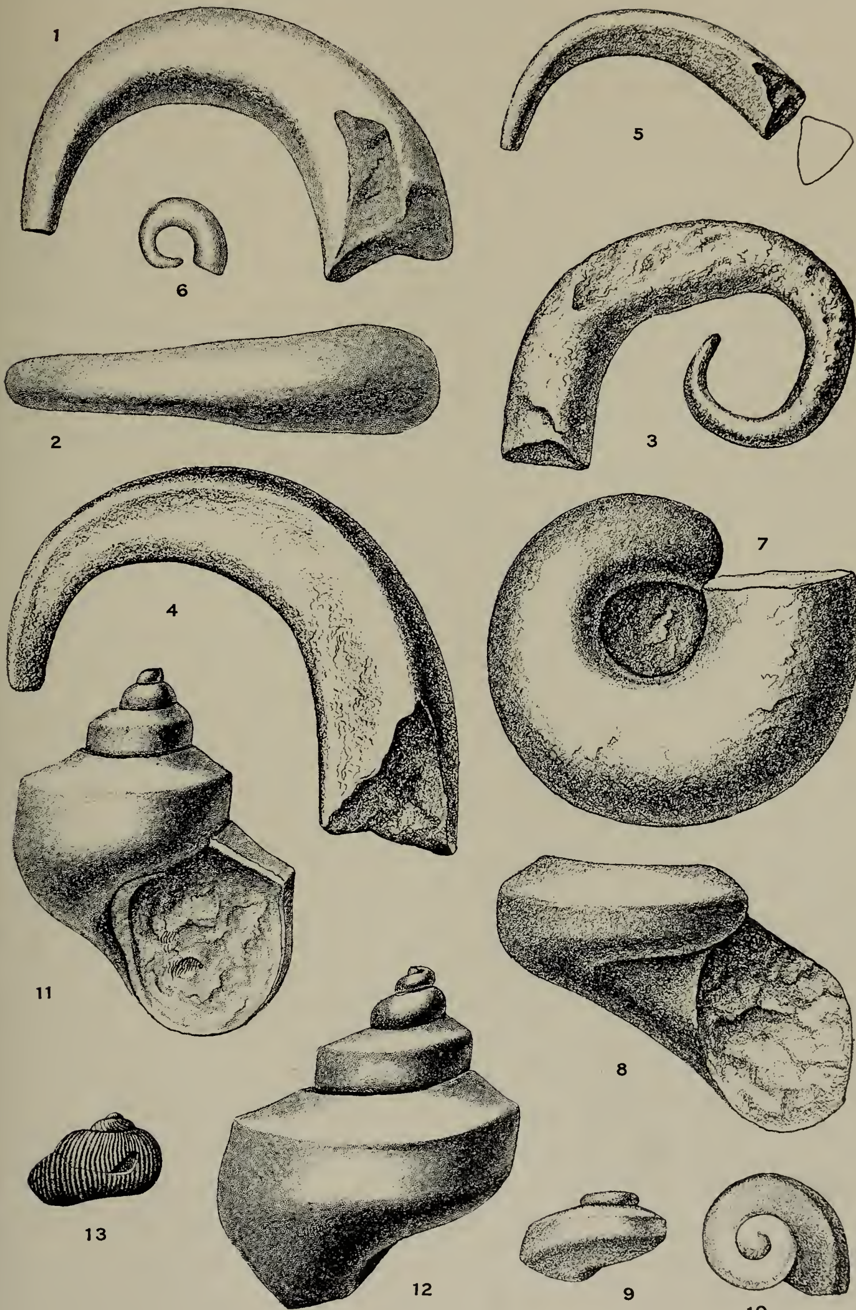
Locality. — This species was described from Crown Point, where it is not uncommon. It occurs also at Valcour and Valcour Island, New York.

The holotype is in the Cornell University Museum. The specimens figured on Plate LIII are from Crown Point and were a part of the series of individuals used in drawing up the original description. They are therefore paratypes. These specimens are now in the Carnegie Museum.

Eccyliomphalus kalmi Raymond.

(PLATE LIII, FIGURE 4.)

Eccyliopterus kalmi Raymond, 1906, Annals of the Carnegie Museum, Vol. III, p. 576.



Sydney Prentice del.

Gastropods from the Chazy Formation.

DESCRIPTION.

Shell small, loosely coiled, apex acute, incurved, but not making a closed volution. The shell is roughly quadrangular in cross-section, flattened on top, sloping outward and downward on the side and obtusely angulated at the lower angle; rounded below and on the inside. The specimen is a cast and does not show any surface markings. This species may be separated from both *Eccyliomphalus fredericus* and *E. proclivis* by its quadrangular cross-section. *Eccyliomphalus fredericus* is circular in cross-section and *Eccyliomphalus proclivis* triangular.

Locality. — A very rare fossil in the Chazy Limestone at Sloop Bay, Valcour Island, New York. Named for the explorer and naturalist, Pehr Kalm, who visited this region in 1749.

The type is in the collection at the Yale University Museum.

Eccyliomphalus proclivis Raymond.

(PLATE LIII, FIGURE 5.)

Eccyliopterus proclivis Raymond, 1906, Annals of the Carnegie Museum, Vol. III, p. 576.

DESCRIPTION.

Shell loosely coiled, apex acute, scarcely incurved. Cross-section of cast triangular. Upper surface flat, the lower side acutely angulated. Both inside and outside are gently convex. The cross-section of this shell easily separates it from either of the preceding species.

Locality. — A very rare fossil in the Chazy at Crown Point, New York.

The type is in the collection of the Carnegie Museum.

Eccyliomphalus sp. ind.

(PLATE LIII, FIGURE 6.)

On the surface of a fragment of sandstone from the basal beds of the Chazy at Valcour Island are three small specimens of a species of *Eccyliomphalus*. The shell is small, nearly circular in cross-section, regularly and evenly coiled, the whorls almost touching. This form is more like *Eccyliomphalus fredericus* than any of the other species, but differs from that shell in its more regular and more closely coiled whorls.

Locality. — In the Chazy Sandstone on the south end of Valcour Island. The figured specimen is in the Carnegie Museum.

Genus **Eccyliopterus** Remele.

Eccyliopterus vagrans Raymond.

(PLATE XLIX, FIGURES 10, 11.)

Helicotoma vagrans Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 376.

This small but characteristic shell occurs only rarely in the Chazy and may readily be identified by the fact that the spire is depressed below the general surface and there is a sharp ridge on the outer angle of the body volution.

DESCRIPTION.

Shell small, the spire flat and depressed below the plane of the highest points on the upper surface. Outer edge of the body whorl angular, raised as a high sharp ridge on the body whorl. Lower surface of shell rounded, the umbilicus very wide, disclosing all the whorls. Section of the body whorl quadrilateral, angular above, rounded below. Surface marked by fine lines of growth which turn back on crossing the angle of the upper surface. This species is related to *Eccyliopterus beloitensis* Ulrich and Scofield.

Locality. — A rare fossil in the Chazy at Valcour Island, New York. The types are in the Carnegie Museum.

Genus **Helicotoma** Salter.

Helicotoma whiteavesiana sp. nov.

(PLATE XLVIII, FIGURES 11, 12.)

In the Aylmer Limestone at Aylmer and at the Hog's Back, near Ottawa, Canada, there occur thousands of casts of a small species of *Helicotoma.* No specimens have been observed which retain any satisfactory surface markings. The shell consists of three flat-topped whorls which expand gradually from the apex. The spire is low and step-like. The lower portion of the body whorl is rounded, the umbilicus rather wide. The periphery of the last whorl has an elevated rounded ridge, beneath which is a slight concavity. One specimen (Plate XLVIII, figure 12) shows the outline of the outer lip. This species resembles *Helicotoma verticalis* Ulrich but differs in being higher in proportion to the width and in having the upper surface of the whorls slightly convex instead of concave.

Locality.— Common in the Aylmer Limestone at Aylmer and at the Hog's Back, near Ottawa, Canada. The type is in the Yale University Museum.

Family TROCHONEMATIDÆ Zittel.

Genus **Trochonema** Salter.

Trochonema biangulatum (Hall).

(PLATE LIII, FIGURES 9, 10.)

Pleurotomaria biangulata Hall, 1847, Paleontology New York, Vol. I, p. 31, Pl. 6, figs. 6*a*, 6*b*.

The type of this species cannot now be located, but there are specimens in the Hall collection in the American Museum of Natural History labeled *Pleurotomaria biangulata* which agree fairly well with the original description and figure and may, perhaps, be accepted as authentic examples of Hall's species. The shells so labeled are small, flattened, with few volutions, and, although they show no surface markings, they apparently belong to the genus *Trochonema*. At Valcour Island this small gastropod occurs sparingly in two or three localities and may be readily separated from all other species of *Trochonema* in the Chazy by its small size, few whorls and small umbilicus. Its nearest ally in the Chazy is *Trochonema dispar*, but it is readily distinguished from that shell by its small umbilicus and its square-shouldered whorls.

DESCRIPTION.

Shell small, with about three whorls which expand gradually. Spire low, raised very little above the body whorl. Body whorl with two carinæ, which are about equally distant from the axis of the shell, thus forming the flattened side of the whorl usually seen in this genus. Upper surface of the whorl slightly convex, often almost flat. Lower surface gently convex. Umbilicus small. All specimens are casts, and show no traces of surface markings. One specimen is 10 mm. in greater diameter and 7 mm. high. The body whorl is 3.5 mm. wide at the aperture. Other specimens are of about the same size, one or two being slightly larger.

Locality. — This species occurs in the Chazy at Valcour Island, New York. The figured specimen is in the Yale University Museum. It is from the south end of Valcour Island.

Trochonema dispar Raymond.

(PLATE LIII, FIGURES 7, 8.)

Trochonema dispar Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 378.

This species is rather rare and is closely related to *Trochonema umbilicatum* Hall. It differs from that species principally in the greater convexity of the under surface of the whorls and the less pronounced angularity of the body whorl.

DESCRIPTION.

Shell rather large, consisting of three whorls with depressed spire and very large body whorl. The suture is very deep and the whorls are almost free. The body whorl has a flat revolving band on the outer side. The top is flat and sloping and the lower side strongly convex. The surface markings are not shown. The umbilicus is large in the cast but rather small in testiferous specimens.

Locality. — Fairly common in the Chazy at the south end of Valcour Island. It is rare elsewhere on Valcour Island and at Chazy, New York.

The type is in the collection of the Carnegie Museum.

Trochonema rectangulare Raymond.

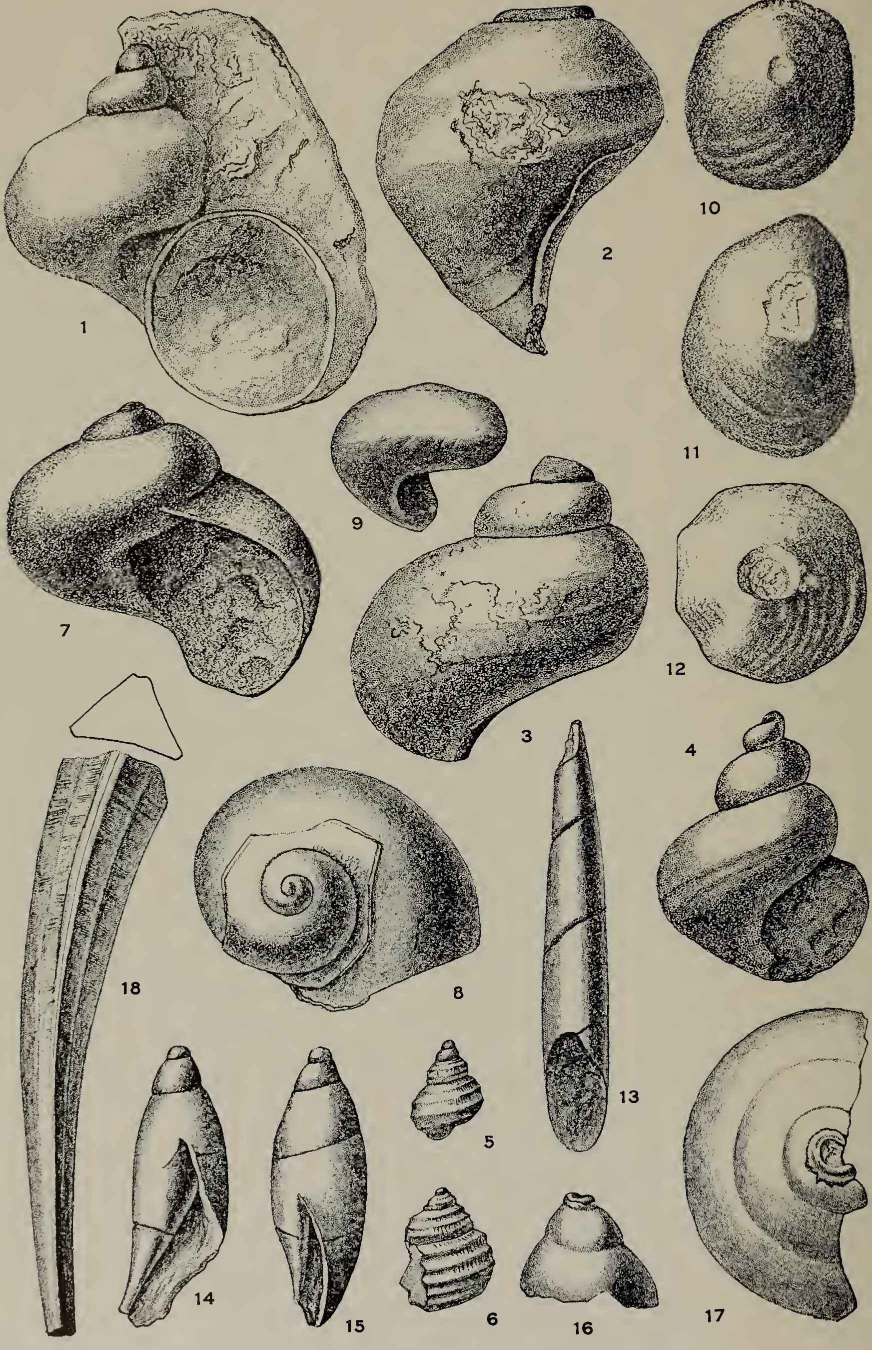
(PLATE LIII, FIGURES 11, 12.)

Lophospira rectangularis Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 377.

Although no surface markings are present in any of the specimens of this species, a fancied resemblance to *Lophospira perangulata* (Hall) led the writer, in the article referred to above, to describe this species under the generic name *Lophospira*. This species somewhat resembles *Trochonema robbinsi* Ulrich and Scofield, and *Trochonema niota* Hall, but can readily be distinguished from both those species by its fewer and more rapidly expanding whorls and the smaller umbilicus. The figures show that it is not similar to any of the other species of *Trochonema* in the Chazy.

DESCRIPTION.

Shell fairly large, with five volutions. Body whorl very large, spire small. The last three whorls have the sides parallel to the axis of the shell. Body whorl with two keels, separated by a flat band, the width



Sydney Prentice del.

Gastropods from the Chazy Formation.

of which increases with the expansion of the shell. Aperture large, nearly circular. The section of the body whorl has its upper side nearly straight, meeting the straight outer side at an obtuse angle. The inner and lower sides of the section are rounded. The umbilicus is very small.

All the specimens in the collection are casts of the interior and do not show anything more than traces of the surface markings.

Locality. — A rare species from the Chazy at Valcour Island, New York.

The type is in the collection of the Carnegie Museum.

Trochonema hudsoni Raymond.

(PLATE LIV, FIGURES 1–3.)

Holopea hudsoni Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 378.

Specimens of this species are usually casts of the interior and in that condition they show the smooth rounded whorls of a *Holopea*, under which genus they were originally described. Certain revolving lines on one of the casts caused Dr. Ulrich to suspect that the shell might be a *Trochonema* of the same type as the *Trochonema obsoletum* described by him from the Trenton of Kentucky. Further search in my collection brought to light a fragment of the body whorl of a testiferous specimen which shows distinctly the flattened peripheral band. The description must therefore be considerably revised.

DESCRIPTION.

Shell *Holopea*-like, with rounded volutions. There are usually four whorls, the body whorl being about three times the height of the spire. A testiferous example shows a wide, flattened peripheral band, above which the whorl is somewhat flattened, and directly above the carina almost concave. Below the band the shell is gently convex. In the cast some specimens show a very slight flattening of the upper side, while in other specimens the cast of the body whorl is regularly rounded, with two or three faint revolving ridges below the center of the whorl. In the casts the whorls of the spire are regularly rounded, and the suture is very deep. The spire of the specimen retaining the shell is broken away. The umbilicus is small, almost closed by the thickening of the inner lip. The aperture is almost circular in outline and the inner lip is free from the body whorl except in the posterior inner side. One specimen is 28 mm. high and 22 mm. in greatest diameter; the spire is 7 mm. high. In the same specimen the transverse diameter of the aperture is 13 mm. and the antero-posterior diameter is 14 mm. A second specimen is 24 mm. in height and 20 mm. in diameter.

Locality. — This species is rather common at Crown Point, Valcour Island, and Chazy, New York. The original of figures 1 and 2, Plate LIV, are in the Yale University Museum, and the original of figure 3 in the Carnegie Museum.

Genus **Eunema** Salter.

Eunema altisulcatum Hudson.

Eunema altisulcatum Hudson, 1905, Report New York State Paleontologist for 1903, p. 291, Pl. 5, fig. 3.

This species is not represented in the collection studied by the writer, and it has been described so recently that the description is not repeated here. The species occurs in the Chazy Limestone at Valcour Island, New York.

Eunema epitome Hudson.

Eunema epitome Hudson, 1905, Report New York State Paleontologist for 1903, p. 290, Pl. 4, figs. 6, 7.

This species, which has been very fully described by Hudson, occurs in the Chazy on Valcour Island, New York.

Genus **Gyronema** Ulrich and Scofield.

Gyronema historicum (Hudson).

(PLATE LIV, FIGURES 5, 6.)

Eunema historicum Hudson, 1905, Report New York State Paleontologist for 1903, p. 288, Pl. 4, fig. 5.

Cyclonema ? normaliana Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 377.

An examination of Hudson's figure and description of *Eunema historicum* has convinced me that *Cyclonema ? normaliana* Raymond was founded on larger and more complete specimens of the same species, with, however, the detail of surface markings less perfectly preserved.

DESCRIPTION.

Shell small, with about four rather flat-sided whorls which expand gradually. Apical whorl smooth, while the succeeding whorls bear four to six revolving ridges. Sutures deeply impressed, the side of the previous whorl meeting the top of the next whorl at a right angle. The lower surface of the body whorl is gently convex; the umbilicus is closed. In addition to the sharp revolving keels, the surface is marked by fine, nearly vertical lines, between which are somewhat deep depressions which do not cross the revolving keels, thus giving the shell a somewhat cancellated appearance.

Locality. — This shell is found near the Normal School at Plattsburgh, New York, and on Valcour Island. The holotype is in the New York State Museum. The plesiotypes are in the Yale Museum.

Gyronema leptonotum Raymond.

(PLATE LV, FIGURE 15.)

Eunema leptonotum Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 378.

DESCRIPTION

Shell small, with about four whorls which expand gradually toward the base. The whorls are all convex, the sutures deeply impressed. The first three whorls are smooth and *Holopea*-like. The fourth, or body whorl, is ornamented by five sharp revolving ridges, equally spaced. These ridges are crossed by fine vertical lines which are close together and give the ridges a flattened appearance. The aperture is not seen. The height of the shell is 5 millimeters; the width at the body whorl 3.5 millimeters.

It is evident that this species is closely allied to *Gyronema historicum* Hudson, but may be readily distinguished from that shell by its somewhat slenderer form and the presence of two or three smooth apical whorls instead of one.

This shell is not uncommon in the Chazy, but on account of its small size and liability to exfoliation it is often overlooked, or is in too imperfect a condition to be positively indentified.

Locality. — Lower Chazy at Chazy, New York.

The type is in the Yale Museum.

Gyronema ? rotalineum Raymond.

(PLATE LIV, FIGURE 4.)

Gyronema ? rotalineum Raymond, 1906, Annals Carnegie Museum, Vol. III, p. 577.

DESCRIPTION.

Shell of medium size for the genus. Whorls five in number, spire acute, volutions rounded. The shell expands gradually from the apex, the body whorl occupying about half, or a little less than half, the total length. All the whorls are robust, nearly circular in section. The suture in the cast is deep. The first three whorls are smooth, but the last two show two or three revolving ridges on the lower side of the whorl, the upper side being smooth. In the middle of the body whorl is a narrow concave band. The aperture was apparently rounded, the columellar lip somewhat excavated. There is no umbilicus. The height of one specimen is 18 mm.; the width of the last whorl, 14 mm.

Locality. — This shell occurs very rarely in the Middle Chazy at Sloop Bay, Valcour Island, New York. The type is in the collection of the Yale University Museum.

Gyronema microclathratum (Hudson).

Holopea microclathrata Hudson, 1905, Report New York State Paleontologist for 1903, p. 294, Pl. 4, figs. 3, 4.

This species, which appears to possess more of the generic characters of *Gyronema* than of *Holopea*, has been very fully described by Hudson in the locality mentioned above. The shell is found in the Chazy, at Valcour Island, New York.

Order *CTENOBRANCHIATA* Schweigger.

Suborder PLATYPODA.

Family SUBULITIDÆ Lindström.

Genus **Subulites** Conrad.

Subulites prolongatus Raymond.

(PLATE LIV, FIGURE 13.)

Subulites prolongatus Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 378.

A single fragmentary specimen from the "Trilobite layers" in Sloop Bay represents a very elongate, conical species of *Subulites* of the type of *Subulites elongatus* Hall, but about the size and shape indicated by the fragments of *Subulites pergracilis* Ulrich and Scofield, illustrated in the "Paleontology of Minnesota," Volume III, part 2, Plate 81. The whorls are, however, longer in our species than in *Subulites pergracilis* and the shell is even slenderer in proportion to the height.

DESCRIPTION.

Shell small, elongate, fusiform, with about six (?) whorls (one specimen shows body whorl and three above). The whorls are long and narrow, decreasing slowly and regularly toward the apex. The body whorl is about equal to the length of the two whorls above it, and is contracted below. The aperture is not shown. The height of the fragment is 29 mm. Probably the total height was about 35 mm.

Locality. — From the Middle Chazy at Sloop Bay, Valcour Island, New York.

The type is in the collection of the Yale University Museum.

Genus **Cyrtospira** Ulrich and Scofield.

Cyrtospira raymondi (Hudson).

(PLATE LIV, FIGURES 14, 15.)

Subulites raymondi Hudson, 1905, Annual Report of New York State Paleontologist for 1903, p. 293, Pl. 4, figs. 1, 2.

This little shell which Hudson described from specimens obtained at Valcour Island occurs also in McCullough's sugar bush at Chazy in the layers with *Sphærocoryphe goodnovi*.

Ulrich and Scofield's genus *Cyrtospira*, which was proposed for species near *Subulites* but differing in the short curved form and large aperture seems well founded, and the present species falls within the limits of that genus. In its double curvature it resembles *Cyrtospira bicurvata* Ulrich and Scofield from the Stones River group, but the spire of the species from the Chazy is higher.

HUDSON'S DESCRIPTION.

"Shell small, fusiform; apical angle about 44°, length of specimen, with apical whorl, or a little more, lost, 9.5 mm. Greatest thickness across axis at middle of shell 3.4 mm. Whorls five or six;

penultimate whorl showing a rapid elongation, body whorl 6 mm. long or considerably longer than the spire.

"Aperture elongate, oblique, narrow, with well formed anterior canal; inner wall of aperture nearly straight; outer lip convex, gradually increasing its distance from the axis for about one-fourth its length, remaining nearly parallel for another fourth and then slightly increasing its convexity to anterior extremity. With the aperture toward the observer, the shell appears slightly angulated at a little above the middle on the right. Turned toward the left through 90°, the right hand outline is more uniformly convex. Suture but slightly impressed. Surface smooth."

Locality. — A rare species in the Chazy, found so far only on Valcour Island and at Chazy, New York.

Family LITTORINIDÆ Gray.

Genus **Holopea** Hall.

Holopea scrutator Raymond.

(PLATE LIV, FIGURES 7, 8.)

Holopea scrutator Raymond, 1905, American Journal of Science, Series 4, Vol. XX, p. 379.

DESCRIPTION.

Shell of medium size, about three whorls, the body whorl constituting by far the larger part of the shell. Spire depressed, sutures not deep. Aperture elongate, oval, entire. Umbilicus small.

The specimens usually occur as casts, but on a few the shell is preserved. It shows no markings except a few growth lines which run diagonally back across the whorl.

When the specimens are exfoliated, the suture lines are much more deeply impressed and the spire appears higher.

This shell is easily recognized by the low spire, the shallowness of the sutures and the general depressed form of the shell.

Locality. — Common in the Chazy at Valcour Island and Chazy, New York. The types are in the Yale Museum.

Holopea harpa (Hudson).

(PLATE LIII, FIGURE 13; PLATE LV, FIGURES 16, 17.)

Straparollina harpa Hudson, 1905, Report New York State Paleontologist for 1903, p. 292, Pl. 5, figs. 4, 5.

Straparollina harpa Raymond, 1906, The Nautilus, Vol. XIX, p. 101, two figures.

This is a rare species and has so far been found only in the typical locality on Valcour Island. Two small specimens from that locality are of unusual interest, as they preserve traces of color markings.

The specimens are very small, the larger being less than one quarter of an inch in diameter. The body color of the shells is a light yellow, which is the prevailing color of the fossils in the particular stratum from which these specimens were taken. Around the top of the body whorl, adjoining the suture, is a narrow, brownish-gray band. Below it is a band of the yellow body color, and then, about the middle of the whorl, another brownish-gray band, more deeply colored than the one on the top of the whorl. Below this principal band is another light yellow band, and adjoining the umbilicus, the color is orange. The yellow color is undoubtedly due to the iron of the decomposed limestone from which the fossils were obtained, but the brown tints may give some hint of the original coloring of the revolving bands.

These are probably the oldest shells on which color markings have been observed, dating, as they do, from Middle Chazy time. The oldest instances of color preservation previously recorded in America are those reported by Professor O. C. Marsh, and Dr. Theodore G. White. Professor Marsh described (Proc. Am. Assoc. Adv. Sci., XVI, p. 326, 1868) certain markings on the shell of a specimen of *Endoceras* (*Cameroceras*) *proteiforme* Hall from the Trenton formation in New York. Dr. White mentions (Trans. N. Y. Acad. Sci., Vol. XV, p. 85, 1896) two specimens of *Holopea symmetrica* Hall from the Black River formation of the Rathbone Brook, N. Y. section, which preserved the original shell material, and one showed the iridescent luster of pearl.

Quite a number of cases of color preservation have been recorded from the Devonian and Carboniferous, but examples from the older formations are exceedingly rare.

The specimen shown on Plate LV, figures 16, 17, has been considerably crushed, which accounts for many of the differences between it and the specimen figured on Plate LIII, figure 13.

For a complete description of this species, see the article by Professor Hudson cited above.

Locality. — The specimens are from the east side of Valcour Island. The original types and the specimen here figured, are all in the Yale University Museum.

Holopea ? plauta Raymond.

(PLATE LIV, FIGURE 9.)

Holopea plauta Raymond, 1906, Annals Carnegie Museum, Vol. III, p. 577.

DESCRIPTION.

Shell small, depressed. Spire scarcely elevated above the level of the body whorl. There are usually two and a half or three volutions, the body whorl expanding very rapidly. Along the outside and at about the middle of the main whorl is a slight ridge, and below this revolving ridge are a series of low broad folds running back into the umbilicus. With this exception the surface is smooth. The aperture is rounded below and rather acute above. The umbilicus is very wide.

This shell in some ways resembles *Holopea scrutator*, but may easily be distinguished from it by the almost total absence of a spire and by the wide umbilicus.

Locality. — A rare shell found in the Chazy on Valcour Island and at Chazy, New York.

The type is in the Carnegie Museum.

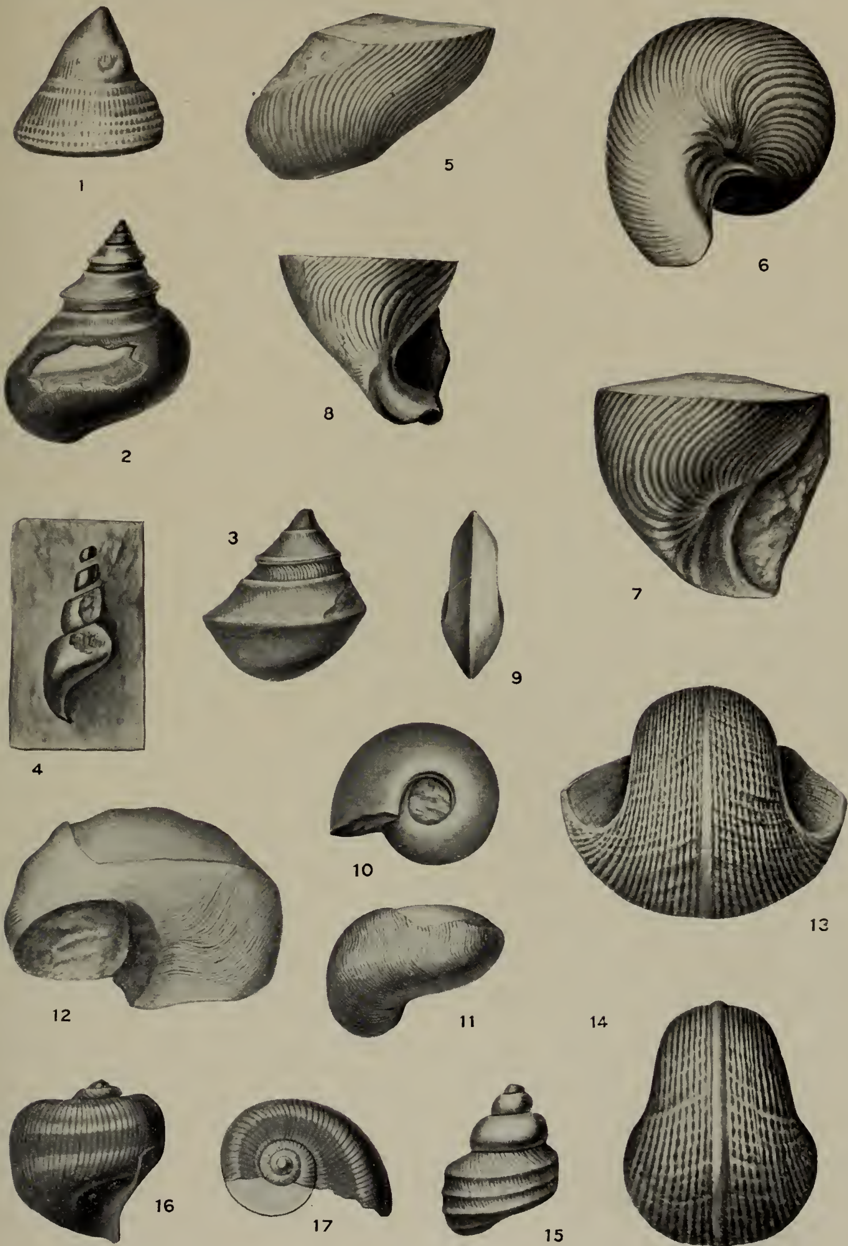
Holopea sp.

(PLATE LV, FIGURES 11, 12.)

Another species of *Holopea* is indicated by two imperfect specimens from Valcour Island. These specimens are somewhat irregular in outline, and the body whorls show corrugations or wrinkles such as are seen in several species of this genus. In neither of the specimens is the spire preserved, but the shell apparently had two or three volutions, which expanded gradually, the body whorl being free for about half a volution. The surface is marked by very fine, wavy, raised lines which have a forward bend on the upper surface of the whorls, turn backward on the periphery and again make a forward-pointing lobe below.

The largest specimen is 9 mm. in greatest diameter, and was probably about 7 mm. high when complete. This species differs from *Holopea scrutator* and *Holopea ? plauta* in the vagrant body whorl.

Locality. — The only specimens so far found are from the Chazy Limestone on the west side of Valcour Island. The figured specimens are in the Carnegie Museum.



Sydney Prentice del.

Gastropods from the Chazy Formation.

Family XENOPHORIDÆ Deshayes.

Genus **Clisospira** Billings.

Clisospira bassleri sp. nov.

(PLATE LIV, FIGURES 16, 17.)

Dr. Ray S. Bassler of the United States National Museum has brought to my attention a small specimen of a species of *Clisospira* from the collection of Chazy fossils in the National Museum. These fossils were collected on Isle La Motte, Vermont, and associated with the *Clisospira* were numerous specimens of *Raphistoma stamineum*, *Scenella montrealensis* and *Bucania sulcatina*.

DESCRIPTION.

Shell small, sinistrally coiled, expanding gradually. Apical angle 70°. Volutions 3½, plump, convex, the last one extending all around, making a large, nearly circular aperture. The shell covers all but the initial whorl, and is thin, smooth, without surface markings. Suture rather deeply impressed. The cast of the initial volution shows that the young shell was loosely coiled, almost in one plane.

This shell is very similar to the two shells described as *Clisospira curiosa* by Billings and to the *Clisospira orientalis* Whitfield from the Trenton of Wisconsin. From the original specimen of *Clisospira curiosa* Billings, our specimen differs in the less expanded aperture, the smaller size and the greater number of whorls. From the second specimen described by Billings under the same specific name, *Clisospira bassleri* differs in lacking the reticulated surface markings. From *Clisospira occidentalis* our species differs in the absence of the indistinct undulations found on that species, the sharper apical angle, and in possessing one more whorl. The holotype is 9 mm. in diameter at the aperture and 7.5 mm. high.

This species differs only slightly from two of the species previously described, yet there are differences, and they should be pointed out. The writer believes that more harm may be done by uniting unlike forms than by a too fine discrimination between closely related ones. The fossils found in the Chazy are usually poorly preserved, and in studying them, it has been the policy of the writer to give new names whenever it was not possible to prove identity with species already described.

Locality. — A rare species in the Chazy on Isle La Motte, Vermont. The holotype is in the United States National Museum.

Suborder CONULARIDA [4] Miller and Gurley.

Family CONULARIIDÆ Walcott.

Genus **Conularia** Miller.

Conularia triangulata Raymond.

(PLATE LIV, FIGURE 18.)

Conularia triangulata Raymond, 1905, American Journal of Science, Vol. XX, p. 379.

A rare fossil in the Chazy is a small, slender *Conularia*, which is almost triangular in cross section. It is not, however, three sided, as it at first appears, but really six-sided, as each of the angles is truncated near the apex so that there are three broad faces and three very narrow ones.

DESCRIPTION.

Shell small, slender, slightly curved, six sided, but three of the sides are so narrow as to give the shell an almost triangular cross section. The narrow faces alternate with the wide ones, the narrow faces truncating the angles which the wide faces would make if prolonged till they met. Along each of the faces, both wide and narrow, is an elevated line which extends longitudinally along the center of the face. The surface markings consist of numerous fine transverse striæ which bend backward on crossing the raised line. The best specimen in the writer's collection is broken at the tip and at the aperture, but, as it stands, is 38 mm. long. The original length was at least 8 mm. more. At the larger end the three wide faces are each 7 mm. wide, and the narrow faces are each 1.5 mm. wide. At the small end the wide faces are 2.5 mm. wide and the narrow faces are reduced to practically nothing, thus showing that in young stages the shell was triangular.

Locality. — The type, which is in the collection of the Carnegie Museum, was found in the upper part of the Chazy on the southeast point of Valcour Island (Cystid Point). This species occurs also near Smuggler's Bay in layers a little lower in the formation.

SPECIES UNRECOGNIZABLE OR BELONGING TO OTHER FORMATIONS.

Euconia amphitrite (Billings).

Pleurotomaria amphitrite Billings, 1865, Paleozoic Fossils of Canada, Vol. I, p. 32.

[4] This suborder is left with the Gastropoda as the classification used in Eastman's translation of Zittel's "Gründzuge" is here followed.

Euconia amphitrite Ulrich and Scofield, 1897, Paleontology of Minnesota, Vol. III, part 2, p. 954.

This species was described by Billings from shells obtained at the Mingan Islands from the "Chazy or Black River." No similar specimens have been found in the Chazy of the Champlain or Ottawa Valleys, but there are four similar species in the Beekmantown, one from the Mingan Islands, one from Newfoundland, and two from Fort Cassin, Vermont. It is very possible that *Euconia amphitrite* is also from the Beekmantown.

Murchisonia ? hermione Billings.

Murchisonia hermione Billings, 1865, Paleozoic Fossils of Canada, Vol. I, p. 33, figs. 34, 35, 35*a*.

From the same locality and formation as *Euconia amphitrite*.

Plethospira hyale (Billings).

Murchisonia hyale Billings, 1865, Paleozoic Fossils of Canada, Vol. I, p. 33.

Plethospira hyale Ulrich and Scofield, 1897, Paleontology of Minnesota, Vol. III, part 2, p. 1009.

This shell was described from one specimen found at Phillipsburgh, Canada, "in beds holding fossils approaching in aspect to those of the Chazy or perhaps Black River Limestone."

Tryblidium eubule (Billings).

Metoptoma eubule Billings, 1865, Paleozoic Fossils of Canada, Vol. I, p. 38.

Tryblidium eubule Whiteaves, 1884, Paleozoic Fossils of Canada, Vol. III, p. 30.

This species also is from Phillipsburgh, probably from the same beds as *Plethospira hyale*.

Platyostoma auriforme (Hall).

Capulus auriformis Hall, 1847, Paleontology of New York, Vol. I, p. 31, Pl. 6, figs. 6*a*, 6*b*.

Stomatia auriformis Emmons, 1855, American Geology, p. 157.

This species was described by Hall as coming from the Chazy Limestone at Galway, Saratoga County, New York. As the Chazy formation does not extend as far south as Galway, it is probable that this is not a Chazy fossil. No specimens of it have been found in the typical region.

Emmons refers it to the Trenton Limestone (*loc. cit.*).

Pleurotomaria antiquata Hall.

Pleurotomaria antiquata Hall, 1847, Paleontology of New York, Vol. I, p. 31, Pl. 7, fig. 1.

No more specimens like the original have been found. The type is in the New York State Museum at Albany.

LIST OF SPECIES OF GASTROPODA DESCRIBED FROM THE CHAZY FORMATION UP TO THE TIME OF THE PUBLICATION OF THE PRESENT PAPER. SYNONYMS AND DOUBTFUL SPECIES IN ITALICS.

Archinacella deformata (Hall).
Archinacella propria Raymond.
Bellerophon sulcatinus Emmons (Bucania sulcatina).
Bucania catilloides Raymond (Oxydiscus catilloides).
Bucania champlainensis Whitfield (Bucania sulcatina).
Bucania rotundata Hall (Bucania sulcatina).
Bucania sulcatina (Emmons).
Capulus auriformis Hall (*Platyostoma auriforme*).
Clisospira bassleri Raymond.
Conularia triangulata Raymond.
Cyclonema ? normaliana Raymond (Gyronema historicum).
Cyrtospira raymondi (Hudson).
Eccyliomphalus fredericus Raymond.
Eccyliomphalus kalmi Raymond.
Eccliomphalus proclivis Raymond.
Eccyliopterus kalmi Raymond (Eccyliomphalus kalmi).
Eccyliopterus proclivis Raymond (Eccyliomphalus proclivis).
Eccyliopterus vagrans Raymond.
Eotomaria obsoleta Raymond.
Euconia amphitrite (Billings). Probably not Chazy.
Eunema altisulcatum Hudson.
Eunema epitome Hudson.
Eunema historicum Hudson (Gyronema historicum).
Eunema leptonotum Raymond (Gyronema leptonotum).

Gyronema historicum (Hudson).
Gyronema leptonotum Raymond.
Gyronema microclathratum (Hudson).
Gyronema rotalineum Raymond.
Helicotoma vagrans Raymond (Eccyliopterus vagrans).
Helicotoma whiteavesiana Raymond.
Holopea harpa (Hudson).
Holopea hudsoni Raymond (Trochonema hudsoni).
Holopea microclathrata Hudson (Gyronema microclathratum).
Holopea? plauta Raymond.
Holopea scrutator Raymond.
Hormotoma infrequens (Billings).
Liospira docens (Billings).
Lophospira aspera (Billings).
Lophospira billingsi Raymond.
Lophospira perangulata (Hall).
Lophospira rectangularis Raymond (Trochonema rectangulare).
Lophospira rectistriata Raymond.
Lophospira seelyi Raymond.
Lophospira subabbreviata (d'Orbigny). Name to be dropped.
Maclurea atlantica Billings (Maclurites atlanticus).
Maclurea magna Emmons (Maclurites magnus).
Maclurea striata Emmons (Raphistoma striatum).
Maclurites atlanticus Billings.
Maclurites magnus Lesueur.
Metoptoma ? dubia Hall (Archinacella deformata).
Metoptoma eubule Billings (Triblidium eubule).
Metoptoma montrealensis Billings (Scenella montrealensis).
Murchisonia abbreviata Hall (*Lophospira subabbreviata*).
Murchisonia asper Billings (Lophospira aspera).
Murchisonia decurta Hall (*Lophospira subabbreviata*).
Murchisonia ? hermione Billings. Probably not Chazy.
Murchisonia hyale Billings (Plethospira hyale).
Murchisonia infrequens Billings (Hormotoma infrequens).
Murchisonia perangulata Hall (Lophospira perangulata).
Murchisonia subabbreviata d'Orbigny (*Lophospira subabbreviata*).
Orbicula ? deformata Hall (Archinacella deformata).
Oxydiscus catilloides Raymond.
Palæacmæa? irregularis Raymond.

Platyostoma auriforme (Hall). Probably not Chazy.
Plethospira hyale (Billings). Probably not Chazy.
Pleurotomaria amphytrite Billings (Euconia amphytrite).
Pleurotomaria antiquata Hall. Not recognizable.
Pleurotomaria biangulata Hall (Trochonema biangulatum).
Pleurotomaria calyx Billings (Raphistoma stamineum).
Pleurotomaria crevieri Billings (Raphistoma stamineum).
Pleurotomaria docens Billings (Liospira docens).
Pleurotomaria immatura Billings (Raphistoma immaturum).
Pleurotomaria pauper Billings (Raphistoma stamineum).
Raphistoma immaturum (Billings).
Raphistoma planistria Hall (Raphistoma stamineum).
Raphistoma planistria parva Hall (Raphistoma stamineum).
Raphistoma stamineum Hall.
Raphistoma striatum (Emmons).
Raphistomina undulata Raymond.
Scalites angulatus Emmons.
Scalites planistria Emmons (Raphistoma stamineum).
Scalites staminea Emmons (Raphistoma stamineum).
Scalites striata Emmons (Raphistoma striatum).
Scenella montrealensis (Billings).
Scenella pretensa Raymond.
Scenella robusta Raymond.
Stenotheca dubia Whitfield and Hovey (Archinacella deformata).
Stomatia auriformis Emmons (Platyostoma auriforme).
Straparollina harpa Hudson (Holopea harpa).
Straparollus magnus Emmons (Maclurites magnus).
Subulites prolongatus Raymond.
Subulites raymondi Hudson (Cyrtospira raymondi).
Tetranota bidorsata? Hall.
Trigyra ulrichi Raymond.
Trochonema biangulatum (Hall).
Trochonema dispar Raymond.
Trochonema hudsoni Raymond.
Trochonema rectangulare Raymond.
Tryblidium eubule (Billings). Probably not Chazy.

EXPLANATION OF PLATES.

PLATE XLVI.

1. *Archinacella deformata* (Hall). A specimen from Valcour Island, enlarged four diameters.

2. Side view of the same specimen, with same magnification.

3. The same species. A specimen from Aylmer, Canada, to compare with figure 2. Enlarged two diameters.

4. The same species. A specimen from Crown Point, N. Y., enlarged two diameters.

5. The same species. A specimen which is partially buried in matrix, four times natural size. Valcour Island, New York.

6. Another view of the same specimen.

7, 8. *Archinacella? propria* Raymond. Top and side views. Enlarged four diameters. Chazy, New York.

9, 10. *Scenella montrealensis* (Billings). Side and apical views of a specimen from Chazy, New York. Four times natural size.

11, 12, 13. *Scenella pretensa* Raymond. Three views of a specimen from Lenoirs, Tennessee. Enlarged four diameters.

PLATE XLVII.

1. *Scenella robusta* Raymond. Top view of the typical specimen. Twice the natural size. Valcour Island, New York.

2, 3. The same species. Top and side views of a specimen from Lenoirs, Tennessee. Twice natural size.

4. *Raphistoma striatum* (Emmons). Side view, showing thickened inner lip. Aylmer, Canada. Twice natural size.

5. Another view of the same specimen, showing form of outer lip, and surface markings. Twice natural size.

6. Same specimen viewed from below, to show the form of the lip. Twice natural size.

7, 8. *Raphistoma striatum* (Emmons). Top and bottom views of a cast of a specimen from King's Bay, Cooperville, New York. Natural size.

9, 10. The same species. Top and bottom views of a cast collected at Aylmer, Canada, to be compared with figures 7 and 8. Natural size.

11. *Raphistoma stamineum* Hall. Side view of the inner whorls of a specimen from Chazy, New York, showing the flat striæ of a small shell. Twice natural size.

12. The same species. Top view of a specimen from Chazy, New York. Notice the slender whorls, as compared with those of *Raphistoma striatum*. Natural size.

13. The same species. A small specimen enlarged four diameters, to show the way in which the striæ are sometimes gathered into fascicles. Valcour Island, New York.

PLATE XLVIII.

1. *Raphistoma stamineum* Hall. View of the spire of a small specimen from Valcour Island. Enlarged four diameters.

2. The same species. Bottom view of a specimen from Chazy, New York, to show absence of umbilicus in a testiferous specimen. Twice natural size.

3. The same species. Bottom view of an exfoliated specimen, showing umbilicus. Natural size.

4. The same species. Enlargement of a part of the surface of an adult specimen, to show the interruption of the striæ on the top of the whorl. Four times natural size.

5, 6. Top and side view of a specimen which appears to be the same species. Twice natural size. Lenoirs, Tennessee. For further illustrations of *Raphistoma stamineum*, see plate LV.

7. *Raphistomina undulata* Raymond. View of the spire of a specimen from Valcour Island, New York. Twice natural size.

8, 9, 10. The same species. Top, side, and bottom views of a specimen from the same locality as the last. Enlarged two diameters.

11, 12. *Helicotoma whiteavesiana* Raymond. Top and side of a specimen from the "Hog Back," near Ottawa, Canada. Twice natural size.

13. *Scalites angulatus* Emmons. A fragment showing the depression just beneath the shoulder of the whorl. Natural size.

14. The same species. A specimen from Plattsburgh, New York, which shows the inner lip well. The outer lip is somewhat crushed and deformed. Natural size.

15, 16. The same species. The natural sections on the rock surface. They show the high spire and the shoulder of these shells. Natural size. Plattsburgh, New York.

PLATE XLIX.

1. *Lophospira billingsi* Raymond. Side view of a specimen from Aylmer, Canada. Natural size.

2. The same species. Another specimen lacking the spire, but with a less distorted body whorl. Natural size.

3, 4. *Lophospira rectistriata* Raymond. Side views of two specimens from Chazy, New York. Twice natural size.

5. The same species. Side view of the body whorl of a specimen from Chazy, New York, showing course of the surface markings. Enlarged two diameters.

6. The same species. Side view of the body whorl of another specimen. Twice natural size.

7, 8. *Lophospira perangulata* (Hall). Two casts, each lacking the apical whorl. Enlarged two diameters. Valcour Island, New York.

9. *Hormotoma* species ind. A fragmentary specimen on a piece of the matrix. Natural size. From Maclurea Point, New York.

10. *Eccyliopterus vagrans* Raymond. Lower side of a specimen from Valcour Island, New York. Twice natural size.

11. The same species A smaller specimen, viewed from above. Twice natural size. Valcour Island, New York.

12. *Eotomaria obsoleta* Raymond. Internal cast of a specimen from Crown Point, New York. Twice natural size.

13, 14. The same species. Top and side views of the paratype, from Valcour Island, New York. Twice natural size.

15. *Bucania sulcatina* (Emmons). A partially exfoliated specimen, showing the lines of growth. Natural size. Crown Point, New York.

16. The same species. A specimen from Isle La Motte, Vermont, showing the form of the aperture. Natural size.

17. The same species. Side view of a specimen from Isle La Motte, Vermont. Natural size.

For specimens of this species showing surface markings, see plate LV.

PLATE L.

1. *Maclurites magnus* Lesueur. The outer view of a partially exfoliated operculum. Crown Point, New York. Natural size.

2. The same species. Cast of a specimen from Lenoirs, Tennessee. Natural size.

3. *Bucania sulcatina* (Emmons). Side view of a partially exfoliated specimen, showing the lines of growth only. Natural size.

4. The same species. Aperture of another specimen from Crown Point, New York. Natural size.

5. *Tetranota bidorsata ?* (Hall). Internal cast of a small specimen from Valcour Island, New York. Twice natural size.

6. *Trigyra ulrichi* Raymond. A testiferous specimen from Isle La Motte, Vermont. The very minute pits on the surface could not be brought out by this process. Twice natural size.

7. Operculum of an unknown gastropod. Valcour Island, New York. Natural size.

PLATE LI.

1, 2. *Maclurites magnus* Lesueur. Top and bottom views of a specimen from Valcour Island, New York. Natural size.

PLATE LII.

1, 2, 3. *Maclurites magnus* Lesueur. Outer, inner, and side views of the operculum. Natural size. Valcour Island, New York.

4. The same species. Side view of the specimen figured on the previous plate.

PLATE LIII.

1, 2. *Eccyliomphalus fredericus* Raymond. Two views of a specimen from Crown Point, New York. Twice natural size.

3. The same species. A somewhat distorted specimen from Crown Point, New York. Twice natural size.

4. *Eccyliomphalus kalmi* Raymond. Upper side of a specimen from Valcour Island, New York. Enlarged four diameters.

5. *Eccyliomphalus proclivis* Raymond. Lower side of a specimen from Crown Point, New York. Twice natural size.

6. *Eccyliomphalus* sp. ind. Enlarged four diameters. Valcour Island, New York.

7, 8. *Trochonema dispar* Raymond. Bottom and side views of a specimen lacking the spire. Twice natural size. Valcour Island, New York.

9, 10. *Trochonema biangulatum* (Hall). Side and top views of a specimen from Valcour Island, New York. Twice natural size.

11, 12. *Trochonema rectangulare* Raymond. Two views of a specimen from Valcour Island, New York. Twice natural size.

13. *Holopea harpa* (Hudson). Four times natural size. Valcour Island, New York. (After Hudson.)

PLATE LIV.

1. *Trochonema hudsoni* Raymond. A cast, partially buried in the matrix. Twice natural size. Valcour Island, New York.

2. The same species. The body whorl of a testiferous specimen from Chazy, New York. Twice natural size.

3. The same species. Another cast from Valcour Island. Twice natural size.

4. *Gyronema rotalineum* Raymond. A cast from Valcour Island, New York. Twice natural size.

5. *Gyronema historicum* (Hudson). A specimen from Plattsburgh, New York. Type of *Cyclonema ? normalianum* Raymond. Twice natural size.

6. The same species. A figure of the type, after Hudson. Four times natural size.

7. *Holopea scrutator* Raymond. A cast from Valcour Island, New York. The inner lip is obscured by matrix. Twice natural size.

8. The same species. Top view of a specimen retaining a part of the shell. Valcour Island, New York. Twice natural size.

9. *Holopea ? plauta* Raymond. A specimen from Chazy, New York. Twice natural size.

10. *Palæacmæa irregularis* Raymond. A small specimen from Chazy, New York. Four times natural size.

11. The same species. A larger specimen, showing a trace of the suture. Twice natural size. Chazy, New York.

12. The same species. A specimen with broken apex. Natural size. Chazy, New York.

13. *Subulites prolongatus* Raymond. Valcour Island, New York. Twice natural size.

14, 15. *Cyrtospira raymondi* (Hudson). Two views of the type. After Hudson. Four times natural size.

16. *Clisospira bassleri* Raymond. Side view of a specimen from Isle La Motte, Vermont. Twice natural size.

17. The same species. Apical view of the same specimen shown in figure 16. Four times natural size.

18. *Conularia triangularis* Raymond. The type, and diagram of section. Valcour Island, New York. Twice natural size.

PLATE LV.

1. *Scenella montrealensis* (Billings). A specimen from Isle La Motte, Vermont, showing surface markings. Twice natural size.

2. *Lophospira aspera* (Billings). One of the types, from the Mingan Islands, Canada. Natural size.

3. *Lophospira seelyi* Raymond. A specimen from Isle La Motte, Vermont. Twice natural size.

4. *Hormotoma infrequens* (Billings). The typical specimen, on a piece of the matrix. Natural size.

5, 6, 7. *Raphistoma stamineum* Hall. Side and bottom views of a specimen from Isle La Motte, to show form of lips and surface markings of an adult. Natural size.

8. The same species. Side view, to show excavated columella. Natural size. Isle La Motte, Vermont.

9, 10. *Oxydiscus catilloides* Raymond. Back and side views of the type. Enlarged six diameters. Valcour Island, New York.

11. *Holopea* sp. ind. The side of a specimen, to show surface markings. Enlarged six diameters.

12. The same species. A larger specimen, viewed from above. The spire is broken off. Enlarged six diameters. Valcour Island, New York.

13. *Buccania sulcatina* (Emmons). A specimen from Isle La Motte, Vermont. Twice natural size.

14. The same species. A very young individual from Valcour Island, New York. Six times natural size.

15. *Gyronema leptonotum* Raymond. A specimen from Chazy, New York. Six times natural size.

16, 17. *Holopea harpa* (Hudson). A somewhat distorted specimen, showing color markings. Six times natural size. Valcour Island, New York.

X. A FURTHER OCCURRENCE OF WYNNEA AMERICANA IN PENNSYLVANIA.

By Otto E. Jennings.

(Plate LVI.)

The rare fungus, *Wynnea americana*, was first described by Thaxter in 1905[1] from specimens collected by himself, in 1888, at Burbank, Tennessee, and at the same place and on the North Carolina mountains at Cranberry, in 1896. A specimen is also mentioned collected by Mr. E. Wilkinson at Mansfield, Ohio.

In September, 1906, Mrs. Jennings and myself found a few specimens of this species at Ohio Pyle, Fayette County, in southern Pennsylvania, as noted and described by Sumstine in the Journal of Mycology.[2] In early September, 1907, Mrs. Jennings and myself found the fungus growing quite abundantly along the lower slopes of the deep wooded valley of Meadow Run, four miles south of Ohio Pyle, and on September 8, 1907, a few specimens were found by Dr. T. D. Davis, Prof. D. R. Sumstine, and the writer on the estate of Mr. James R. Mellon, on the Laurel Hill Mountains of northeastern Westmoreland County, near New Florence.

The Ohio Pyle and New Florence specimens were both found in shaded soil derived from sandstone formations rich in humus, and in both places were near the bottom of the slope where the soil is constantly moist. The aërial portion of the fungus, resembling a rabbit's ear, varied from a purplish red, when young, to a dark velvety brown, when old. The underground portion consisted of a very irregularly lobed, tuber-like body, always comparatively large and much heavier than the aërial portion. This tuber-like sclerotium was tough and cartilaginous and usually presented the appearance of a perennial

[1] Thaxter, Roland. A New Species of *Wynnea*. Contr. Crypt. Lab. Harvard Univ. LX. Bot. Gaz. 39 : 241–247. April, 1905.

[2] Sumstine, D. R. Note on *Wynnea americana*. Jour. Mycol. 12 : 59. March, 1906.

Wynnea americana Thaxter. One-half natural size. Photographed by O. E. Jennings.

growth, many parts of the tuber showing old shells or husks, which were evidently the remains of former protuberances.

The accompanying photograph, taken by the writer at Ohio Pyle, Pa., Sept. 1, 1907, shows the appearance of the species when just dug out of the earth. The photograph shows the specimens one-half natural size.

Carnegie Museum,
November 20, 1907.

XI. A PRELIMINARY ACCOUNT OF THE PLEISTOCENE FAUNA DISCOVERED IN A CAVE OPENED AT FRANKSTOWN, PENNSYLVANIA, IN APRIL AND MAY, 1907.[1]

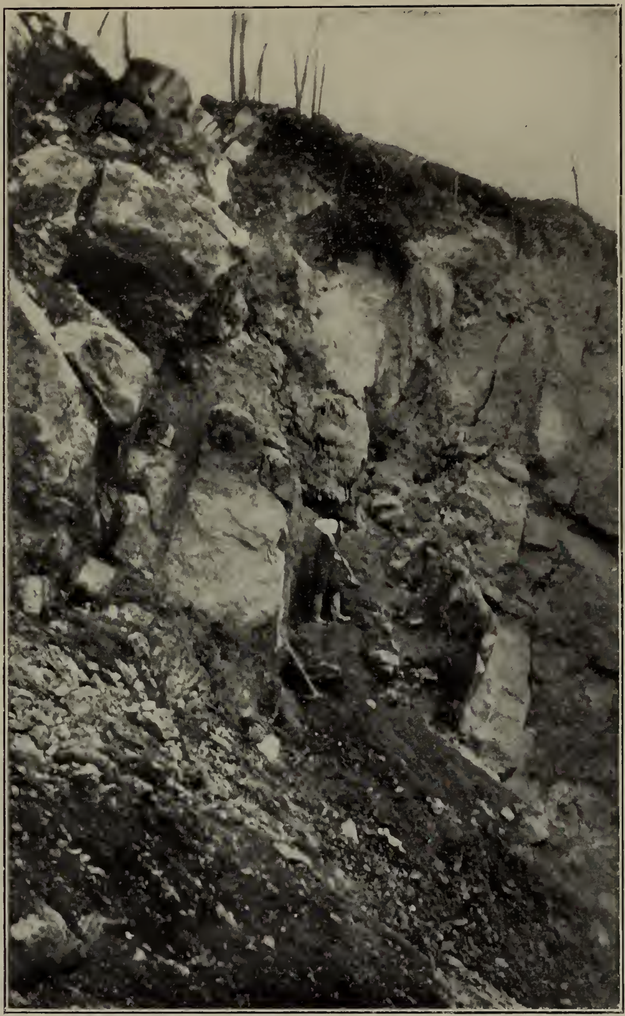
By W. J. Holland.

(Plates LVII–LVIII.)

In the latter part of April of the present year the writer received messages from Mr. H. H. Jack and Mr. E. H. L. Page of Hollidaysburg, Pa., calling attention to the fact that there had been discovered in the quarries of the American Lime and Stone Company near Frankstown, Pa., the fossil remains of a number of large animals, and suggesting that a careful examination of the locality should be made. Mr. O. A. Peterson of the Section of Paleontology in the Carnegie Museum was promptly dispatched to the spot with instructions to report upon the character of the deposits. He returned after a few days bringing with him some material of sufficient interest to cause the writer to feel justified in requesting him to return to the locality and to carefully continue the work of recovering whatever might be found. He spent nearly three weeks in the work, being visited during that time by the writer, who made a careful inspection of the site and helped a little in the task of recovering specimens. A great deal of assistance was accorded to Mr. Peterson by Mr. James King Henry, the Superintendent of the American Lime and Stone Company, who not only instructed his men while at work to help Mr. Peterson so far as was possible, but himself with great kindness at times personally aided Mr. Peterson in the laborious task of taking up the deposits which were encountered.

The quarries of the American Lime and Stone Company are situated on the top of a hill rising about four hundred feet in height above the banks of the Juniata. The kilns of the Lime and Stone Company are located in the historic hamlet of Frankstown, in Blair County, on the line of the Petersburgh branch of the Pennsylvania Railroad. The limestone in which work is being carried on, is a fine compact blue

[1] Paper read at the Seventh International Zoölogical Congress, held in Boston, August, 1907.



View of the eastern end of the cave after its north and south walls had been removed in great part together with the top. Mr. Peterson is seen standing by the remnant of the north wall. Above him may be seen stalagmites pendant from the rocks.

limestone, the purity of which has caused the product of the quarries to be much sought after by manufacturers of paper. The rock has been extensively faulted, and the fissures, which vary in thickness from a few millimeters to as much as a foot in diameter, have been filled with calcite. The rock is lower Devonian, locally known as Lewistown limestone. The hill, in which the cavern is located, con-

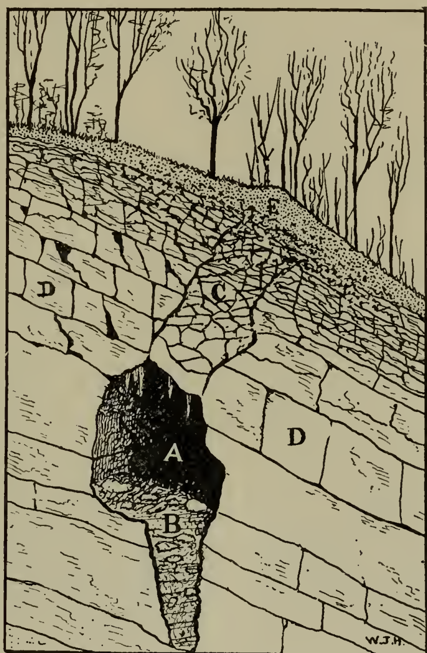


FIG. 1. Diagrammatic section of the cave before its walls were removed in the process of blasting and excavation. A. Open chamber. B. Space filled with earth and stones in which bones were found. C. Fissure closed with rocks. D. Limestone strata dipping to the south. E. Soil bearing forest growths.

tains several small caves, or grottoes, the floors of two of which were explored by Mr. Peterson, but neither of them showed any evidence of extinct animal life. The cave in the limestone quarry was apparently originally a cleft or fissure, which, owing to falling in of the upper strata, had gradually become roofed over by large blocks, which had been in part cemented together by stalactitic deposits with which earthy matter washed down from the surface had become mingled.

No evidence existed on the top of the hill of an approach to this cave, and it was only as the process of blasting was being carried forward that its existence was revealed. The cave itself, as nearly as can be determined, was about forty feet in length, averaging from six to eight feet in width, and at the highest point was not more than ten or twelve feet high. Its floor was about thirty feet below the top of the hill. The bottom of the cave was filled in at most places to a depth of approximately two feet with red soil traversed everywhere by bands and layers of dark material rich in organic matter and somewhat spongy in texture. A deeper crack at one point descends to a depth of about fourteen feet. This it was impossible to explore at the time, but borings made by Mr. Henry after our visit, yielded no bones. Mingled with the finer deposits were fragments of stalactites and pieces of stone, which had fallen from the roof and sides of the cave, varying from large blocks several feet in diameter to mere chips. These angular fragments were so commingled with the finer material as to make the work of recovering the bones which lay at the bottom of the cave a task of much difficulty. The fall of rock in past ages had led to the fracture of many of the bones, which had been crushed down into the looser material in which they were imbedded.

As the work of quarrying went forward from time to time portions of the floor of the cave were brought down. Mr. Peterson was always on hand to investigate, and from the stuff, which was dislodged, he carefully extracted everything which could be preserved, and he also went forward into the cavern and endeavored to explore the floor before the blasting and quarrying were advanced. Rains were constant, and Mr. Peterson worked most of the time in mud. As the result of his labors, upon which he deserves to be congratulated, there were brought back to the Carnegie Museum a great number of specimens, mostly in a broken and shattered condition, due to no fault of the collector.

A superficial examination of the collections taken from the cave shows the remains of a number of species of mammals, birds, and reptiles.

The genus *Megalonyx* is represented by a number of teeth; to what species they should be referred has not yet been determined. It is possible that another genus of *Edentata* is represented, but this can only be decided after a more careful investigation than the writer has had time to bestow upon the subject. The genus *Tapirus* is repre-

View of the eastern end of the cave after its sides and top had been almost entirely removed, taken from the southern edge of the quarry. The two men are standing with their backs to the north wall of the cave.

sented by the third and fourth left lower premolars of a small species about the size of *Tapirus americanus* Brisson. The *Suidæ* are represented by the remains of a number of peccaries. A remarkably well-preserved mandible I determine to be that of *Dicotyles pennsylvanicus* Leidy, the type of which is the fragment of a mandible of an immature specimen, which was found in Hartman's Cave near Stroudsburg, Pa. Our specimen is the lower mandible of an adult, accompanied by other portions of the skeleton, including well-preserved metapodials and vertebræ. The animal was, judging from what we possess, considerably larger than either of the existing peccaries. The lower jaw is longer than in either *Dicotyles labiatus* or *torquatus*, and the metapodials are longer. The canine teeth, which are wanting in Professor Leidy's type, are also much longer and more formidable weapons than in either of the existing species of the genus. Another peculiarity is the fact that the jaw at its inner angle flares outwardly, whereas the existing species of *Dicotyles* are characterized by the recession of the lower jaw at the angle. The species might well be referred to the genus *Platygonus*, in which, however, it has not been placed by Hay in his Catalogue. Lydekker regards *Platygonus* as practically synonymous with *Dicotyles* or *Tayassu*, but the distinction between the two genera the writer believes to be valid. Portions of a skeleton referable to *Bison* were uncovered. The *Cervidæ* are represented by three species, one of them of very large size, possibly representing *Cervalces*, the other two smaller. There has not been time to carefully decide the generic location of these species, which are principally represented by the teeth of the lower jaws. A fragment of an antler, possibly belonging to *Cariacus virginianus*, was discovered. The remains of mastodons were exceedingly plentiful. *Mastodon americanus* is represented by portions of one mature and five or six immature specimens. The remains of rodents are very numerous. Numerous jaws of *Erythizon*, *Lepus*, *Sciurus*, *Fiber*, and other smaller genera are recognizable. *Chiroptera* are present in the remains of one or more species. The *Ursidæ* are represented by two species. Fragments which are no doubt correctly referable to *Ursus americanus* were found, but far more interesting are the remains of several individuals of a huge bear which I identify without any hesitation as *Arctodus haplodon* Cope. The presence of the entepicondylar foramen in the humerus, the two masseteric fossæ of the mandible and the peculiar shape of the first inferior true molar are characters which serve to reveal at once the identity of the animal with the species described by Cope. The material in our possession is better than that at the command of Professor Cope. It is, unfortunately, fragmentary, but very well preserved so far as it goes, and it is quite abundant, though not sufficient in quantity to enable us to restore the skeleton. The genus *Mephitis* is represented by at least one species. The remains of the genus *Canis* are quite numerous. Several well-preserved jaws show an animal not differing greatly in size from *Canis occidentalis*, but differing somewhat in the dentition, which more nearly resembles that of the Esquimaux dog of to-day, of which it may have been the ancestor. The Felidæ are represented by fragments of an animal comparable in size with the jaguar. Unfortunately there is not much of the skeleton preserved, except the bones of the foot.

In addition to the remains which I have mentioned there are the remains of several other smaller carnivores represented by teeth and portions of jaws which it has been impossible as yet for lack of time to identify.

The remains of birds are not infrequent, and among them the bones of a large species undoubtedly belonging to the genus *Meleagris* are rather numerous.

The collection also contains the remains of Ophidia and Batrachia. These are scattered and so completely disarticulated as to make restoration apparently hopeless, and even determination of the genera problematical.

It has been of course impossible, on account of the brief time at the command of the writer since the material was received, to carefully work it out and to study it with sufficient care to enable a correct reference to be made in all cases. Mr. Peterson, who took up the material, is inclined to the view that from thirty to forty species and several hundred individuals are represented in the material which has been secured.

A comparison of the fauna found in this cave with that discovered in a similar cave at Port Kennedy, in the valley of the Schuylkill, and which was made the basis of several papers by the late Professor E. D. Cope, shows many points of similarity and some marked differences. The scarcity of the remains of *Megalonyx*, which were very abundant in the Port Kennedy deposits, is noticeable. Some of the neo-tropical genera reported by Cope are not found among the remains taken from the Frankstown cave. But the existence of the peccary, the tapir, and of *Ursus haplodon*, which, as has been pointed out by Cope, shows affinities to the fossil Ursidæ of South America, rather than to existing North American species, shows that at the time when these deposits were made there was a commingling on the soil of Pennsylvania of nearctic and neotropical genera, though the nearctic forms predominated. The deposits in the Frankstown cave were probably a little later in their origin than those at Port Kennedy.

Probably the most interesting of all the numerous specimens obtained in the cave at Frankstown is the mandible of a very young mastodon, sufficiently well preserved to enable a study to be made of the early stages of the dentition. It is, I think, the most perfect specimen of its kind in existence in any collection. It recalls at once the publication by Dr. Godman in 1830 of his genus *Tetracaulodon* for the reception of certain specimens which Dr. Isaac Hays in 1834 figured in the Transactions of the American Philosophical Society for that year. Dr. Hays with great chivalry defended the position of Dr. Godman, which had been assailed, and maintained the valid character of the genus *Tetracaulodon*, which was based principally upon the existence of four incisors, or tusks, in the lower jaw. No better evidence of the correctness of the position of Dr. Godman's critics could be found than that given by the remains discovered in the Frankstown cave.

The presence of the remains of numerous infant mastodons and of various species of artiodactyles in the cave, associated with the remains of the huge *Arctodus haplodon*, suggests that the latter, at a time when what later became a sealed cavern was still an open cleft in the rocks, preyed upon young mastodons, which they may have separated from their mothers and chased over the edge of the cliff-like wall. Falling to the bottom they became an easy prey to the great bears, just as calves to-day fall a prey both to the black bear and to the grizzly. In like manner these bears dragged into this place, which was their lair, in order to feed their young, the carcasses of deer and other hoofed animals. Or they may have driven them over the rocks, as it is possible to imagine that the young mastodons were driven. *Arctodus haplodon* was a bear somewhat larger than the grizzly and in weight might well have been quite equal, if not superior, to a young mastodon, judging from the size of the jaws of the latter which we possess. A young mastodon could not have been larger than a baby elephant and probably was not more than three and a half feet in height. It is an interesting picture of the life of the Pleistocene period in Pennsylvania which these fragments suggest.

XII. DESCRIPTION OF VERTEBRATE FOSSILS FROM THE VICINITY OF PITTSBURGH, PENNSYLVANIA.

By E. C. Case.

(Plate LIX.)

The fossils described below were placed in the hands of the author by the kindness of Dr. W. J. Holland, Director of the Carnegie Museum, and Dr. Percy E. Raymond, their discoverer. To both of these gentlemen I desire to express my thanks for the opportunity to examine these most interesting specimens.

They were collected by Dr. Raymond at Pitcairn, about fifteen miles east of Pittsburgh. Dr. Raymond in a letter to me says: "The bones are from the upper part of the formation which I. C. White has named the Pittsburgh Red Shale (Geol. Survey West Virginia, Vol. 11, p. 263). This formation is usually from 100 to 125 feet thick in the vicinity and consists of red clays and red and yellow sandstones. At the top there is a bed of almost structureless clay which varies from 18 to 40 feet in thickness. At Pitcairn the clay is 37 feet thick and the fossils were found 4 feet above the base of the clay. Three feet above the base of the clay there is a layer of nodular limestone, and the teeth were found lying on this layer where it projects from the bank on the roadside. The other bones were all imbedded in the clay about one foot above the limestone. . . . On the Pittsburgh Shale rests the Ames Limestone, the youngest of the marine limestones in the region. It is almost exactly in the middle of the Conemaugh series. It is 315 feet below the base of the Pittsburgh Coal, and 695 feet below the base of the Dunkard series (Permian). The Ames Limestone is about 300 feet above the Freeport Coal (top of the Allegheny series)."

It will be seen at once that this horizon is decidedly lower than any in which terrestrial reptiles have been found, unless those from Vermilion County, Illinois, shall turn out to be from well within the Pennsylvanian.

The collection consists of numerous bones and fragments, about twenty of the specimens being determinable. They are distinctly of the same character as the bones from the beds of northern Texas.

There are recognizable vertebræ, ribs, and intercentra of Amphibia; teeth and chevron bones from Diadectid forms; a fragment of a spine probably belonging to the genus *Naosaurus;* and an ilium and fragments of a large pelvis from some undetermined forms. With the exception of *Bathygnathus* from Prince Edward Island these bones are from the easternmost locality known for Permian (?) vertebrates. In general the collection resembles rather those from Texas than those from Illinois, but the specimens are far too few to base any generalizations as to distribution upon them.

The specimens are described in detail below.

AMPHIBIA.

Eryops. — A dorsal vertebra is very probably from this genus (Fig. 1). The specimen consists of a nearly perfect vertebra, lacking only the anterior zygapophyses and the upper portion of the neural spine. It shows no character that would warrant its separation from the genus, and indicates a medium-sized individual. The zygapophyses are well formed with clean-cut articular faces. The pleurocentra are thickened above with well-defined articular faces, which were applied to faces on the neural arch just posterior to the origin of the transverse process. The intercentrum is of the familiar half-moon shape, thick and heavy below, and thinner toward the extremities; the anterior edge is marked near the top by the indentation found on the intercentra of *Eryops*.

Fig. 1. Dorsal vertebra of *Eryops*. Left side. $\frac{1}{1}$.

Height of the vertebra from the middle of the lower face of the intercentrum to the middle of the neural canal .035 m. Width of intercentrum .026.

The second recognizable specimen is a neural spine from the caudal series (Fig. 2). This is without question a portion of the skeleton of an *Eryops*. Similar spines were described by Cope as *Eryops* (*Epicordylus*) *erythroliticus*, but later discoveries seem to show that similar characters occur in other species of the genus as well. The apex of the spine is bifurcate, the space between extremities is concave and perfectly smooth; below the sides of the spine are rather rugose and marked with ridges. The lower portion of the spine is elongated antero-posteriorly and the edges are marked with sharp, double ridges.

Three ribs (Fig. 3) also belong, in all probability, to the genus *Eryops*. The head of each rib is broad and the articular edge is divided between two faces which meet at an angle somewhat greater

FIG. 2. Anterior view of dorsal spine of caudal vertebra of *Eryops*. $\frac{1}{1}$.

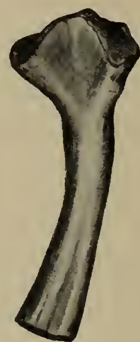


FIG. 3. Rib of *Eryops*? $\frac{1}{1}$.

than a right angle; the two faces are continuous. The shaft is somewhat flattened and in the undistorted specimens is gently curved. The length of the largest rib is about .07 m.

Other than these specimens there are several small intercentra and the neural spine of a caudal vertebra from some undetermined amphibian.

REPTILIA.

Diadectidæ.— This family is represented by a fragment of an upper jaw with four teeth and the roots of a fifth and several chevron bones.

The teeth (Fig. 4) are of peculiar interest as they represent an intermediate stage between those of *Bolbodon* and those of *Empedias*. They seem to indicate with little doubt the existence of a new genus which may be called *Desmatodon hollandi*. The type is the specimen before me, which I designate specifically as *Desmatodon*. The teeth are transversely elongate; the crown is slightly wider than the root and is also somewhat swollen in the antero-posterior direction. The outer half of the crown rises gently into a sharp apex from which there is a sharp descent to the inner half, which is lower than the outer half.

FIG. 4. Tooth of *Desmatodon hollandi*. $\frac{1}{1}$. Antero-posterior diam. = .001 m.

The inner side of the apex is nearly vertical and presents a flat face inwards, this more prominent on the posterior and largest of the teeth than on the anterior ones. The surface of the crown is marked with fine lines and the sides of the root show the same character, but here the lines are coarser. The inner half of the crown of the anterior and the posterior teeth shows no wear, but on the two in the middle there are surfaces worn by attrition on both the inner half of the crown and on the apex. The relation of this genus to its nearest related forms is indicated in the figure here given (Fig. 5).

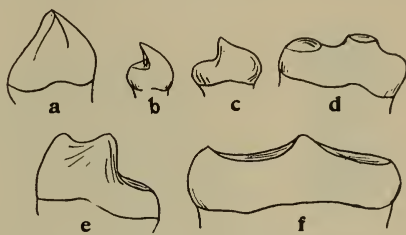


FIG. 5. Teeth of various Diadectids and related forms. *a*, *Bolbodon*; *b*, *Bolosaurus*; *c*, *Desmatodon*; *d*, *Diadectes*; *e*, *Diadectes*; *f*, *Empedias*.

It has recently been shown (Case 1907) that *Bolosaurus* is a member of the reptilian group Synaptosauria, but it is probably nearer to the Pariotichidæ than the Chelydosauria, so that the intermediate forms of the teeth of *Desmatodon* may indicate rather a stage of adaptation to food supply than a step in a phylogenetic series. The teeth of the Diadectids are so characteristic in form that their discovery is especially fortunate, as it places beyond any doubt the correlation of this fauna with that of Texas.

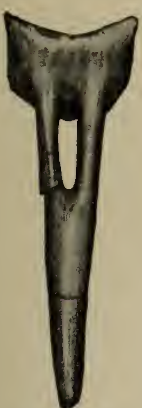


FIG. 6. Chevron bone of a Diadectid. $\frac{1}{1}$.

There are seven chevron bones preserved (Fig. 6); they all have the characteristic form already described (Case 1903). The upper portion is nearly semicircular and the articular face is divided into two portions which lie nearly at a right angle to each other, so that the shaft of the bone, in its natural position, with the articular faces interposed between the lower edges of the articular faces of two adjacent vertebræ, was nearly parallel to the tail. The distal portion of the bone is comparatively long and the extremity is somewhat flattened from side to side. The largest of the chevrons is .051 m. in length, which indicates an animal from four to five feet long.

Pelycosauria. — A small fragment of what is evidently a neural spine gives evidence of the existence of a new member of this suborder (Fig. 7). The fragment is very small, not over .012 m. in length, but of characteristic form. The shaft is somewhat oval in cross section and from the sides extend the bases of four lateral projections such as occur only in the genus *Naosaurus*. As there seem to be no characters other than its size by which this specimen can be separated from typical specimens of *Naosaurus* it seems best to retain it provisionally in that genus and it may be known as *Naosaurus* (?) *raymondi*. The spine is oval in section with the greatest diameter antero-posterior; the lower end is expanded in the opposite direction and seems to be broken not far from the point where it joined the neural arch. There is no means of distinguishing the front and rear sides. As indicated by the stumps the lower pair of processes were located nearly opposite to each other and were inclined somewhat upwards. The upper pair was located rather on the same side of the spine than opposite to each other and one is farther up the spine than the other. Greatest diameter of the upper end .004 m.

FIG. 7. Part of the dorsal spine of *Naosaurus* (?) *raymondi*. $\frac{2}{1}$.

Incertæ Sedis. — There are fragments of the acetabula of two reptiles of large size and a complete ilium of a smaller form. This latter is of considerable interest, but, as in all probability it belongs to some form described from another portion of the skeleton, it will not be given a new name here. In outline it is somewhat between that of the amphibian *Eryops* and the reptile *Naosaurus* (Fig. 8). Instead of the main axis of the bone lying in the antero-posterior direction it is vertical. The lower end is divided into two separate articular faces for the ischium and pubis, the larger (pubic?) face looks almost directly downward and the smaller (ischial?) lies nearly at a right angle to this with the face vertical. Just above the articular end the bone is contracted into a flattened shaft and above this expands into a broad thin plate. The anterior edge of the plate is turned outward as a rather prominent ridge. The inner face is marked by a series of prominent rugose lines radiating from a point on the shaft and serving for the attachment of the sacral ribs. The length of the ilium is .090 m. and the width of the distal end 0.53 m.

The other two fragments are evidently portions of the acetabula of two large reptiles, probably pelycosaurs, but perhaps they were *Diadectidæ*. They show no determinative characters, but indicate animals of considerable size, from 5 to 6 feet in length, if pelycosaurian; and from 4 to 5 feet, if Diadectid.

The main interest of these specimens lies in the light which they cast on the geological position of these forms and their geographical distribution.

Though it has been pretty generally accepted that the beds in Texas were Permian, there has been no little evidence that they may be

FIG. 8. Ilium of an undetermined reptile. External view. $\frac{1}{1}$.

lower. Recently the discussion as to their geological age has been summarized by Beede and Case (Beede 1907, Case 1907). The remains from Vermilion County, Illinois, occur in a region of Pennsylvanian rock, but until quite recently it has been supposed that they were buried in the deposits of a Permian River on a Carboniferous land. This idea seems to be wrong (*fide* Williston). The important discovery by Dr. Raymond of this fauna, so definitely located in the Pennsylvanian, must reopen somewhat the discussion of the age of the Texas Red Beds. It certainly places the advent of a distinctly terrestrial reptilian fauna earlier than has hitherto been supposed. The suggestion may not be impossible that conditions for terrestrial life of a high order were reached earlier in the east than in the west, and, that the Carboniferous swamps of Pennsylvanian time, giving place to upland surfaces before the advance of the Appalachian uplift, made possible a type of life that was homotaxially equivalent to a similar type, which developed at a later time in the west.

Evidence has been gradually accumulating that the *Pelycosauria*, and the reptilian and amphibian forms associated with them, had a widespread distribution over North America. Forms are now known from Prince Edward Island, Pennsylvania, Illinois, Kansas, Oklahoma, Texas, and New Mexico. Though there seems to be some difference in the collections from the different localities it is not sufficient to warrant the inference that there were marked faunal differences in North America. It seems more probable that the fauna was rather homogeneous, inhabiting the ponds, lakes, swamps, and uplands of the entire area of the central and eastern part of North America. The occurrence of a large number of forms in Texas is due to their deposition in the delta of a large river, which drained an extensive area to the north.

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EXPLANATION OF PLATE LIX.

(All figures are natural size.)

Fig. 1. *Desmatodon hollandi* Case. The holotype, consisting of a fragment of a jaw with four teeth.

Fig. 2. A diadectid reptile. Chevron of an undetermined species.

Fig. 3. *Naosaurus* (?) *raymondi* Case. Holotype, consisting of the neural spine of a vertebra.

Reptilian Remains found near Pittsburgh, Pa.

Fig. 4. An amphibian. Sp. ind. The neural arch and spine of a caudal vertebra.

Fig. 5. *Eryops* sp. ind. A nearly complete (composite) vertebra. The parts were found dissociated, and may not all pertain to the same vertebra.

Fig. 6. *Eryops* sp. ind. One of the pleurocentra.

Figs. 7, 8. *Eryops* sp. ind. Two ribs, somewhat distorted.

Fig. 9. The ilium of an undetermined reptile. The opposite side of the same specimen is shown in the text, Figure 8.

XIII. NOTES ON ORDOVICIAN TRILOBITES: ILLÆNIDÆ FROM THE BLACK RIVER LIMESTONE NEAR OTTAWA, CANADA.

By Percy E. Raymond and J. E. Narraway.

Introduction.

This is one of a series of papers on the trilobites of the Ordovician, and deals with some new or little known species of Illænidæ from the Lowville and Black River Limestones at Ottawa, and a few related species from the Chazy and Trenton Limestones.

The material on which this study is based is a large collection obtained by Mr. Narraway from the Ordovician formations about Ottawa. Mr. Narraway has been fortunate in obtaining many entire specimens of species which are rare, so that we are able to supplement the description of some species previously known only from fragments.

Whole specimens of trilobites are very rare, and for material for comparative study, we have been obliged to draw upon the resources of some of the older museums.

This survey of the material has shown that in the past the boundaries of some of the species have been somewhat loosely drawn, and several forms with a general resemblance have been placed in the same species. While such a course is one of great convenience, especially to the student who wishes to identify the ordinary imperfect material in his collection, it is a source of confusion when certain kinds of work are undertaken. This lax identification of species makes particularly difficult the study of zoölogical provinces and the distribution of isolated or connecting basins in the Paleozoic seas. As an example, take the case of *Bumastus milleri* Billings. At Ottawa there occurs a distinct group of trilobites of the genus *Bumastus*, all very much alike and all having nine segments. To call these animals *Bumastus milleri* invites attention to this distinctive characteristic, but to include these trilobites under the name *Bumastus trentonensis* with other fossils from New York having from eight to ten segments and with forms from Minnesota having eight or nine segments, obscures the evidence which might be obtained from them. All the forms are closely related, and a description can be drawn up which will include them all, but if they are all put under one name, there is nothing to show the fact that certain forms have been isolated and have developed into a race with fixed characters. Some may question the propriety of a course which seems to give to geographic variations the rank of species, and we ourselves should have hesitated to give a new name under such conditions, even though we feel that there should be some way of designating such forms. In this particular instance however, it is only necessary to revive a name previously given by an acute student of these organisms.

The following is a list of the trilobites which have thus far been found in the Black River Limestone in the vicinity of Ottawa.

Bathyurus extans (Hall),
B. spiniger (Hall),
Asaphus romingeri Walcott,
Isotelus gigas Dekay,
Illænus conradi Billings,
I. angusticollis Billings,
Illænus latiaxiatus sp. nov.,
Thaleops ovata Conrad,
Bumastus milleri (Billings),
Bumastus indeterminatus (Walcott),
Ceraurus pleurexanthemus Green,
Cybele ella Narraway and Raymond,
Pterygometopus callicephalus (Hall).

Sub-Kingdom ARTHROPODA.

Class CRUSTACEA.

Sub-Class *TRILOBITA*.

Order OPISTHOPARIA Beecher.

Genus Illænus Dalman.

Illænus latiaxiatus sp. nov.

(PLATE LX, FIGURES 4–8.)

This species presents many points of similarity to *Illænus americanus* Billings, but the pygidia are so markedly different that we are unable to refer them to that species. No complete specimens have yet been found, but enough material is at hand to enable us to describe all the parts except the free cheeks.

DESCRIPTION.

Cephalon apparently a little less than half as long as wide, strongly arched, nearly semicircular in outline. The dorsal furrows are deep at the posterior margin of the cephalon, but quickly become shallow and fade out less than half way to the front. They converge slightly for the greater part of their length, but at the anterior ends turn outward a little. On the cast they are more strongly defined, wider, and reach further forward and outward. Midway in their course they pass through two lunate depressions, thus making a sigmoid curve, as described by Billings in *Illænus americanus*. The surface of the cranidium is covered with punctæ with the exception of the posterior border. The punctæ are especially strong on the glabella, but perfect specimens show four smooth, oval areas on either side of the median line of this region. The arrangement of these smooth areas, which is shown in Fig. 8, Plate LX., suggests the form of the glabellar lobes of many trilobites. They probably indicate points of attachment of muscles.

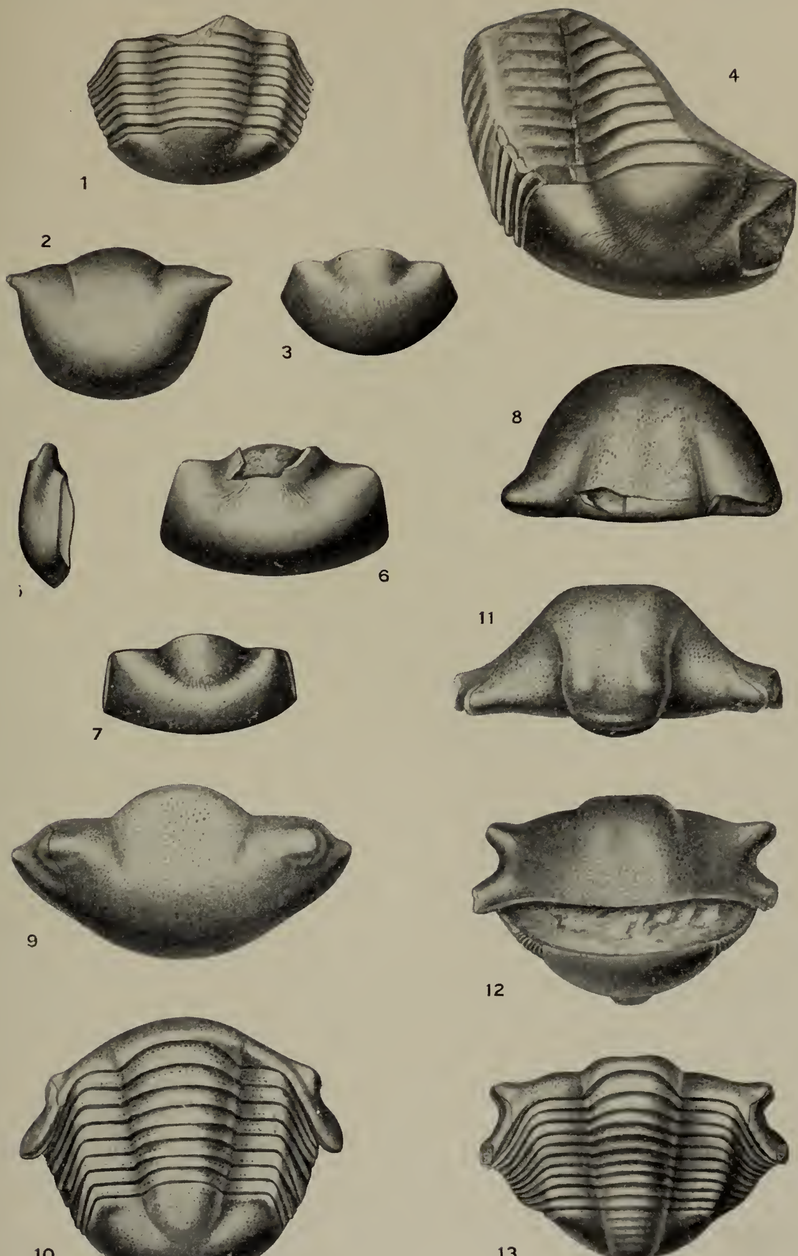
The eyes are rather large, and are situated less than half their length from the posterior margin of the cephalon.

The thorax shows ten wide, flat segments. The axial lobe is rather strongly arched, and over one third the total width of the thorax. The pleura are flat for about one half their width, then abruptly deflected.

The pygidium is about as long as the thorax, somewhat rectangular in outline, three-fifths as long as wide. Its most remarkable feature is the abrupt truncation of the sides, which are at almost right angles with the anterior margin. Axial lobe strongly convex on the anterior margin, outlined by deep furrows at the sides, and by a shallow furrow around the posterior end. The lobe is about half the length of the pygidium. From the axial lobe radiate faint cracks, as in *Illænus americanus*. These cracks are formed by the confluence of the numerous punctæ.

This species differs from *Illænus americanus* chiefly in the form of the pygidium, which is much more strongly truncated at the sides, less arcuate posteriorly, and has a more convex and prominent axial lobe. The cephalon differs in that it is wider in proportion to the length, and has shorter, straighter, and shallower dorsal furrows.

Locality.— This species occurs in the Black River Limestone at Tetreauville and Mechanicsville, near Ottawa, Canada, and also at Pattersonville and Newport, New York. Probably many of the specimens of *Illænus americanus* reported from the Black River at various localities really belong to this species. The cotypes are in the private collection of Mr. Narraway.



Sydney Prentice del.

Trilobites from the Black River Formation.

Illænus conradi Billings.

(PLATE LX, FIGURES 9, 10.)

Illænus conradi Billings, 1859, Canadian Naturalist and Geologist, Vol. IV., p. 372.

Panderia conradi Vodges, 1893, Occasional Papers California Academy of Sciences, No. 4, p. 330.

We are able to add but little to Billings' elaborate description of this species, but have introduced figures of this rare trilobite to show its relation to *Illænus angusticollis*. From that species it differs in the greater width of the axial lobe and the glabella, the direction of the dorsal furrows, and the less extended genal spines. On the axis of the pygidium, annulations are suggested by faint lines or rows of punctæ, but the rings are not so definitely marked as in *Illænus angusticollis*. The first two thoracic segments are marked by two or three parallel rows of punctæ, while the other six segments usually show one row each.

Locality.— This species occurs in the Black River Limestone about Ottawa, but perfect specimens are very rare. In several years of collecting Mr. Narraway has found only ten entire specimens, four of which were enrolled. These specimens have been obtained at Tetreauville and Mechanicsville, on opposite banks of the Ottawa River, at La Petite Chaudière, near Ottawa, Canada.

Illænus angusticollis Billings.

(PLATE LXI, FIGURES 1–5.)

Illænus angusticollis Billings, 1859, Canadian Naturalist and Geologist, Vol. IV., p. 376, figs. 10*a*–10*d*.

Only the cephalon of this species was known to Billings, but Mr. Narraway has been fortunate enough to secure several entire specimens. From this material the following description has been drawn up.

DESCRIPTION.

Body ovate, the greatest width exceeding the length. Dorsal furrows deep, extending upon both cephalon and pygidium. Length of an average specimen, about 12 millimeters.

Cephalon wide, the anterior margin gently arcuate, somewhat contracted in front of the eyes, the free cheeks extended into short spines. The dorsal furrows are deeply incised, outlining a narrow glabella.

The course of the furrows, from the posterior margin, is first diagonally inward, while crossing the neck ring, which is not otherwise defined, and then straight forward, parallel to the line of the axis. Just before they fade out at the summit of the cephalon they turn abruptly outward. In favorable light three pits may be seen at the bottom of each furrow.

The cephalon is covered with fine punctæ, those on the median lobe being much larger and more numerous than those scattered over the remainder of the surface. The eyes are large, rather prominent, but not pedunculated.

In ten out of twelve whole individuals the thorax has eight segments. The other two have nine. The segments are narrow, run nearly straight across the body, and turn downward and backward at the sides. Axis about one fifth the width of the dorsal surface, and moderately convex, while the pleura are nearly flat. The first four segments are thickly marked with fine punctæ arranged in almost straight lines across the thorax, four or five rows to the segment. On the remaining segments there are very few punctæ.

Pygidium short and wide, somewhat square in front, rounded posteriorly. Axis elevated, convex, about half as long as the pygidium. It is isolated by deep furrows at the sides and a slight furrow behind. On the cast the posterior end of the axial lobe is abruptly divided, and back of the axis is a shallow groove which extends nearly to the posterior margin. Some of the specimens show three, others four, rings on the axial lobe. The surface is minutely punctate.

The species approaches *Thaleops ovata* in having its axial lobe sharply defined on the pygidium and thorax, and in the narrow, strongly outlined glabella. The genal angles also show a tendency toward the formation of spines. On the other hand its close relationship to *Illænus conradi* connects it with *Illænus* rather than *Thaleops*.

It is remarkable that in so specialized a group as the *Illænidæ* there should occur such a primitive character as variation in the number of the thoracic segments. This character has been observed in other species of the group, notably in *Bumastus trentonensis*, which may have eight, nine, or ten segments. Clarke, in commenting on *Bumastus trentonensis*, observes that "Such variations in the degree of segmentation are not, indeed, usual in the mature condition of a species; they are, however, altogether in harmony with the laws of morphogeny, and deviations from the normal Trenton type with ten segments are to be interpreted as phylogenetically immature or senile phases of the specific type." In the case of *Illænus angusticollis*, the specimens showing eight segments are smaller in size than those with nine, and may possibly be immature individuals.

Locality. — This species has not so far been reported from other than Canadian localities. Billings cited the Island of St. Joseph and the west side of Grant's Island, Lake Huron, and La Petite Chaudière, Hull, Quebec. The specimens with eight segments here described are from both sides of the Ottawa River at La Petite Chaudière. Those with nine segments were obtained from the basal beds of the Black River, at Pelton's Quarry, about six miles south of Ottawa, Canada.

Subgenus **Thaleops** Conrad.

Conrad, 1843, Proceedings Academy Natural Sciences, Philadelphia, Vol. I, p. 332.

Hall, 1847, Paleontology of New York, Vol. I, p. 259.

Clarke, 1897, Paleontology Minnesota, Vol. III, pt. 2, p. 716.

This subgenus, as defined by Conrad, could hardly be differentiated from *Illænus*, and was therefore accorded scant recognition until Clarke brought out the salient characters in describing specimens of *Thaleops ovata* from Minnesota. These characters, as remarked by Clarke, are the "peculiar extension of the palpebra and the long, attenuate, and projecting cheeks."

In the various descriptions of the typical species, much stress has been laid upon the complete isolation of the axial lobe, but this same characteristic is seen in *Illænus angusticollis*. *Illænus angusticollis* and *I. conradi* are two forms which almost bridge the gap between the typical *Illænus* and *Thaleops*.

Thaleops ovata Conrad.

(PLATE LX, FIGURES 11–13; PLATE LXI, FIGURES 6, 7.)

Thaleops ovata Conrad, 1843, Proceedings Academy Natural Sciences, Vol. I, p. 332.

Thaleops (*Illænus*) *ovatus* Hall, 1847, Paleontology New York, Vol. I, p. 259, Pl. 67, figs. 6*a*, 6*a*, 6*b*.

Illænus ovatus Whitfield, 1882, Geology Wisconsin, Vol. IV, p. 238, Pl. 5, figs. 1, 2.

Illænus herricki Foerste, 1887, Fifteenth Annual Report Geological and Natural History Survey of Minnesota, p. 479, fig. 2.

Thaleops ovata Clarke, 1897, Paleontology Minnesota, Vol. III, pt. 2, p. 716, figs. 25–28.

Not *Thaleops ovatus* Raymond, 1902, Bulletin American Paleontology, Vol. III, Pl. 18, fig. 9.

Not *Thaleops ovata* Raymond, 1905, Annals Carnegie Museum, Vol. III, p. 352, Pl. 13, fig. 5.

This species is well known and has been so frequently described that it is only necessary to add here a description of the genal spines. As shown by the figures, these spines are strong, rather heavy, with a prominent keel on the upper surface, making the spine triangular in section. This character of the genal spines is especially well shown on specimens from Ottawa, and is also exhibited by Conrad's types, which are preserved in the American Museum of Natural History, New York City.

Entire specimens of this species are very rare in the vicinity of Ottawa, while fragments are very common. The entire specimens vary in length from 19 to 47 millimeters.

Thaleops arctura (Hall).

(PLATE LXI, FIGURE 8.)

Illænus arcturus Hall, 1847, Paleontology of New York, Vol. I, p. 23, Pl. 4 bis, fig. 12.

Illænus arcturus Emmons, 1855, American Geology, Vol. I, pt. 2, p. 235, Pl. 3, fig. 12.

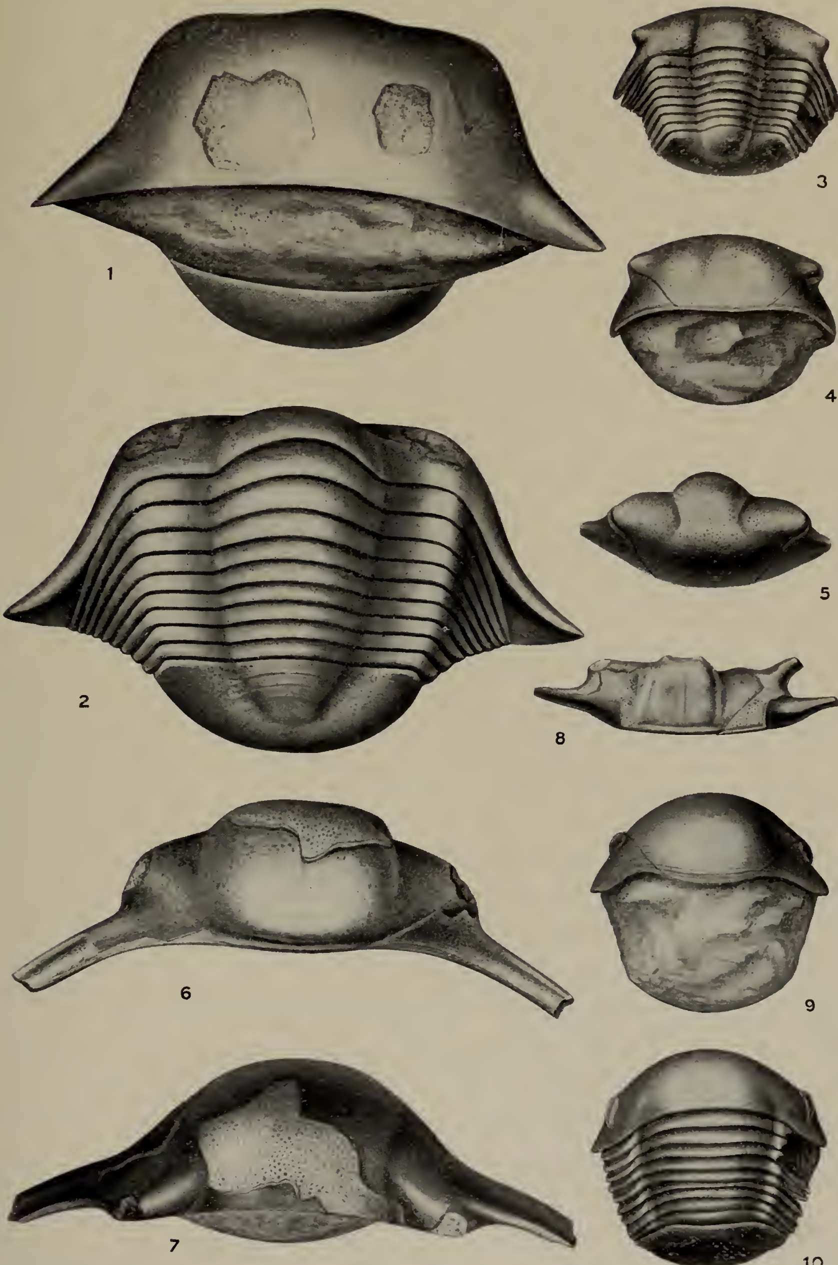
Thaleops arctura Clarke, 1897, Paleontology of Minnesota, Vol. III, pt. 2, p. 718.

Thaleops ovatus Raymond, 1902, Bulletin of American Paleontology, Vol. III, Pl. 18, fig. 9.

Thaleops ovata Raymond, 1905, Annals Carnegie Museum, Vol. III, p. 352, Pl. 13, fig. 5.

At the time this species was described by Raymond in the articles cited above, he was unable to compare the Chazy specimens with any well-preserved specimens from the Trenton and none of the published descriptions allude to the rather minor characters which separate *Thaleops arctura* from *Thaleops ovata*. In *Thaleops ovata*, the palpebral lobes are depressed, and are at the same level as the summit of the fixed cheeks, while in *Thaleops arctura* the eyes are much more prominent and rise at an angle of about 30 degrees with the surface of the fixed cheeks. Furthermore, the genal spines in the

Plate LXI.



Sydney Prentice del.

Trilobites from the Black River Formation.

Chazy form are much smaller than those of the Trenton specimens, and nearly circular, instead of triangular, in cross section.

Judging from Clarke's figures of *Thaleops ovata* (Paleontology of Minnesota, Vol. III, pt. 2, p. 718, fig. 28) it is possible that *Thaleops arctura* occurs in the Trenton. The genal spines of the specimen there delineated approach much more closely to the form observed on our specimens from the Chazy at Crown Point and elsewhere than they do the spines on the specimens collected by Mr. Narraway in the Black River near Ottawa.

We have not yet been able to seize upon characters which will serve to distinguish the specimens usually found, namely, the detached cranidia and pygidia.

Subgenus **Bumastus** Murchison.

Bumastus milleri (Billings).

(PLATE LXI, FIGURES 9, 10; PLATE LXI, FIGURES 3–5.)

Cf. *Illænus trentonensis* Emmons, 1842, Geology New York, Report of Second District, p. 390, fig. 3.

Illænus milleri Billings, 1859, Canadian Naturalist and Geologist, Vol. IV, p. 375, fig. 10.

Illænus milleri Walcott, 1877, Advance Sheets, Thirty-first Annual Report, New York State Museum Natural History, p. 20.

Illænus milleri Walcott, 1879, Thirty-first Annual Report New York State Museum Natural History, p. 71.

Cf. *Bumastus trentonensis* Clarke, 1897, Paleontology of Minnesota, Vol. III, pt. 2, p. 718, figs. 30–35.

Cf. *Bumastus trentonensis* Weller, 1902, Paleontology New Jersey, Vol. III, p. 194, Pl. 14, figs. 8–13.

In the "Paleontology of Minnesota," Dr. Clarke referred to *Illænus milleri* as a synonym of *Bumastus trentonensis* (Emmons), reviving the latter name for the smaller of the *Illæni* described by Emmons. (See the description of the following species for a fuller account of these names.) Emmon's name *Illænus trentonensis* was applied to a specimen found in the Black River or Trenton Limestone at Watertown, New York, and though figured, this specimen was not described. The present location of this specimen does not appear to be known, so only the figure is left to define the species. Under these circumstances we cannot agree with Dr. Clarke in superseding Billings' name, which is supported by a good description and a figure, by a name which is dependent only on a rather poor figure. Moreover, as we now know more than one species of *Bumastus* from the Black River and Trenton formations, it is not at all certain that Emmons and Billings described the same species. The specimens from Ottawa invariably show nine segments, while Emmons' figure represents a specimen with only eight. Clarke has described two specimens of *Bumastus* from the Trenton at Trenton Falls, New York, one with eight, and one with ten segments. The specimen with ten segments differs from the specimens found in the Black River Limestone at Ottawa in having a longer and narrower form, fainter dorsal furrows on the cephalon and more delicate thoracic segments in addition to having one more segment. In these smooth trilobites, all apparently descended from the same stock, it is very difficult to seize upon distinguishing characters, even where the whole aspect of each animal is quite characteristic. Where the form is constant, as in the specimens at Ottawa, it seems important that there should be some ways of designating it. In this case it is only necessary to revive Billings' name for the *Bumastus* at Ottawa, leaving to *Bumastus trentonensis* the forms described by Clarke.

This species has been too fully described by Billings to require a formal description here. It is very abundant in the Black River Limestone about Ottawa, and though the collection contains specimens varying in length from eight to thirty millimeters, all have nine segments.

Bumastus billingsi sp. nov.

(PLATE LXI, FIGURES 1, 2.)

Cf. *Bumastus trentonensis* Emmons, 1842, Geology New York, Report of Second District, p. 390, fig. 1.

Cf. *Illænus trentonensis* Hall, 1847, Paleontology New York, Vol. I, p. 230, pl. 60, fig. 5.

Cf. *Bumastus orbicaudatus* Clarke, 1897, Paleontology Minnesota, Vol. III, p. 722, fig. 36.

The history of the species *Bumastus trentonensis* Emmons and *Illænus trentonensis* Emmons has been given by Clarke (Paleontology of Minnesota, 1897, p. 718), but a part of it will have to be repeated in order to explain the names here adopted for the species called *Bumastus trentonensis* and *Illænus milleri* by authors and collectors.

Bumastus trentonensis was figured by Emmons (Geology New York, Report of the Second District, 1842, p. 390, fig. 1) from a specimen obtained from a boulder at Hogansburg, New York. The figure shows a trilobite with a wide, yet defined axial lobe on the thorax, and faint, arcuate dorsal furrows on the cephalon. The original specimen was lost before Hall studied the material for Vol. I, "New York State Paleontology," but Hall figured a plaster cast of the specimen.[1] Hall's figure differs from that given by Emmons in showing no dorsal furrows on the thorax. Clarke remarks that, as thus figured, it is "an excellent *Bumastus*," while the figure given by Emmons leads one to consider it an *Illænus*. The figure given by Hall corresponds in size and proportions with a *Bumastus* found in the Trenton Limestone at Ottawa, and which is known to local collectors as *Bumastus trentonensis*. These specimens from Ottawa differ from Hall's figure only in the direction of the dorsal furrows on the cephalon. Hogansburg is just south of the St. Lawrence, 60 miles southeast of Ottawa and only 40 miles south of the Ottawa Valley, so that it seems very possible that Emmons' specimen may have come from that region.

Illænus trentonensis was the name given by Emmons to a small trilobite figured on the same page of the "Geology of New York" as the species discussed above. Emmons says, in explanation of the figure:

"No. 3. For this small trilobite, I am indebted to Dr. Crawe, of Watertown. It seems to be rather rare, though it has been found in the Valley of the Mohawk. The specimen from which the drawing was taken was found at Watertown."

This small *Bumastus* was taken by Clarke as the type of *Bumastus trentonensis*.

If, however, the No. 1 of Emmons' figures is also a *Bumastus*, as seems probable, the same specific name can not be used for both, and the larger form would be entitled to the name *Bumastus trentonensis*. To make this transference of names now would lead to endless confusion. Since the type of Emmons' No. 1, *Bumastus trentonensis* is lost, it is not possible to say positively what his species was, and it will simplify matters to follow Clarke in retaining the name for the smaller specimen, and describe the large form under a new name.

[1] The plaster cast of Emmons' specimen is still preserved in the collection of the American Museum of Natural History.

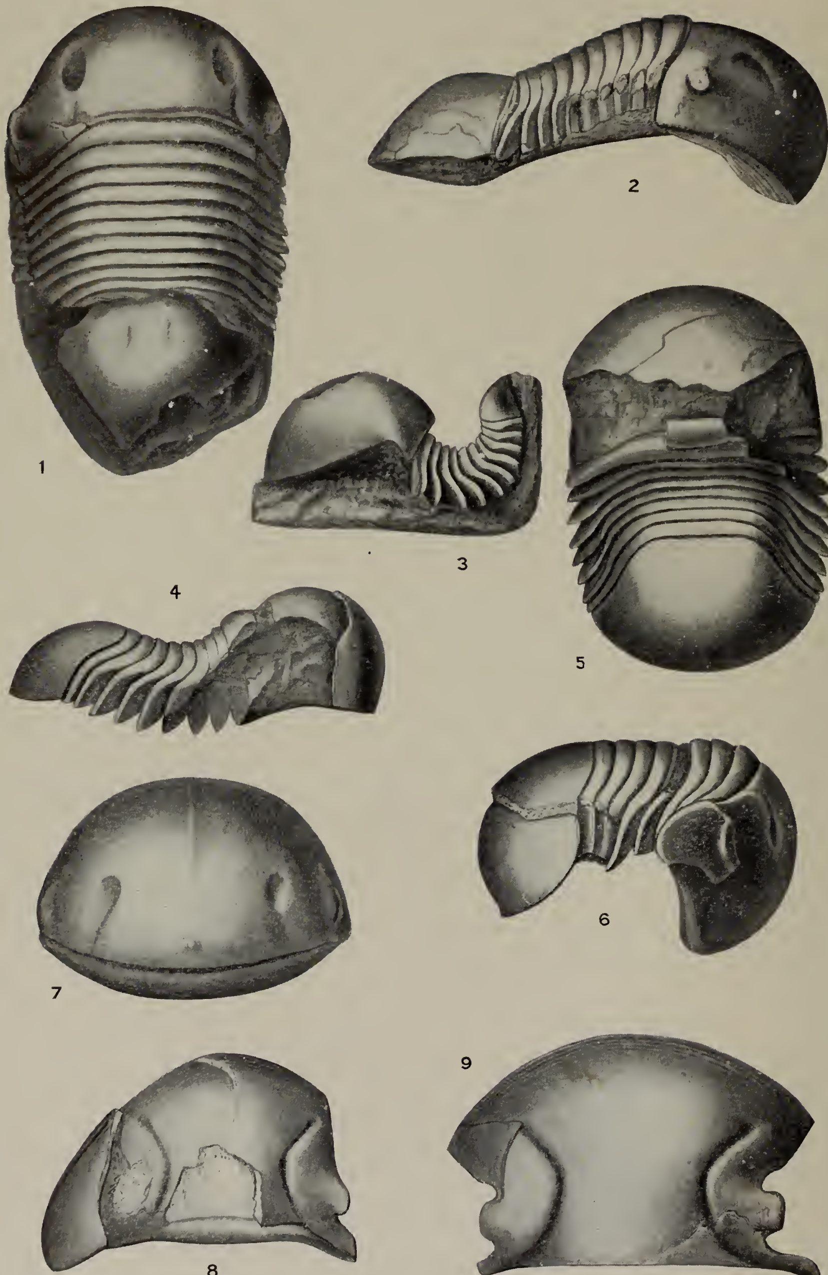
DESCRIPTION.

Entire test oblong, the width about six tenths the length. Dorsal furrows almost obsolete on the thorax, entirely so on the pygidium, but fairly strong on the cephalon. One entire specimen is 60 millimeters long and 38 millimeters wide at the genal angles; another is 83 millimeters long and 49 millimeters wide.

Cephalon regularly rounded in front, with very slight constrictions in front of the eyes. Free cheeks small, the eyes situated very far apart and about half their own width from the posterior margin of the cephalon. Neck ring faintly defined on the cast; not distinguishable on testiferous specimens. The dorsal furrows on the cephalon are far apart, and rather faint on the test, but strongly defined on the cast. Their course from the posterior margin is first diagonally inward for a short distance, and then straight forward, until they merge into large lunate markings, which, in the cast, appear as depressions. Thorax of ten segments, which are smooth, rather wide, and nearly flat. At the dorsal furrows, which are very far apart and almost obsolete, the segments are bent downward and a little backward, but the deflection is not abrupt as in other *Illæni*. The pygidium is large, regularly arched, a little wider than long. It shows no trace of the axial lobe. On the cast there are four or five transverse lines, suggestive of annulations, and two rather large oval prominences which may correspond to scars of muscular attachments on the inside of the test.

This species differs from *Bumastus trentonensis* and *B. milleri* in the following particulars: the size is much greater, the dorsal furrows on the cephalon are stronger, and on the thorax are further apart and fainter, the cephalon is more strongly arched and incurved in front, the lunate scars of the cephalon are further forward and stronger, and the thoracic segments are proportionally wider. The most striking difference is, of course, the size. Under most circumstances we would not attach much importance to this, but our smallest specimen is twice the size of the largest specimen of *B. trentonensis* figured by Clarke, and none of the specimens of *B. milleri* from Ottawa, with nine segments, seem to exceed 30 millimeters in length.

Locality. — So far as is known, this species is confined to the Trenton Limestone. The specimens figured are from Hull, Quebec, Canada, and are in Mr. Narraway's private collection.



Sydney Prentice del.

Trilobites from the Black River and Trenton Formations.

Bumastus bellevillensis sp. nov.

(PLATE LXI, FIGURES 6, 7.)

Another species of *Bumastus* which is very interesting in connection with the preceding forms, has been found in the Trenton Limestone at Belleville, Canada, by Mr. W. R. Smith. These specimens have eight segments, and on first sight seemed to be the young of *Bumastus billingsi*, but the presence of a small median pustule on the posterior margin of the cephalon precludes that possibility. This characteristic also separates it from any other *Bumastus* now known from the Ordovician. This species differs from *Bumastus milleri* in its wider segments and more arched and incurved cephalon, two characters which separate *Bumastus billingsi* from *B. milleri*. The specimens of the present species are also considerably wider than are specimens of *Bumastus milleri* of the same length.

One of the specimens, which is exfoliated, shows a small median pustule on the posterior margin of the cephalon. Another which retains the test shows a small pustule over each of the lunettes formed by the dorsal furrows on the cephalon. These lunettes are raised, instead of depressed, as in most species of *Bumastus*.

The best entire specimen in the collection is twenty-two millimeters long and twenty-one millimeters wide at the genal angles. The thorax is eight millimeters long, the cephalon fourteen millimeters, and the pygidium thirteen millimeters. The width between the eyes is nineteen millimeters.

The type is from the Trenton Limestone at Belleville, Canada, and is in the Carnegie Museum.

Bumastus indeterminatus (Walcott).

(PLATE LXII, FIGURES 8, 9.)

Illænus indeterminatus Walcott, 1877, Advance Sheets, Thirty-first Annual Report New York State Museum Natural History, p. 19.

Illænus indeterminatus Walcott, 1879, Thirty-first Annual Report New York State Museum Natural History, p. 70.

Illænus cf. *I. indeterminatus* Clarke, 1897, Paleontology of Minnesota, Vol. III, pt. 2, p. 716, fig. 24.

Cf. *Illænus indeterminatus* Raymond, 1905, Annals Carnegie Museum, Vol. III, p. 347, Pl. 13, figs. 1, 2.

Three imperfect cranidia of this species have been found in the

Black River Limestone at the falls of La Petite Chaudière. One specimen shows the larger part of a free cheek. In this specimen the genal angle is rounded, not drawn out into a spine as in the specimens from the Chazy referred to this species by Raymond. The dorsal furrows on the specimens from the Chazy are also much straighter than those of the specimens from the Black River. It seems very possible that the form from Valcour Island represents another, but closely allied, species.

A specimen from Mechanicsville shows fragments of four thoracic segments, similar in size and shape to those of *Bumastus billingsi*. Walcott says of the thorax of his specimens: "Thorax uniformly arched, not trilobed; nine segments only can be counted; the crushing together of the segments may have forced one beneath the head." From the shape of the thorax as shown by these two specimens, it seems probable that this species should be referred to *Bumastus*.

Locality. — This species is found rather rarely in the Black River Limestone at Mechanicsville, Ontario, and Tetreauville, Quebec.

SUMMARY.

In the preceding pages, one new species of *Illænus* from the Black River, and two new species of *Bumastus* from the Trenton Limestone have been described. The thorax and pygidium of *Illænus angusticollis*, previously unknown, have been described, and the differences between *Thaleops ovata* and *Thaleops arctura* pointed out. Reasons are given for retaining the specific name *milleri* for the small *Bumastus* described by Billings, and *Bumastus indeterminatus* is figured for the first time from specimens obtained in the Black River formation.

EXPLANATION OF PLATES.

PLATE LX.

1. *Illænus americanus* Billings. Thorax and pygidium of a specimen from the Trenton Limestone, Hull, Canada. One third larger than natural size.

2. The same species. A cranidium, viewed from the front. Same magnification as the preceding.

3. The same species. The same pygidium as shown in Fig. 1, looked at from above. One third larger than natural size. Compare Fig. 1 with 4, and 3 with 6 and 7.

4. *Illænus latiaxiatus* Narraway and Raymond. An imperfect thorax and pygidium. One third larger than natural size.

5. The same species. A pygidium viewed from the side.

6. The same pygidium, viewed from above. One third larger than natural size.

7. The same species. Another pygidium. Same enlargement as the preceding.

8. The same species. A cranidium, one third larger than natural size.

9. *Illænus conradi* Billings. The cephalon of a perfect specimen. Twice natural size.

10. The same species. A dorsal view of the same specimen.

11, 12, 13. *Thaleops ovata* Conrad. Three views of a nearly perfect specimen. Twice natural size.

PLATE LXI.

1, 2. *Illænus angusticollis* Billings. Two views of a specimen with nine thoracic segments. Enlarged four diameters.

3, 4, 5. The same species. A specimen with eight segments. Enlarged two diameters.

6, 7. *Thaleops ovata* Conrad. Two views of a cephalon. Enlarged two diameters.

8. *Thaleops arctura* (Hall). The front view of a nearly complete specimen. Natural size.

9, 10. *Bumastus milleri* (Billings). Two views of a very small specimen. Four times natural size.

PLATE LXII.

1, 2. *Bumastus billingsi* Narraway and Raymond. Two views of a nearly complete but exfoliated specimen. Natural size.

3. *Bumastus milleri* (Billings). An incomplete specimen from the Lowville Limestone. Twice natural size.

4, 5. The same species. Two views of another specimen. Twice natural size.

6, 7. *Bumastus bellevillensis* Narraway and Raymond. Two views of the same specimen. Twice natural size.

8. *Bumastus indeterminatus* (Walcott). An incomplete cephalon, showing one free cheek. Natural size.

9. The same species. A somewhat larger cranidium. Natural size.

The specimens from which figures 11, 12, 13, Plate LX, figures 3, 7, 9, 10, Plate LXI, and figures 3–7, Plate LXII, were made are in the Carnegie Museum. The others, with the exception of the original of figure 8, Plate LXI, are in Mr. Narraway's collection. The original of figure 8, Plate LXI, is in the Cornell University Museum. With the exception of the specimen of *Thaleops arctura*, all the specimens figured were collected by Mr. Narraway. Casts of all figured specimens are in the Carnegie Museum.

XIV. RHINOCEROSES FROM THE OLIGOCENE AND MIOCENE DEPOSITS OF NORTH DAKOTA AND MONTANA.

By Earl Douglass.

(Plates LXIII–LXIV.)

Aphelops montanus sp. nov.

(Plate LXIII.)

(Type No. 1569, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type consists of a skull with the mandible, the two femora, parts of a humerus, and other fragments of the skeleton. It came from the Flint Creek (Upper Miocene) beds on the west side of the Flint Creek valley, near New Chicago, Granite County, Montana. It was collected by Professor Fred D. Smith and Earl Douglass in 1899, but it was not fully cleared from the matrix and its characters determined until the summer of 1906.

The following are some of the distinguishing characters of the type:

Skull long (dolichocephalic); supraorbital region not broad; nasals long and tapering, not laterally compressed and not possessing horn-rugosities; posttympanic rounded, not wing-like as in Aphelops ceratorhinus; teeth brachyodont or brachyhypsodont; number of premolars complete (4)*; all the upper cheek teeth except* P^1 *having crotchets, and all except* M^1 *and* M^2 *with antecrotchets; limbs long and slender for so large a rhinoceros.*

The skull of this species appears to be similar in form to that of *Aphelops ceratorhinus*, though the cranium of the type of the latter is not complete. The posterior upper portion of the skull of the type of *Aphelops montanus* is crushed, but the upper contour was evidently straighter than that of most of the American Miocene rhinoceroses which have been described. The nasals are smooth, moderately long, and evenly narrowed. They show no rugosities for the attachment of horns. They are convex transversely on the upper surfaces, but are not turned or rolled inward on the posterior portions of the outer borders as in *Aphelops ceratorhinus*. The frontal plane was nearly flat and there was no sagittal crest. The supratemporal ridges are

Aphelops montanus Douglass. Type. $\frac{1}{1}$.

moderately broad and converge backward until they are 2 cm. apart; then they begin to diverge 8 cm. anterior to the occipital crest. The upper posterior portion of the skull resembles that of specimen No. 840, which is described in this paper, but in the latter specimen the supratemporal ridges diverge more rapidly toward the occiput.

There are two infraorbital foramina in the maxillary above the third and fourth premolars. The lower of these foramina is large and round. The other foramen is just above and a little posterior to the first and is oblong-oval in form, with the apex of the oval antero-inferior. The malar is rather shallow beneath the orbit, but is deeper farther back. The posterior upper angle of the zygomatic portion of the squamosal is low. The external auditory opening is entirely surrounded by the temporal bone, as the postglenoid and posttympanic portions are in contact by the enlargement and forward trend of the posttympanic, which is large, rounded on the outer surface, and somewhat roughened by shallow depressiosn. The paroccipital processes, as seen from the side, are quite broad. They are near the occipital condyles.


Fig. 1. Femur of *Aphelops montanus*. $\frac{1}{4}$.

The occiput appears to have been nearly perpendicular, not much inclined either forward or backward. It is low in proportion to the length of the skull and is broad, not narrowing rapidly upward as in specimen No. 854 (*Aphelops ceratorhinus?*). The middle of the occiput immediately above the foramen magnum is very convex transversely and projects backward overhanging that opening.

The depth of the mandible is greater than that of the type of *Aphelops ceratorhinus*, it is much thinner transversely, and the angle is not so large.

The femur is long and very slender for so large a rhinoceros. Only portions of other bones are preserved.

MEASUREMENTS.

	mm.
Length of skull from tips of nasals to crests of occiput	567
Width of skull including zygomatic arches, greatest	330
Width of skull at post-tympanics	200
Height of skull at orbit	205
Height of skull at occiput	200
Length of nasals, approximately	170
Height of paroccipital processes	51
Width of paroccipital processes at base	51
Height of mandible under P_4	85
Height of ascending ramus of mandible, estimated	255
Width of ascending ramus of mandible from M_3 backward	150
Length of upper molar-premolar series	265
Length of lower molar-premolar series	268
Length of femur about	520

Proportion of height of skull at occiput to length of top of skull = 35.2 : 100.

The Flint Creek beds, from which this rhinoceros was obtained, are closely related in time to the Deep River beds of the Smith River Valley in Montana, though *Palæomeryx ? borealis* is the only species that is now known to be common to the two formations.

COMPARISONS OF APHELOPS MONTANUS WITH OTHER SPECIES OF RHINOCEROSES.

Comparison with A. ceratorhinus.

Aphelops montanus much resembles *A. ceratorhinus* in the size and proportions of the skull, in having a complete upper premolar series, and in having teeth which are not strongly hypsodont. Some of the differences are: the lack of horn-rugosities on the nasals of *Aphelops montanus*, the absence of an inward-turning scroll-like border on the posterior outer portions of the nasals, the different form of the posterior basal elements of the skull, and of the postero-superior portion. There are some differences in the proportions of the teeth, especially the molars, as is shown in the following measurements which are arranged for comparison :

	A. montanus.	*A. ceratorhinus.*
	mm.	mm.
Length of P^1	27	26.5
Width of "	20	22
Length of P^2	36	35
Width of "	40	43
Length of P^3	41	42
Width of "	53	56
Length of P^4	40	46
Width of "	58	58
Length of M^1	53	50
Width of "	63	55
Length of M^2	60	52
Width of "	62	58.5
Length of M^3	44	45
Width of "	56	53

Comparison with Aphelops Megalodus.

A. montanus agrees in having the smooth elongated nasals, which are devoid of horn-rugosities, and in the comparatively brachyodont teeth, but it is a more dolichocephalic type, has a lower occiput, more slender zygomatic arches, and a broader roof to the brain-case.

Our knowledge of Miocene rhinosceroses is still too incomplete to allow us to arrange them all under their proper generic names; but as *A. megalodus* is the type of *Aphelops*, the present series which resembles it in so many particulars, should, for the present, be assigned to that genus, though the resemblance may not be due to a very close relationship.

This species, but for the fact that it has no horn-rugosities on the nasals, would, with *Aphelops ceratorhinus*, come under Professor Osborn's definition of the third phylum of Miocene rhinoceroses. This phylum, according to Professor Osborn,[1] is distinguished by decidedly long limbs and feet, long skull, brachyodont teeth, and flattened pointed nasals with small terminal horn-rugosities. It is barely possible that the type of *Aphelops montanus* is a female and the male possessed horns, though I do not think it probable.

[1] "New Miocene Rhinosceroses," *Bulletin of the American Museum of Natural History*, Vol. XX, 1904, p. 324.

Aphelops ceratorhinus Douglass.[1]

(PLATE LXIV.)

The type of *Aphelops ceratorhinus* is No. 857, Carnegie Museum Catalogue of Vertebrate Fossils. This specimen was not all accessible or fully prepared for study when the first description was made.

Fragments of the skull were originally found in a cattle-path on a steep bluff on the east side of the Lower Madison Valley in Montana. By digging into the sand, portions of a much broken skull and a nearly complete mandible were found. A good portion of one side of the skull has been put together, but the upper posterior portion is still wanting. Fragments of vertebræ and limb-bones were found weathered out just below where the skull and mandible were obtained.

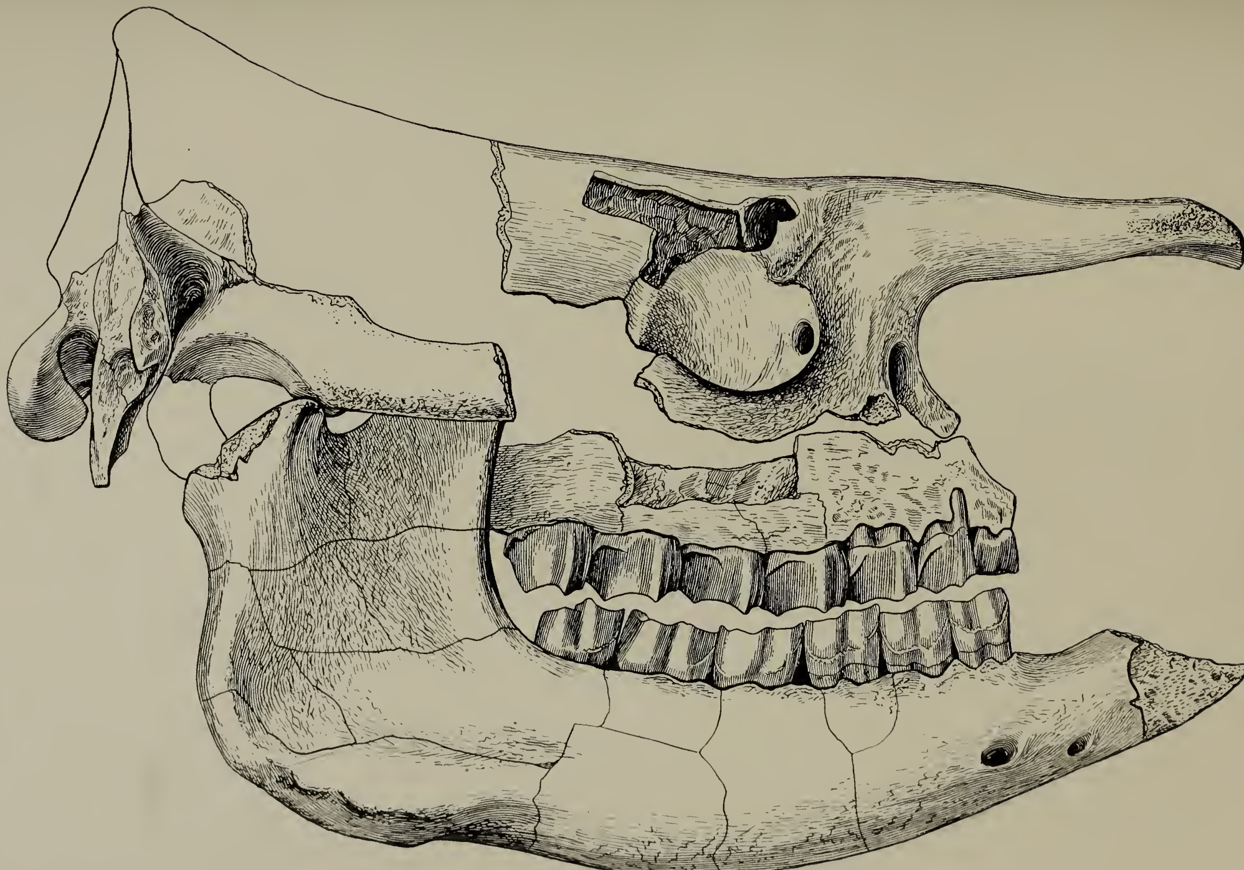
From the same beds as the type are other portions of the skulls, which, judging by the forms of the nasals and the basal portions of the skulls belong to the same or nearly related species. These enable us to get the approximate proportions of the missing parts of the cranium of *Aphelops ceratorhinus* and to make the restoration of the skull which is given in Plate LXIV.

FIG. 2. Calcaneum of type of *Aphelops ceratorhinus*. $\frac{1}{4}$.

Principal Distinguishing Characters. — Size large; skull long (dolichocephalic); nasals long and slender, with small terminal horn-rugosities; external auricular opening closed below; post-tympanic expanding outward in wing-like processes; paroccipitals concave behind and in front, separated from occipital condyles by a concave area; cheek teeth brachyodont with cingula on interior portions of premolars; $P^{\underline{4}}$ to $M^{\underline{3}}$ with crotchets; mandible long and comparatively shallow, but thick and heavy; ascending ramus only moderately high, angle rounded, alveoli for canines large.

Judging from the posterior portion of the skull of another individual (No. 854, see Fig. 3), which is smaller, the occiput was low and narrowed upward. The nasals turned downward slightly at the tips just anterior to the nasal rugosities. The borders of the nasals, beginning at the rugosities, expand and have a decidedly downward trend for more than one half of the distance backward. On the posterior half

[1] "New Vertebrates from the Montana Tertiary," *Annals of the Carnegie Museum*, Vol. II, No. 2, 1903, p. 195.



Aphelops ceratorhinus Douglass. $\frac{1}{4}$.

the borders are folded or turned inward apparently for the purpose of strengthening the nasals for the support of the anterior weapon of defence. The anterior portion of the frontal plane is slightly convex transversely, but nearly flat.

FIG. 3. Outline of back of skull of *Aphelops ceratorhinus?* $\frac{1}{4}$. (No. 854.)

The paroccipital process is different from that of any other species which I have observed. It is situated at some distance anterior to the occipital condyles and there is a quite large concave space between the

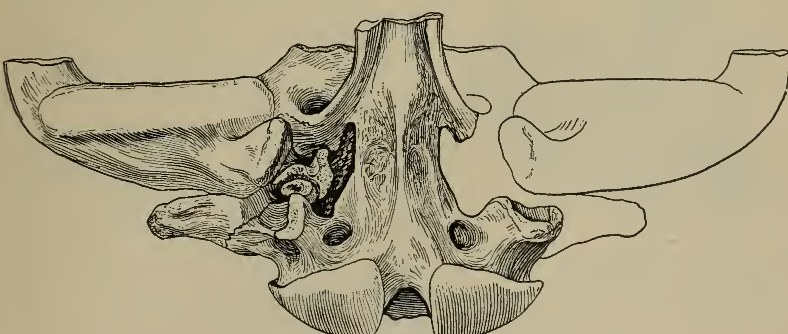


FIG. 4. Basi-occipital view of skull of *Aphelops ceratorhinus?* $\frac{1}{4}$. (No. 854.)

two. The process is concave on the anterior and posterior surfaces. The anterior surface is trough-shaped, but the posterior has a large depression at the base of the process, and farther down a concavity which is smaller and deeper. The post-tympanic is very different from that of *Aphelops montanus*. It is not rounded antero-posteriorly, but is wing-like, expanding antero-externally. It is quite thick antero-posteriorly.

Measurements will be found in the original description of *A. ceratorhinus*.

Aphelops ceratorhinus?

Carnegie Museum Catalogue of Vertebrate Fossils, No. 854.

This specimen consists of the posterior portion of a skull. The posterior basal portions of the crania are preserved both in this specimen and in the type of *Aphelops ceratorhinus* and the corresponding parts agree in all essential particulars, though, as would be expected, there are some minor differences.

The occiput is moderately high for the width and narrows upward as in *Aphelops megalodus*. The supraorbital ridges unite for a short distance forming one low narrow ridge which represents the sagittal crest. The paroccipital processes and the post-tympanics are essentially like those of the type of the species. The former have deep posterior concavities in the bases, and a prominent ridge extends, external to the cavities, from the posterior portion of the processes to the base of the occipital condyles. The anterior faces of the paroccipital processes are trough-shaped. The post-tympanics are not so large and rugose as in the type. The external auditory opening is long, comma-shaped, and below this the post-tympanic and post-glenoid processes are nearly in contact for some distance. The median basal portion of the skull has a nearly flat area between the occipital condyles and anterior to them. Anterior to this is a high, narrow, median ridge in front of which there is a rounded knob, or protuberance, just posterior to the pterygoid fossa and between the glenoid articular surfaces.

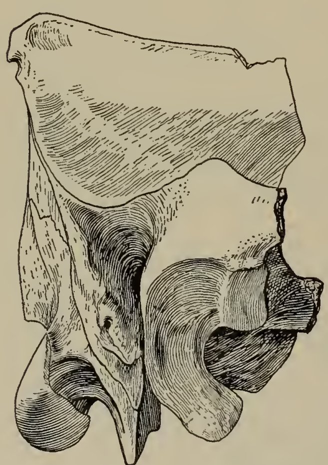


FIG. 5. Lateral view of back of skull of *Aphelops ceratorhinus?* $\frac{1}{4}$. (No. 854.)

MEASUREMENTS.	mm.
Height of occiput	225
Width of occiput	270
Height of paroccipital processes	65

Though the type of *Aphelops ceratorhinus* represents a large rhinoceros, portions of a skull, vertebræ, and limb-bones of another individual (Carnegie Museum Catalogue of Vertebrate Fossils, No. 842, from the Madison Valley) indicate a very much larger animal, possibly belonging to a different species. The greater portion of the humerus is preserved and an outline is given in Fig. 6.

The measurements are as follows:

	mm.
Length of humerus from upper articular surface to distal end	487
Whole length of humerus, estimated	500
Width of distal end, transverse	178
Diameter of distal end antero-posterior.	124
Thickness of shaft above distal trochlea	95

Teleoceras ? sp.?

Carnegie Museum Catalogue of Vertebrate Fossils, No. 840.

This specimen is the top of a skull with the nasals and occipital crest complete. It came from the bluffs on the east side of the Lower Madison Valley a mile or two farther north than the type of *Aphelops ceratorhinus*. Like most of the remains of rhinoceroses from this region, the specimen was found in a bed of sand near the bottom of the Upper Miocene (Loup Fork) beds. The portion of the skull which is preserved suggests a somewhat different rhinoceros from any other that has been named, but there is not sufficient material on which to found a species. The following are some of the more noticeable characteristics:

FIG. 6. Humerus of *Aphelops?* sp.? $\frac{1}{4}$. (No. 842.)

Size medium; top of skull flattened; occiput somewhat elevated; sagittal crest wanting; nasals rather short, turned upward in front, and possessing rugosities for a terminal horn.

This specimen is much smaller than the types of *Aphelops ceratorhinus* and *A. montanus.* The nasals are short, laterally compressed, and turned upward toward the points, which are roughened, evidently for the accommodation of one terminal horn. They are very convex transversely on top and correspondingly concave beneath. They are not coössified. From the tips backward the borders trend upward for a short distance, then downward and outward and then curve backward. They are

FIG. 7. Lateral and superior views of fragment of skull of *Teleoceras?* sp.? $\frac{1}{5}$. (No. 840.)

thickened posteriorly yet the inner edges are sharp and there is a beveled border facing inward and downward. The frontal region is flattened, but somewhat concave antero-posteriorly as the supra-occipital border is elevated. The cavities above and antero-internal to the orbits are large. There is no sagittal crest. The supra-temporal ridges are low and broad. A large concavity with one low median ridge and two lateral ridges occupies the posterior upper portion of the occiput. The lateral ridges end at the supero-external portion of the occipital crest.

MEASUREMENTS.

	mm.
Length of skull from tips of nasals to middle of occipital crest	457
Width of occipital crest	165
Width of skull at supero-anterior borders of orbits	218
Length of free nasals	122
Width of free nasals, posterior	83
Width of rugosities for horn	35
Length of rugosities for horn	35

ACERATHERIUM.

In August, and again in November, 1905, the writer obtained, at White Butte and in the Little Bad Lands in North Dakota, many remains of rhinoceroses. Among them are two exceptionally complete skulls, one of which has the mandible attached. Though there are some differences in details in the two skulls yet I place them both, provisionally, in the species *Aceratherium tridactylum*.

Aceratherium tridactylum Osborn.

(Carnegie Museum Catalogue of Vertebrate Fossils, No. 1585.)

This specimen consists of a skull and mandible which are nearly complete. Small portions of the left angle of the mandible and of the occipital crest had weathered away. It was found in a hard, heavy, green sandstone concretion, or part of a sandstone stratum, just above the nodular Oreodon layer. A stratum of sandstone a little distance away contained many bones and teeth of rhinoceroses and some teeth of horses. Above was a gray, rather soft sandy stratum about fifteen feet in thickness containing the jaws of rodents and remains of crocodiles.

The specimen differs somewhat from the specimen figured and described by Osborn in his "Memoir on The Extinct Rhinoceroses."[1] The nasals are shortened and truncate, not narrowing to a point, or suddenly contracting forward at a point a little distance posterior to the apex, as in Osborn's figure. There are two incisive alveoli in the premaxillaries, the posterior is nearly as large as the anterior alveolus, and the two are very close to each other. The paroccipital processes are prismatic, having three sides. The mandibular symphysis is quite long and the canine fairly large. The most striking peculiarity of this specimen is its shortened truncate nasals.

[1] Memoirs of the American Museum of Natural History, Vol. I, Part III, April, 1898, p. 158, Pl. XVII.

MEASUREMENTS.

	mm.
Length of skull from premaxillaries to occipital condyles	512
Length of skull from nasals to occiput	477
Length of free nasals	80
Height of skull at orbits not including teeth	140
Height of skull at occiput	175
Length of upper series of cheek teeth	194

Proportion of height of skull at occiput to length = 175 : 512 = 34 : 100.

Another skull (No. 1586, Carnegie Museum Catalogue of Vertebrate Fossils) was found at White Butte, by Harry Roberts, a rancher's boy, while hunting specimens with me. It was enclosed in a block of rather soft gray sandstone on the sloping surface of the nodular Oreodon beds, but it had fallen down from a cliff above, the rocks of which undoubtedly belong to the Upper White River beds. It probably came from a slightly higher level than No. 1585 just described. The nasals are moderately long and taper gradually forward to the tips. They are bent somewhat downward. The orbits are large and the zygomatic arch slender, at least as far back as the molars extend. There is quite a wide space between the tympanic and the basisphenoid. The paroccipital processes are broad, flat, and rounded, and not pointed at the lower extremities. Their broadest surfaces face antero-externally and postero-internally. To them the post-tympanics are firmly united. The latter are quite thick and are roughened on the outside. They are triangular in cross-section and have short blunt processes extending downward and toward the post-glenoid processes from which they are separated by narrow spaces, so that the external auditory openings are not closed below.

MEASUREMENTS.

	mm.
Length of skull from tips of nasals to crest of occiput	514
Length of molar-premolar series	194
Height of skull at orbits	155
Height of skull at occiput	167
Width of top of skull just posterior to orbits	180
Width of skull just anterior to glenoid articular surfaces	257

Proportion of height of skull to length 167 mm.: 514 mm. = 32.5 : 100.

XV. FOSSIL HORSES FROM NORTH DAKOTA AND MONTANA.

By Earl Douglass.

Until recently, there has been no opportunity to study the fossil horses which have been obtained in Montana and North Dakota for the Carnegie Museum. At the request of Dr. W. J. Holland, the director of the museum, a preliminary account of some of the more interesting of these remains has been prepared. When all the material from these regions has been thoroughly studied and compared with that from other localities, much will be added to our knowledge of the history of the fossil horses.

In 1905, the expeditions from the Carnegie Museum which had previously confined their operations to western Montana, extended them into parts of Minnesota, Idaho, and North Dakota. In the last mentioned state, the deposits which probably were visited by Professor E. D. Cope,[1] in 1883, were searched for fossil mammals. In the "Little Bad Lands" southwest of Dickinson, another area of Oligocene deposits was discovered. In both localities the three divisions of the White River (lower, middle, and upper) are exposed, and from the middle and upper horizons many fossil mammals were obtained.

The White River beds of North Dakota and their mammalian faunæ are much like those of South Dakota, though there are some local differences. On the other hand the various Tertiary deposits of western Montana do not exactly agree in character with those of the plains. As one by one the families of fossil mammals from the Tertiary horizons of Montana have been studied, it has been found that most of the species and part of the genera are different from those which have been obtained elsewhere. It might have been suspected that the camels and horses were more cosmopolitan than some of the other animals, and that identical species would be found in beds which were supposed to be nearly or quite contemporaneous in the mountains and on the plains. In the present paper, I have included provisionally under old names, some species which I believe will eventually

[1] *Proc. Amer. Philos. Soc.*, Vol. XXI, p. 216.

prove to be new. The horses, then will probably not form an exception to the general rule. A preliminary study has also been made of the camels and they tell the same story.

It seems, then, from the evidence thus far obtained, that the two regions (that of Montana and of the plains) all through Oligocene and Miocene times (at least the portions of them represented by fossil-bearing deposits) have been faunally distinct; or else the preservation of mammalian remains seldom, if ever, exactly coincided in time in in the two localities.

Mesohippus portentus sp. nov.

(PLATE LXV, FIGURES 1–4.)

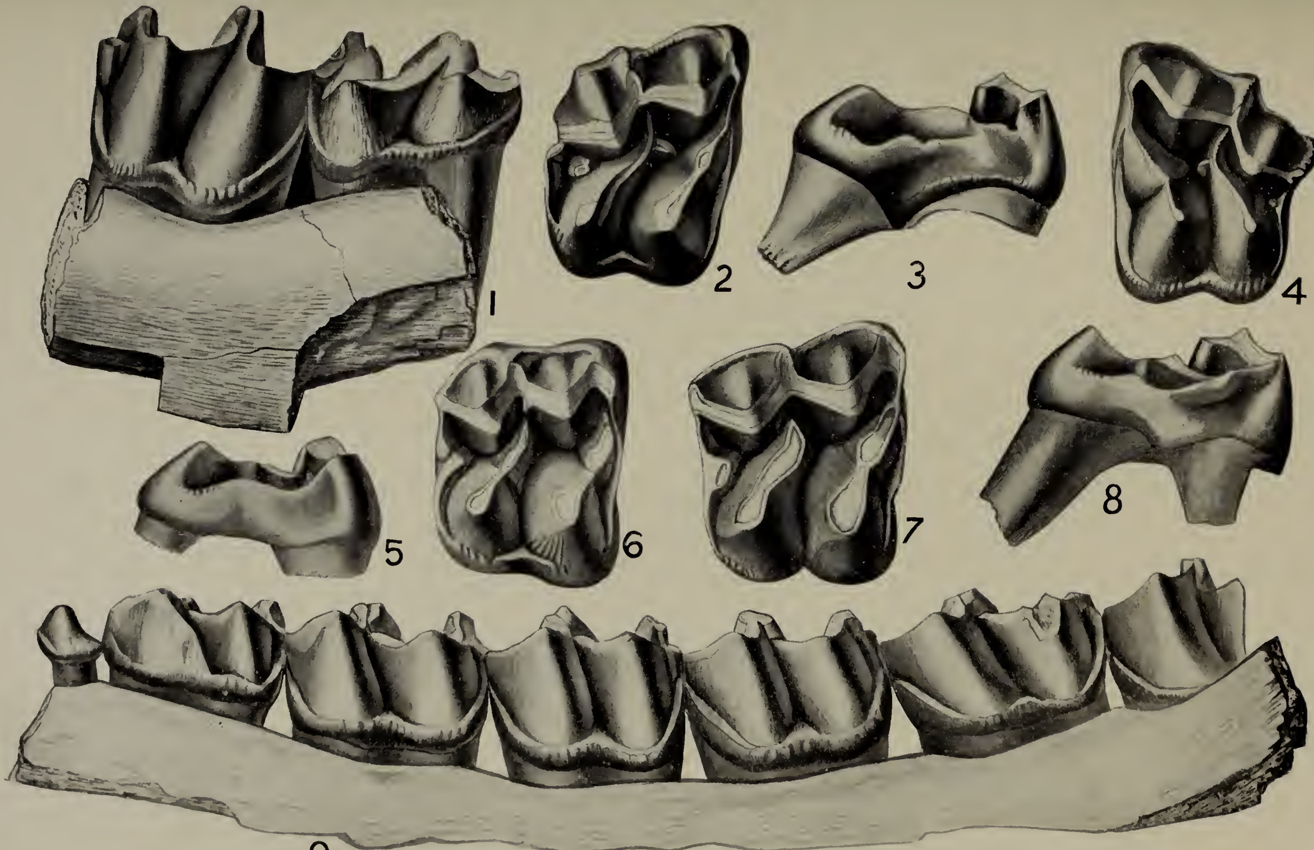
(Type No. 1622, Carnegie Museum Catalogue of Vertebrate Fossils; Pl. LXV, figs. 2 and 3.)

The type is a second right upper molar tooth from the Lower White River ("Titanotherium") beds near Pipestone Creek in Montana. The specimens which I have associated with the type are No. 1624, a left upper premolar; No. 1623, a last left upper molar; No. 1633, two lower molars; and No. 1634, one lower molar. All are from the same region and formation as the type.

DESCRIPTION OF TYPE.

(1) Size large and (2) crests of molars high for a horse from this horizon, (3) ectoloph very oblique, (4) protoloph and metaloph nearly equal in length, (5) protoloph large and connected with the parastyle, (6) metaloph narrow and nearly connected with ectoloph, (7) protoconule easily distinguishable, but (8) metaconule absent, (9) a crotchet present on the metaloph, and (10) a small conule in the posterior valley of the tooth, (11) a rudiment of a cingulum between protocone and hypocone, (12) parastyle and (13) hypostyle small.

The metaloph, external to the metacone, is thin and has a sharp crest. The crotchet extends forward and slightly outward from the metaloph where the latter bends outward toward the ectoloph. It extends nearly across the valley to the posterior base of the protoconule. If the crotchet were higher and united with the protoconule it would produce an "enamel-lake" like those which occur in some Upper Miocene horses. There is a minute conule in the posterior



Teeth of Fossil Horses from North Dakota and Montana.

valley of the tooth between the metaloph and the hypostyle. The hypostyle is simply a thickening of the posterior cingulum.

Measurements. — Antero-posterior diameter of crown 13.3 mm., transverse diameter 18 mm., length of protoloph 12.2 mm., length of metaloph 12 mm., height of hypocone 8.1 mm.

Specimen No. 1623 (Plate LXV, fig. 4) probably belongs to this species. It is a third upper molar, therefore its transverse diameter is not so great as that of the type. The crotchet in the present specimen is not so large and there is no conule in the posterior valley.

No. 1633 (Plate LXV, fig. 1) is a portion of a mandible with two teeth in position. On account of the size and height of these teeth it is assumed that the specimen belongs to the species now under consideration. The antero-posterior diameter of the two teeth is 26 mm. The height is 9 mm. The cingula on the outer faces of the teeth are continuous but not heavy. The metaconid and metastylid are beginning to separate. Another lower tooth (No. 1634) has the same characters as the teeth just described.

Mesohippus hypostylus ? Osborn.

(PLATE LXV, FIGS. 7–9.)

Bulletin of the American Museum of Natural History, Vol. XX (1904), Art. XIII, p. 170, fig. 2.

I include provisionally in this species three upper teeth, Nos. 1625, 1630, and 1631, also a portion of a mandible with nearly complete molar-premolar series (No. 1635 Carn. Mus. Cat. Vert. Fossils) from the Lower White River beds on Pipestone Creek in Montana. All the teeth are considerably larger than those of the type of *Mesohippus hypostylus* and it is doubtful if they belong to the same species.

No. 1625 (Plate LXV, figs. 7 and 8) is a right upper molar. Its antero-posterior diameter is 14.5 mm., its transverse diameter 17 mm., and the height of the protocone, though worn, 8 mm. The ectoloph and cross-crests are moderately oblique. The protoloph is connected, apparently in part by the cingulum, with the parastyle. The protoconule is large and is plainly distinguished from the protocone. The metaloph is much narrower than the protoloph, and there is only a slight constriction to distinguish the metaconule from the metacone. The metaconule or the outer portion of the metaloph is broad and not connected with the ectoloph at the top. There is no internal cingulum on the tooth. The hypostyle is small.

No. 1631 is a second upper premolar. The antero-external style is not large. The antero-external cusp is quite large but there is no outer tubercle on the protoloph. The posterior external tubercle on the metaloph is well developed. There is a large hypostyle and it is connected by wear with the postero-internal cusp. The antero-posterior diameter is 15 mm. and the transverse diameter 15 mm.

No. 1635 (Plate LXV, fig. 9) is a portion of a mandible with all the cheek-teeth except part of the last molar. Because of the size and height of the teeth it is provisionally associated with the upper teeth described above. The length of the molar-premolar series, exclusive of $M_{\overline{3}}$, is 70 mm. The length of $M_{\overline{2}}$ is 15 mm. and the height of the protoconid is 9 mm. The teeth are high for a species from the Lower White River horizon. $P_{\overline{1}}$ is small. There are prominent external cingula on all the teeth except the first premolar. There is a tendency toward a separation of the metastylid from the metaconid but this is not shown by an inner groove. The entostylid is quite well developed.

Mesohippus bairdi (Leidy).

Palæotherium bairdi Leidy. Proceedings of the Academy of Natural Sciences, Philadelphia, Vol. V, 1850, p. 122.

The anterior portion of a skull containing the molar-premolar series of both sides, was found below the middle of the nodular beds (Middle White River) on White Butte in Billings County, North Dakota. The specimen is No. 1644 of the Carnegie Museum Collection of Vertebrate Fossils. The teeth are extremely brachyodont for a horse from this horizon — more so than any specimens I have seen from the Lower White River beds of Montana. By the pattern of the teeth they could hardly be distinguished from those usually considered as belonging to *Mesohippus bairdi*, though I have not access to the type of that species. The preorbital fossa is quite large and deep, making the top of the muzzle narrow.

UPPER WHITE RIVER BEDS.

Mesohippus brachystylus ? Osborn.

(PLATE LXV, FIGURES 5 AND 6.)

Bulletin of the American Museum of Natural History, Vol. XX, 1904, Art. XIII, p. 175, fig. 6.

I include provisionally in this species Nos. 1639, 1641, and 1643 (Carn. Mus. Cat. Vert. Foss.). They consist of teeth which were found by the writer in the Upper White River beds of White Butte in North Dakota. Though they differ somewhat from the type of *Mesohippus brachystylus* as described by Osborn, I refer them with doubt to this species. No. 1639*a* and 1639*b* are two upper molars, 1641 an upper molar, and 1643 a last lower molar.

Measurements. — Specimen No. 1639*a*, apparently a first molar (Plate LXV, figs. 5 and 6), has the antero-posterior diameter of crown 13 mm., transverse diameter 16.5 mm., height of protocone (slightly worn) 5 mm., height of paracone 6 mm.

The most prominent characteristics of these teeth are the following: (1) crowns low, cross-crests especially so; (2) parastyle fairly large and connected with the anterior cingulum, but not with the outer angle or point of the protoconule; (3) protoconule and metaconule well developed and of nearly equal form and size; (4) hypostyle well developed, tending near apex to separate from the portion of the cingulum external to it; (5) inner cingulum rudimentary; (6) outer median ribs on crescents not prominent; (7) form of tooth nearly quadrate.

No. 1641 is an upper molar. The antero-posterior diameter of the crown is 13 mm. and the transverse diameter 16 mm. It differs from the teeth just described in having a shorter inner antero-posterior diameter, making the tooth less quadrate.

No. 1643 is a last left lower molar. The antero-posterior diameter is 20 mm. and the transverse diameter 10 mm. The metastylid is not separated from the metaconid, but a faint external groove indicates a beginning of this separation.

MIOCENE DEPOSITS.

Altippus taxus gen. et sp. nov.

(PLATE LXVII, FIGS. 3 AND 4; PLATE LXVIII, FIGS. 6–8.)

(Type No. 836, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type, which was found by the writer near the little railroad station of Woodin on Divide Creek, about six miles south of the continental divide, in Silver Bow County, Montana, consists of parts of a skull, the greater portion of a mandible, a radius, portions of two femora, a tibia, a nearly complete hind foot, other bones of toes, and numerous fragments. The only associated fossils were part of a skull of *Entoptychus* Cope and parts of upper and lower jaws which are not very different, except in size, from the corresponding parts of the type of *Ticholeptus breviceps*, which was found about a mile farther south, apparently at a little lower level.

Generic Characters. — (1) *Deciduous teeth brachyodont;* (2) *permanent teeth somewhat hypsodont;* (3). *both permanent and temporary teeth without cement on crowns;* (4) *metaloph on the upper permanent teeth not united with ectoloph;* (5) *protoconule small;* (6) *metaconule faintly indicated on the metaloph;* (7) *hypostyle moderately large triangular and having a central pit;* (8) *limbs long;* (9) *metapodials unusually long and slender;* (10) *ungual phalanges long and narrow;* (11) *metatarsals nearly the length of the radius.*

The zygomatic arch is slender and the orbit large. The infraorbital foramen is over the third temporary molar. The first temporary molar is one half of the width and a little over one half of the length of the second temporary molar. The latter tooth has a small median internal pillar between the two internal cusps. The third and fourth temporary molars are nearly equal in size and their antero-posterior and transverse diameters are nearly equal. The protoloph and metaloph are connected with the ectoloph. The hypostyle is large. The first and second permanent molars are nearly equal in size. Their ectolophs are oblique, the anterior portion of the tooth being broader than the posterior portion, and the protoloph being larger than the ectoloph. The cross-crests are not connected with the external crest except at the bases. The parastyle is small and its inner portion is a sharp vertical ridge. The mesostyle is low and thin and there are faint median external ridges on the paracone and metacone. The protoconule is small but well defined, but the metaconule is only faintly indicated by a minute protuberance on the top of the metaloph.

The first lower deciduous molar is a little more than one-third the length of the second. It had one simple cusp and a low heel. The second temporary molar is the longest tooth in the mandible. There are cingula on the outsides of the third and fourth deciduous molars. The first permanent lower molar retains the pattern of the teeth of Oligocene horses, but it is higher than the more brachyodont forms. The proportion of the height to the antero-posterior diameter is only about six per cent. greater than in *Mesohippus portentus* from the lower White River beds.

The radius, like all the other bones of the limbs, is long and slender. Its shaft is transversely concave on the posterior surface. The transverse diameter at its narrowest part is one-twentieth its length. The tibia is nearly a fourth longer than the radius. Its length is fourteen times its narrowest transverse diameter. The shaft of the outer lateral metatarsal is considerably more reduced than that of the inner metatarsal. The lateral phalanges are considerably shorter than the median phalanges, therefore the tips of the unguals were evidently free from the ground when the animal was standing. The lateral unguals, like the median, are slender.

A remarkable characteristic of this horse is the extreme length and slenderness of the limbs combined with the primitive pattern of the teeth, which, with the exception of the somewhat greater height of the different elements and the partial separation of the metaconid and metastylid, are scarcely more progressive in the direction of the modern horse than are the teeth of some of the horses of the Lower Oligocene; though apparently the horse here described is not older than Middle Miocene.

MEASUREMENTS.

	mm.
Length of Upper Molar-premolar series except M^3	88
Length of Upper Premolar series	58
Length of M^1	15
Width of M^1	18
Height of M^1	13
Length of M^2	15
Width of M^2	18
Length of first lower temporary molar	6.5
Width of first lower temporary molar	4
Length of second lower temporary molar	18
Length of third lower temporary molar	16
Length of fourth lower temporary molar	15.5
Length of M_1	15
Width of M_1	10
Height of M_1	13
Length of radius	173
Width of shaft of radius, least	14.5
Length of tibia	225
Width of shaft of tibia, least	16
Length of median metatarsal, not less than	167
Length of median metatarsal, estimated	180
Width of shaft of median metatarsal	12.5
Length of median ungual phalanx	28
Width of median ungual phalanx	19
Length of lateral ungual phalanx	19
Width of lateral ungual phalanx	7

Merychippus ? missouriensis sp. nov.

(PLATE LXVI; LXVII, FIGURE 5; PLATE LXVIII, FIGURES 1 AND 2.)

(Type No. 905, Carnegie Museum Catalogue of Vertebrate Fossils.)

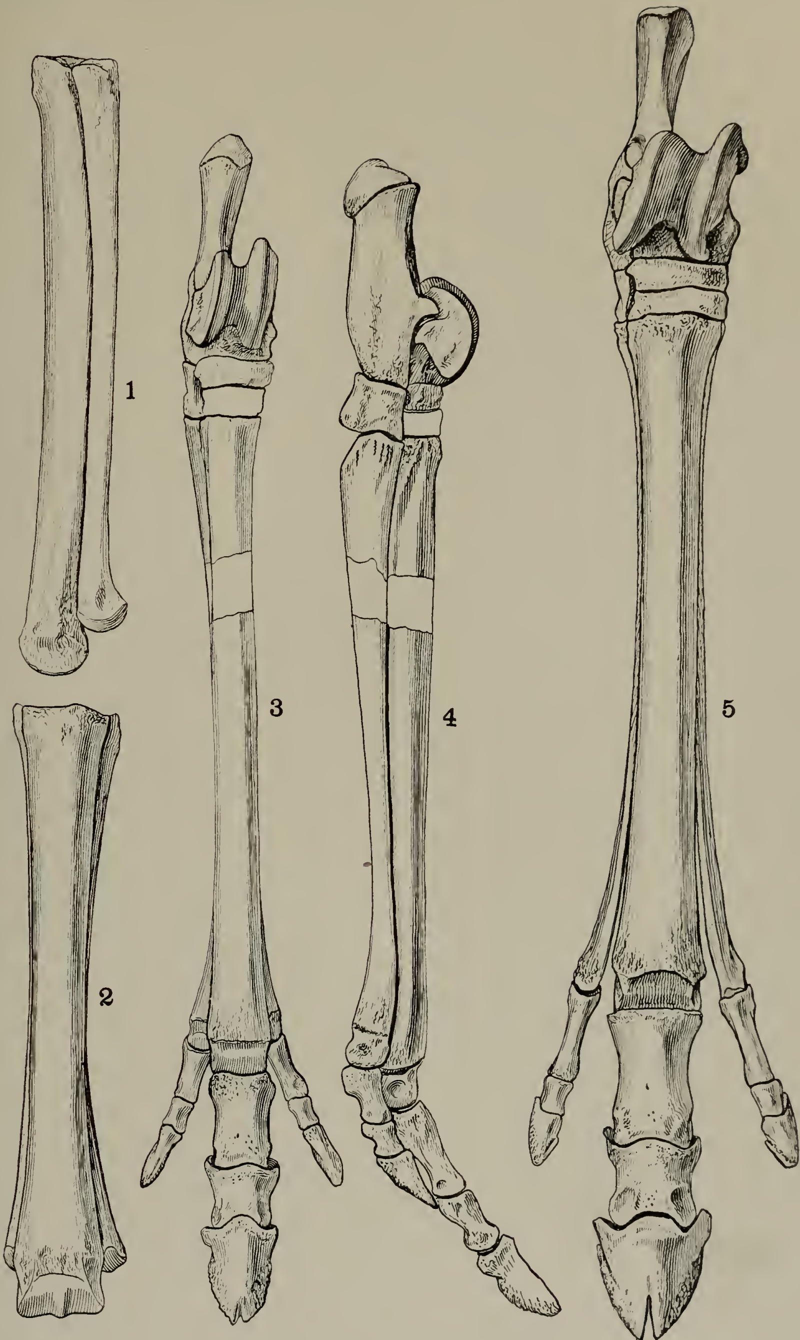
The type of this species is a portion of a skull, a mandible, a radius, two femora, two complete and two incomplete metapodials, also numerous fragments. These bones represent a young individual, which was found in the upper Miocene formation (Loup Fork). These beds form a part of the bluffs along the eastern side of the Missouri River north of Confederate Creek and east of Winston in Montana. The type was collected by Earl Douglass and Ray Roberts in 1902. From the same locality, only a few feet away, a nearly complete hind foot (No. 858) was obtained. This undoubtedly belongs to the same species as the type, and the age of the two individuals was nearly the same, as shown by corresponding portions of mandibles with teeth.

Distinguishing Characters of the Type. — (1) Lachrymal fossa long and moderately deep, (2) malar pit with steep posterior side, bounded below by a thin shelf-like malo-maxillary ridge, (3) temporary molars brachyodont or brachy-hypsodont, (4) permanent molars curved and strongly hypsodont, (5) both series of teeth with a coating of cement which is not very thick, (6) enamel-lakes simple with only one or two simple enamel-folds on each, (7) protocone and hypocone laterally compressed, the former separate from the protoconule but having an angular projection toward the latter, (8) first temporary lower molar minute, (9) intermediate external conule on lower temporary molars concave on the inside, more or less flattened on the outside, (10) metapodial nearly ninety per cent. of the length of the radius and eighty-four per cent. of the length of the femur exclusive of the proximal epiphysis.

MEASUREMENTS.

	mm.
Length of upper temporary molar series	84.2
Length of $DM\frac{1}{}$	13.7
Length of $DM\frac{2}{}$	28
Length of $DM\frac{3}{}$	22
Width of $DM\frac{3}{}$	21.5
Length of $DM\frac{4}{}$	21.5
Length of $M\frac{1}{}$	22
Width of $M\frac{1}{}$	21
Length of $M\frac{2}{}$	21
Length of mandible	260

Skull of *Merychippus missouriensis* Douglass. $\frac{1}{2}$.



Miocene Horses from Montana.

Miocene Horses from Montana. (Figs. 6 and 7 natural size; all other figures one-half natural size.)

Length of symphysis of mandible	49
Length of femur exclusive of proximal symphysis	233
Length of radius	218
Least antero-posterior diameter of femur	30
Length of median metapodial	194
Transverse width of shaft of median metapodial	17.5
Length of ungual phalanx	32.5
Width of ungual phalanx	19

Of the paratype (No. 858) there is, besides other bones, a nearly complete hind foot. The specimen was of nearly the same age as the type and the bones so far as shown have the same sizes and proportions. A figure of the foot of the paratype is given on Plate LXVII, fig. 5.

Merychippus insignis Leidy.

(PLATE LXVII, FIGURES 1 AND 2; PLATE LXVIII, FIGURES 3-5.)

Proc. Acad. Nat. Sci. Phila., Vol. VIII, 1856, p. 311.

This specimen, Nô. 1377, Carnegie Museum Catalogue of Vertebrate Fossils, consists of a portion of a maxillary with incomplete upper teeth, the horizontal rami of a mandible with the molar-premolar series of both sides, three metapodials of one foot, a femur and portions of other limb and foot bones. This specimen was found in the Miocene deposits on Deep Creek, southeast of Townsend in Broadwater County, Montana. As no other fossils were found in these deposits at this place the exact horizon cannot be determined. The specimen was collected by Earl Douglass in 1898.

Distinguishing Characters. — (1) Upper cheek-teeth transversely narrow, (2) enamel lakes comparatively simple, each having from one to three enamel-folds which are usually small, (3) protocone and hypocone of nearly equal size and connected respectively with the protoconule and metaconule, (4) symphysis of mandible shallow, but horizontal rami increasing quite rapidly in depth posteriorly, (5) $P_{\overline{1}}$ absent, (6) teeth of molar-premolar series decreasing in size from $P_{\overline{3}}$ to $M_{\overline{3}}$, and decreasing in length from $P_{\overline{2}}$ to $M_{\overline{2}}$, (7) metapodials comparatively short, (8) lateral digits small, (9) femur long, being one and one half times the length of the metapodials.

MEASUREMENTS.

	mm.
Length of lower-premolar series	109.5
Length of $P_{\overline{2}}$	21

Length of $P_{\overline{3}}$	18.5
Length of $P_{\overline{4}}$	17.5
Length of $M_{\overline{1}}$	15.5
Length of $M_{\overline{2}}$	16
Length of $M_{\overline{3}}$	21
Length of femur	247
Transverse diameter of femur	21
Antero-posterior diameter of femur	31
Length of median metapodial	165
Width of median metapodial	18

Proportion of transverse diameter to length of femur = 8.5 : 100. Transverse diameter to length of median metapodial 10.9 : 100.

EXPLANATION OF PLATE LXV.

Fossil Horses from the Oligocene Deposits of North Dakota and Montana.

All figures twice natural size.

Fig. 1. *Mesohippus portentus?* No. 1633. Two lower teeth in portion of a mandible.

Fig. 2. *Mesohippus portentus* sp. nov. Type. No. 1622. A right upper molar. Crown view.

Fig. 3. *Mesohippus portentus* sp. nov. Type. No. 1622. The same as Fig. 2. Anterior view of tooth.

Fig. 4. *Mesohippus portentus?* No. 1623. A fourth left upper molar. Crown view.

Fig. 5. *Mesohippus brachystylus?* Osborn. No. 1639. Anterior view of crown of tooth.

Fig. 6. *Mesohippus brachystylus?* Osborn. No. 1639. Crown view.

Fig. 7. *Mesohippus hypostylus?* Osborn. No. 1625. Right upper molar. Crown view.

Fig. 8. *Mesohippus hypostylus?* Osborn. No. 1625. Anterior view.

Fig. 9. *Mesohippus hypostylus?* Osborn. No. 1635. Lower teeth. External view.

EXPLANATION OF PLATE LXVI.

Skull of Merychippus missouriensis sp. nov.

Type. No. 905. From Upper Miocene deposits. From Missouri Valley, east of Winston, Montana.

One-half natural size.

EXPLANATION OF PLATE LXVII.

Miocene Horses from Montana.

All figures are one half natural size.

Fig. 1. *Merychippus insignis?* Leidy. No. 1377. From Deep Creek southeast of Townsend, Montana. Lateral view of metacarpals.

Fig. 2. *Merychippus insignis?* Leidy. No. 1377. Front view of metacarpals.

Fig. 3. *Altippus taxus* sp. nov. Type. No. 836. From Divide Creek, near Woodin, Montana. Anterior view of hind foot.

Fig. 4. *Altippus taxus* sp. nov. Type. No. 836. Lateral view of foot.

Fig. 5. *Merychippus missouriensis*. Paratype. No. 858. From Missouri Valley, east of Winston, Montana. Anterior view of hind foot.

EXPLANATION OF PLATE LXVIII.

Miocene Horses from Montana.

All figures except 6 and 7 one half natural size. Figures 6 and 7 natural size.

Fig. 1. *Merychippus missouriensis* sp. nov. Type. No. 905. From Missouri Valley, east of Winston, Montana. Left upper cheek teeth. The milk molars and the first two permanent molars.

Fig. 2. *Merychippus missouriensis* sp. nov. Type. No. 905. Inferior milk dentition.

Fig. 3. *Merychippus insignis?* Leidy. No. 1377. From Deep Creek, southeast of Townsend, Montana. Fragmentary superior dentition.

Fig. 4. *Merychippus insignis?* Leidy. No. 1377. Lower cheek teeth. Top view.

Fig. 5. *Merychippus insignis?* Leidy. No. 1377. Right ramus of mandible with cheek teeth.

Fig. 6. *Altippus taxus* sp. nov. Type. No. 836. From Divide Creek, Montana. Four temporary upper molars and first two molars of right side. Natural size.

Fig. 7. *Altippus taxus* sp. nov. No. 836. Lower temporary molars and first two permanent molars of right mandible. Natural size.

Fig. 8. *Altippus taxus* sp. nov. No. 836. Portions of skull and mandible.

XVI. SOME OLIGOGENE LIZARDS.

By Earl Douglass.

Glyptosaurus? montanus sp. nov.

(Type, No. 1050, Carnegie Museum Catalogue of Vertebrate Fossils.)

The type of this species is the greater portion of a skull and mandible, a limb bone, and several separate shields. The specimen was found by the writer in a hard nodule in the Lower White River (Titanotherium) beds north of the Big Hole River at the southeastern base of McCarty's Mountain, about fifteen miles north of Dillon in Montana. It was associated with a considerable portion of a skeleton of *Ischyromys*. The nodules containing the two specimens had been

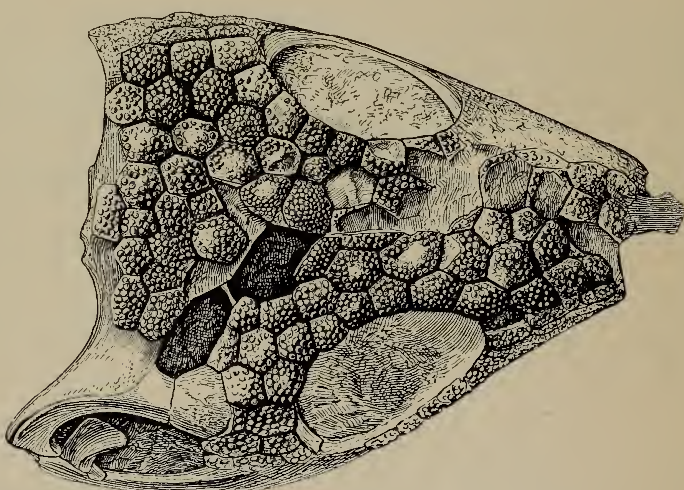


Fig. 1. *Glyptosaurus? montanus*. Type No. 1050. Top view of skull. $\frac{2}{1}$.

weathered out of the bed which enclosed them, but they were evidently not far from their original position. At nearly the same level were specimens of *Limnenetes* and *Hyracodon*.

Distinguishing Characters. — The skull is broad posteriorly and gradually narrows toward the muzzle. It is short in proportion to the width. The orbits are large and oval with the long axis antero-posterior. Their *vertical diameter is nearly the same as the distance between their upper borders. There is a superior temporal arcade. The mandible is moderately heavy. The teeth are smooth, have low rounded chisel-shaped crowns, and are pleurodont. Those on the maxillary are directed slightly backward. The skull is nearly covered with tuberculated osseous shields which are arranged in a concentric manner around the orbits. These shields are not large but vary somewhat in size and form. They are convex on the upper surfaces and are covered with minute tubercles, which are nearly equal in size.*

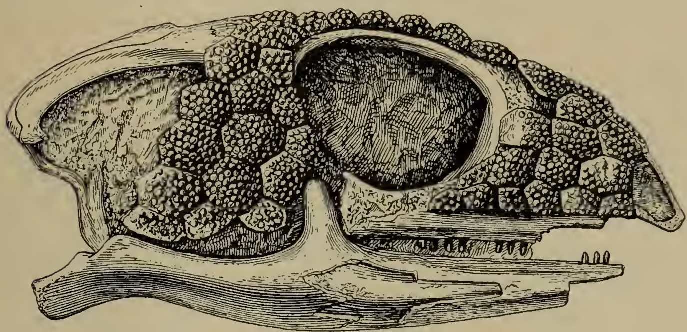


FIG. 2. *Glyptosaurus? montanus.* Type No. 1050. Side view of skull. Part of plates posterior to the orbit restored from the other side. $\frac{2}{1}$.

Detailed Description. — The parieto-frontal plane of the skull is flat and very broad, twice as broad as the space between the orbits. Beginning above the anterior portion of the orbits the superior plane of the skull slopes downward to the anterior portion of the muzzle. The orbits are large and elliptical, the longer axis being in the direction of the long axis of the skull.

There is a superior temporal arcade, and the jugal arch is heavy. The upper surface of the parietal was covered with shields. On removing these plates along the anterior border of the parietal and the matrix from the under surface of the bone it was seen that there was no contact with the frontal or any bone anterior to the parietals, except what appears to be a small thread of bone from the antero-external surface of the parietal to the frontal or post-orbital. I am not able to say whether this is a normal condition or not, as there is no other skull with which to compare the type. The space between the bones, like the remainder of the roof of the skull, was covered with hard bony shields. The parietal sends out wings postero-laterally. These wings are sharp and thin anteriorly, but have ridges on their postero-inferior surfaces. Their upper surfaces are slightly convex, but are nearly in a horizontal plane. They do not face upward and forward as in *Iguana*. The parietal overlaps the squamosal with which it has a long surface of contact. The squamosal is long and sickle-shaped. The shields prevent one from determining how far the bone extends anteriorly. There are no separate mastoid or prosquamosal bones. The quadrate is in place, but not all of it can be seen. It has a posterior longitudinal angle or ridge and the posterior upper portion of the bone projects backward. The frontals between the orbits are only moderately thick.

The mandible is quite thick transversely and is rounded on the inferior surface. The post-dentary portion is nearly or quite as long as the dentary portion. It arches outward, the articulate portion being bent inward. The coronoid process is quite high. The teeth form an even row and are only a short distance apart. In the upper jaw the teeth which are visible increase slightly in height anteriorly. Apparently their antero-posterior diameters are slightly greater than their transverse diameters. They are low and their apices rounded.

The hard, osseous shields nearly cover the bones of the skull and the spaces between them. They vary in size, but none are as large proportionally as those of *Helodermoides tuberculatus* Douglass. Their upper surfaces are convex, and the forms of their peripheral boundaries vary with the amount of crowding of the contiguous shields. Some are nearly circular, some four-, some five-, and some six-sided. They are arranged with a fair degree of regularity around the orbits. Each orbit had about twenty of these shields surrounding it in the fringing row or circle; the next row had at least twenty-three and probably twenty-six. The third row was not continuous, but was interrupted beneath the orbit, and the two rows on the opposite sides unite on the median line of the skull between the orbits, thus making five complete rows here. Posterior to the lower portion of the orbit the shields are larger. A central shield is surrounded by five large shields and one small shield. The three concentric rows around the orbits do not include an area on the median posterior parietal portion of the skull, which is covered with about a dozen or more shields which are arranged in the form of a triangle, these short rows composing it extending in the same direction as the contiguous concentric rows. A little above the dental borders of the maxillaries the shields end abruptly, leaving a border of the maxillary bare. There were undoubtedly shields on the skin of the lower part of the head or throat. There are six still in the matrix beneath the post-coronoid portion of the mandible. There are also some larger, rather thin shields, which probably belong to the lower part of the body.

The tubercles on the shields of the head are arranged in imperfectly concentric rows. There are from three to five or six of these rows on each scute. The tubercles are nearly equal in size. As before stated the shields are convex on the upper surfaces.

MEASUREMENTS.

	mm.
Length of skull, approximately	48
Posterior width of skull	35
Width of skull between the orbits	12
Height of skull	16
Height of skull including mandible	23
Antero-posterior diameter of orbit	19
Vertical diameter of orbit	10
Antero-posterior diameter of largest shields on skull	5
Transverse diameter of largest shields on skull	3.2
Length of body shields	7.4
Estimated length of humerus	30
Diameter of shaft of humerus	2.7

These remains probably represent a lizard not less than 13 or 14 inches in length.

This specimen undoubtedly belongs to the family Anguidæ, and apparently to the genus *Glyptosaurus* Marsh, though I have not had the opportunity of examining the various types of *Glyptosaurus* and they are not figured.

In all the species as in all known members of the family Anguidæ the skull is covered with shields and the teeth are pleurodont.

For convenience I give below the characters of the different species given by Marsh. This will aid in making comparisons with the specimens here described.

Glyptosaurus sylvestris Marsh.

American Journal of Science (3), I, 1871, p. 456.

The shields on the frontals between the orbits are of moderate thickness and are but little elevated. In the middle row on each frontal they are broader than long. Each shield is covered with small polished tubercles without definite arrangement. From Bridger beds, Grizzly Buttes, Wyoming.

Glyptosaurus nodosus Marsh.

American Journal of Science (3), I, 1871, p. 458.

Frontals thicker on median suture than those of *Glyptosaurus sylvestris*. Shields between orbits very convex. The middle shield on the frontals longer than wide and hexagonal. Length of animal about three feet. From Bridger beds, Grizzly Buttes, Wyoming.

Glyptosaurus oscellatus Marsh.

American Journal of Science (3), I, 1871, p. 458.

Cranial plates very thick and united by sutures, and having the tubercles in concentric series. The outer row considerably larger than the others. The next two or three rows considerably smaller, and the inner rows very small, without definite arrangement. Larger than *Glyptosaurus sylvestris* or *G. nodosus*. Bridger beds, Grizzly Buttes, Wyoming.

Glyptosaurus princeps Marsh.

American Journal of Science (3), IV, 1872, p. 302.

Lower teeth close together. Bases deeply fluted. Frontal very massive. Malar arch complete. Parietals thick with a parietal foramen. Length fully six feet. Bridger beds, Grizzly Buttes, Wyoming.

Glyptosaurus brevidens Marsh.

American Journal of Science (3), IV, p. 305.

Teeth rod-like, close together, and short, part of them barely projecting from the jaw. Summits obtuse and marked by irregular striæ. Dermal scutes on malar region very thick, and heavy; tubercles in concentric rows. More than four feet long. Bridger beds, Grizzly Buttes, Wyoming.

Glyptosaurus rugosus Marsh.

American Journal of Science (3), IV, p. 305.

Osseous scutes on frontals smaller than in *Glyptosaurus sylvestris*. Prominently convex. Tubercles nearly equal in size, without definite arrangement. Prefrontals and postfrontals approach more nearly to each other above orbit. About three or four feet long. Bridger beds, Grizzly Buttes, Wyoming.

Glyptosaurus sphenodon Marsh.

American Journal of Science (3), IV, p. 306.

Referred doubtfully to *Glyptosaurus.* Teeth different from any previously described from Green River Basin. Crowns of upper teeth long and cylindrical, separated slightly, and directed obliquely backward, compressed and very sharp, bases rugose. Animal two or three feet long. From Henry's Fork, Wyoming.

Glyptosaurus anceps Marsh.

American Journal of Science (3), I, 1871, p. 458.

Only vertebræ known. They represent an animal about two feet long. From Grizzly Buttes, Wyoming.

Rhineura hatcheri Baur.

(FIGURES 3–5.)

American Naturalist, Vol. XXVII, 1893, p. 998.

On the page cited above Dr. George Baur briefly described without figures, two Amphisbænians, *Rhineura hatcheri* and *Hyporhina antiqua.*

On 1901 Mr. O. A. Peterson obtained two nearly complete skulls[1] of the former species and a fragment of a third, from the White River formation on Bad Land Creek in Sioux County, Nebraska.

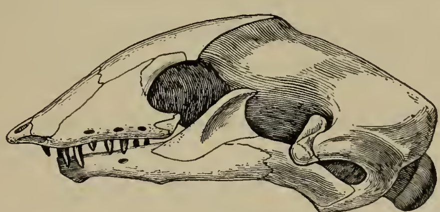


FIG. 3. *Rhineura hatcheri.* (No. 423A.) Side view of skull. $\frac{4}{1}$ *nearly.*

The distinguishing characters of *Rhineura hatcheri* given by Bauer are the following:

Nasals inferior in position; the single premaxillary widely separated from the frontals by the nasals which are distinct and which extend to the border of the muzzle overroofing the nostrils; prefrontal large and placed between the parietal, frontal, and maxillary, forming the superior border of the orbit; jugal rudimentary and connected with the

[1] No. 423, Carnegie Museum Catalogue of Vertebrate Fossils.

maxillary only; no post-orbital arch; one tooth on the premaxillary and six pointed teeth on each maxillary. Length of the skull from the middle portion of the condyle to the anterior end of the premaxillary

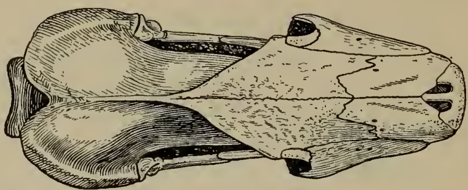


FIG. 4. *Rhineura hatcheri.* (No. 423A.) Top view of skull. $\frac{4}{1}$ *nearly.*

13 mm. Transverse diameter of the skull between posterior ends of maxillaries 5½ mm. Distinguished from *Rhineura floridana* Baird by the slenderer form of the skull.

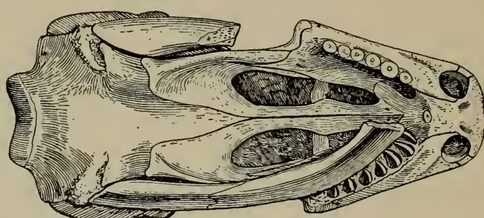


FIG. 5. *Rhineura hatcheri.* (No. 423B.) Palatal view of skull. $\frac{4}{1}$ *nearly.*

The accompanying illustrations of the skulls in the Carnegie Museum (No. 423) show very well the relations of the different bones.

Peltosaurus granulosus? Cope.

Paleontological Bulletin, No. 15, 1873, p. 5.

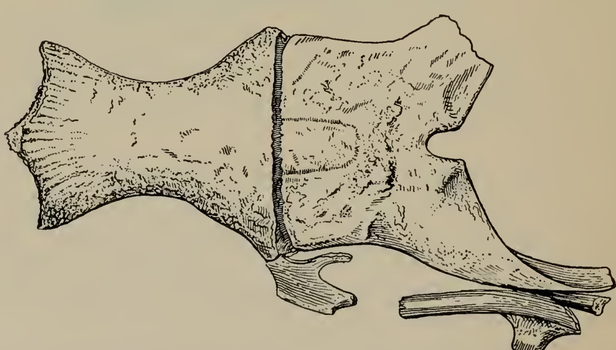


FIG. 6. *Peltosaurus granulosus.* (No. 425.) Top view of part of skull. $\frac{2}{1}$ *nearly.*

The type of this species consists of portions of a skull and skeleton, parts of which were figured and described by Cope in his Tertiary Vertebrata (pages 773–775, Plate LX, figs. 3–11).

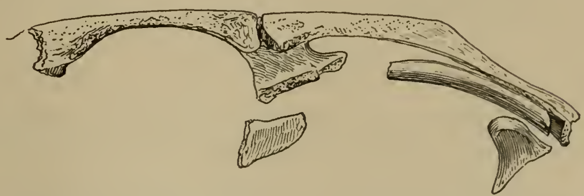


FIG. 7. *Peltosaurus granulosus.* (No. 425.) Side view of part of skull. $\frac{2}{1}$ *nearly.*

A portion of a skull (No. 425, Carnegie Museum Catalogue of Vertebrate Fossils) was found by O. A. Peterson in the Middle White River (Oreodon) beds, on Prairie Dog Creek in Sioux County, Ne-

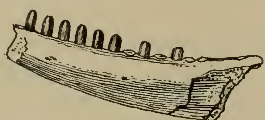


FIG. 8. *Peltosaurus granulosus.* (No. 425.) Portion of a mandible. $\frac{2}{1}$.

braska. As this specimen shows some portion of the skull not figured by Cope drawings of it are given in this paper.

XVII. DESCRIPTION OF THE TYPE SPECIMEN OF STENOMYLUS GRACILIS Peterson.[1]

By O. A. Peterson.

Since the first account of this aberrant cameloid was issued the remainder of the type specimen has been cleared from the matrix and is here more fully described in connection with a number of illustrations. In view of the additional material which has been collected recently in the same locality and geological horizon (the lower Harrison beds of Nebraska) by different field parties it is thought that a more detailed description of the type, especially the cervical vertebræ, the limbs and the feet, may be of interest and assistance to the student.

Stenomylus Gracilis Peterson.

(Type No. 1610, Carnegie Museum Catalogue of Vertebrate Fossils.)

The Skull.

Some characters of the skull are, as has been stated on pages 41–43 of this volume, entirely different from any cameloid living or extinct. Thus, the large size and anterior position of the posterior nares with relation to the pterygoids (see Plate XII), the hypsodont, elongated and narrow molars, the high position of the eye (the anterior border of the orbit is on a vertical line with the posterior face of m^3 when the skull rests on the paroccipital processes and the dentition), and the incisiform lower canine and first premolar, which form a continuous series with the incisors, are characters most unusual; while the skull is otherwise quite like that of the Miocene camels generally.

In my first description (*l. c.*, p. 42) of the skull I stated that the skull has no sagittal crest, which is incorrect, since I was not then aware of the short and rather broad eminence of the parietals immediately anterior to the occiput on account of the damaged condition of the skull in this region. The general arrangement of the base of the skull back of the pterygoids is not unlike that of *Lama huanaco*. In fact the general contour of the entire skull seems to be unusually

[1] Annals of the Carnegie Museum, Vol. IV, No. 1, pp. 41–43, Pl. XII, 1906.

advanced in comparison with other Miocene camels, which are known, and more nearly approaches that of the recent form.

Foramina. — The condyloid foramina are, as in *Lama huanaco*, well back and cannot be seen on a direct palate view. The posterior, median, and anterior lacerated foramina occupy the same identical position as those in the *Lama*. And, as in the latter genus, the foramen ovale is immediately lateral to the foramen lacerum anterius and at the antero-external angle of the tympanic bulla. The foramen rotundum is also in the same relative position as that in the recent genus and

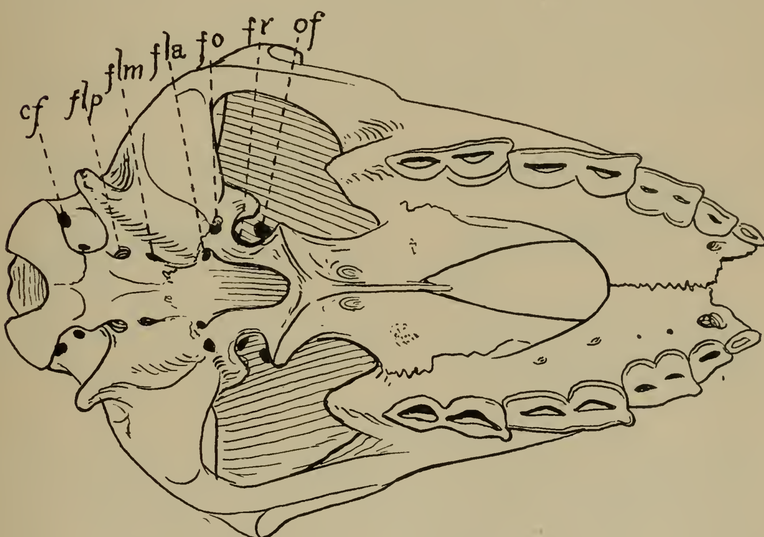


FIG. 1. Diagram of skull of *Stenomylus gracilis* indicating the position of the foramina. Type No. 1610. ⅔ nat. size. *cf*, condylar foramen; *flp*, foramen lacerum posterius; *flm*, foramen lacerum medium; *fla*, foramen lacerum anterius; *fo*, foramen ovale; *fr*, foramen rotundum; *of*, foramen opticum.

cannot be seen on a direct palate view, as the base of the pterygoid overhangs the exit (Fig. 1 is only a diagram indicating the different foramina). The optic foramen is relatively somewhat large and is placed closer to the foramen rotundum than is the case in *Lama huanaco*. The surface of the bone in the region of the lachrymal foramen is broken away, so that its position cannot be ascertained. The palatine foramina are small and distributed along the palate close to the alveolar border. The largest foramen is opposite p^4, while in

Lama huanaco, here used for comparison, the corresponding foramen is slightly further back (opposite the anterior portion of m^1).

The general outline of the lower jaw is quite similar to that in the recent genus. The diastemata in front of the molar series are, however, shorter, as are also the coronoid processes. The inferior sigmoid notch is shallower, and the posterior face of m_3 is closer to the base of the coronoid process than in *Lama huanaco.*

Cervical Vertebræ. — The atlas and axis are not present in the type but the succeeding cervicals are all represented. The third cervical vertebra is represented only by the posterior portion, which is identical, except in the smaller size, with that in *Oxydactylus longipes* Peterson. The fourth cervical is very nearly complete and is very long and slender. The neural spine is represented only by a small rugose

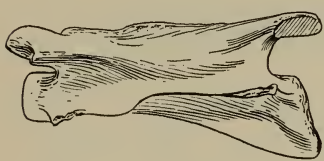


FIG. 2. Fourth cervical vertebra of *Stenomylus gracilis.* Left side. Type No. 1610. ½ nat. size.

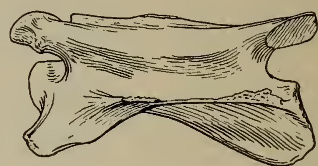


FIG. 3. Fifth cervical vertebra of *Stenomylus gracilis.* Left side. Type No. 1610. ½ nat. size.

elevation on the superior face in the middle of the neural arch. The neural canal is of fairly large size and subcircular in outline. The prezygapophyses are well separated by a deep emargination of the neural arch, while the postzygapophyses are separated only by a very shallow emargination as in *Oxydactylus longipes* and unlike that in *Lama huanaco.* On the ventral surface is a very strong keel which results in giving to the posterior face of the centrum a subtriangular outline. The anterior face of the centrum is quite hemispherical. The anterior division of the transverse process projects outward and downward and the posterior portion projects more directly outward. There is no visible vertebrarterial canal. On the whole the vertebra is, except for its smaller size and less developed neural spine, almost identical with that of *Oxydactylus longipes.*

The fifth cervical differs from the fourth practically only by its greater robustness. Its neural spine is very little increased in size and the bone as a whole is slightly shorter than the preceding vertebra.

The posterior division of the transverse process terminates anteriorly in a compressed and sharp ridge which continues forward a short distance on the external face of the anterior division of the process. This character is less pronounced in *Oxydactylus* and *Lama huanaco*. There is no visible vertebrarterial canal piercing the pedicels, the anterior portion of the neural canal being damaged in the region where it would be located.

The sixth cervical is nearly complete anteriorly, while posteriorly it is represented only by the postzygapophyses. The neural spine of this vertebra is of greater prominence than on the two preceding vertebræ, but is relatively less developed than in *Oxydactylus*. The zygapophyses face upward more obliquely than on the preceding

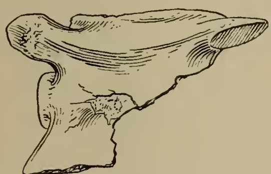


FIG. 4. Sixth cervical vertebra of *Stenomylus gracilis*. Left side. Type No. 1610. ½ nat. size.

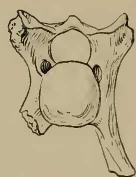


FIG. 5. Sixth cervical vertebra of *Stenomylus gracilis*. Anterior view. Showing the vertebrarterial canal. Type No. 1610. ½ nat. size.

vertebræ, and are also more expanded laterally. The transverse process is broken off close to its base, but enough is preserved to show that in relative size and position it is identical with that of *Oxydactylus*. The lamella below the process is apparently fully as well developed, pointing downward in its anterior region, and was perhaps a thin plate of bone, as in *Oxdactylus* and *Poëbrotherium*, while that in *Lama huanaco* is distinctly divided into an anterior and a posterior portion. The vertebrarterial canal is visible at the base of the pedicle, as in *Oxydactylus* and the recent genera (see fig. 5).

The greater portion of the seventh cervical vertebra is present in the type. Its neural arch is quite heavy, but the spine was evidently comparatively small in proportion. The centrum is damaged anteriorly and posteriorly, but the transverse process of the right side is present; it is a heavy plate of bone, which apparently covered a considerable portion of the lateral face of the centrum. There is no vertebrarterial canal in the seventh cervical.

MEASUREMENTS.

		mm.
Fourth cervical.	Greatest length	83
Fourth cervical.	Length of centrum	75
Fourth cervical.	Transverse diameter of centrum, anteriorly	14
Fourth cervical.	Vertical diameter of centrum, anteriorly	14
Fifth Cervical.	Greatest length	80
Fifth Cervical.	Length of centrum	72
Fifth Cervical.	Transverse diameter of centrum, anteriorly	16
Fifth Cervical.	Vertical diameter of centrum, anteriorly	15
Fifth Cervical.	Vertical diameter of centrum, including keel, posteriorly.	23
Sixth Cervical.	Greatest length	67
Sixth Cervical.	Transverse diameter of centrum, anteriorly	17
Sixth Cervical.	Vertical diameter of centrum, anteriorly	17
Seventh Cervical.	Greatest length	42

Fore Limb.— The humerus of *Stenomylus gracilis* is relatively short. The head is well formed and occupies a considerable portion of the proximal end, with the antero-posterior diameter[2] apparently somewhat greater than the transverse. The great trochanter is very prominent and rises high above the head, terminating radially in an obtuse heavy tubercle, which overhangs the bicipital groove very extensively. The lesser trochanter is also quite prominent and rises to a somewhat less elevation, terminating in a laterally compressed tubercle, which forms the radial border of the deep and narrow bicipital groove. On the antero-radial face of the lesser tuberosity is a broad shallow groove, which corresponds to the much deeper and narrower groove in the recent camels. The deltoid ridge does not extend as low down on the shaft, but terminates in a small oblong tubercle, which projects over the ulnar border of the shaft. Below the deltoid ridge the shaft is contracted rapidly in the antero-posterior direction, though of a greater diameter in the latter direction than in the transverse, which makes the cross-section ovate. Nearer the distal end the shaft changes to a greater transverse diameter, which is due to the development of the supinator ridge. The latter has the same relative development as in *Oxdactylus* and *Lama huanaco*, but less than in *Camelus bactrianus*. The transverse diameter of the distal end is considerable. The supratrochlear fossa is low, shallow and broad. The anconeal fossa is also rather low, but narrow and deep. The entepicondyle is quite prominent and terminates distally in an enlarged tubercle which

[2] The proximal end of the humerus is slightly crushed, which undoubtedly adds somewhat to this measurement.

projects downward and outward, forming an interlocking hook on the radial face of the ulna when the humerus is articulated with the latter.

Fig. 6. Anterior view of humerus of *Stenomylus gracilis*. Type No. 1610. $\frac{1}{2}$ nat. size.

Fig. 7. Radial view of ulno-radius of *Stenomylus gracilis*. Type No. 1610. $\frac{1}{2}$ nat. size.

The trochlea is rather broad transversely, with the intertrochlear ridge little developed and shifted well over toward the ulnar border.

The ulno-radius is very long and slender. The two bones are well coössified, leaving little or no indication of a suture between them. The olecranon process of the ulna projects but little above the sigmoid notch and is much compressed transversely, while antero-posteriorly its diameter is considerable; it is in every respect similar to that in *Oxydactylus* except in the absence of the groove for the extensor tendon on the anterior superior face of the process. The absence of this groove is also characteristic of the recent camels. The articulation of the sigmoid notch is divided by a prominent ridge which is placed further over towards the ulnar border than in *Oxydactylus*, and in this respect it is more nearly like the recent camels. The radial border of the sigmoid notch is different from that in *Oxydactylus* and the recent camels in having an interrupted area in the deepest part of the notch. This sulcus is comparatively shallow and does not extend to the median ridge, thus leaving the internal facet for the humerus uninterrupted throughout to the upper extremity of the sigmoid notch of the ulna, as in the latter genera. The head of the radius has a large tubercle for muscular attachment on the ulnar face, which adds considerably to the transverse diameter and furnishes characters quite similar to those in *Camelus bactrianus*. Immediately below the head of the radius the shaft of the ulno-radius is rapidly contracted, so that its diameters are nearly uniform throughout. Proximally the shaft is strongly arched forward, while the distal two thirds have an almost vertical position when articulated with the limb. The distal end has a considerable transverse expansion. The three facets for the carpus are divided in nearly the same proportion as in the camel and *Lama huanaco*, *i. e.*, the facet for the pyramidal is broad, while that for the lunar is of comparatively small transverse diameter. In *Oxydactylus* the lunar facet occupies a comparatively greater area, while that for the pyramidal is the smallest of the three. The articulation as a whole has not the oblique appearance seen in the latter genus.

Carpus. — The carpus as a whole is rather high and its transverse diameter is correspondingly small. The scaphoid has very nearly the same relative proportions as in *Lama huanaco* and is consequently of proportionately greater transverse diameter than in *Oxydactylus*. The lunar is more compressed laterally than in the latter genus and approaches more closely to the condition of this bone found in the recent forms. The pyramidal again compares more closely with the same bone in recent forms than in *Oxydactylus*, though possessing comparatively a slightly less transverse diameter than in the former genus. The pisiform is in its outline almost identical with that of *Lama huanaco*, but slightly longer in proportion. In *Oxydactylus*, this bone has a longer shaft and does not have the oblique postero-inferior face of the free end seen in the present genus, but is more cubical in outline.

In view of the general modification of the fore limb, which seems to be slightly more advanced than in *Oxydactylus* and perhaps the Miocene camels generally, it is surprising to find a trapezium of nearly the same proportions as in *Oxydactylus longipes*. The trapezium of the present genus is an oblong nodule resembling a sesamoid. The anterior face is entirely taken up by a large articular facet for the trapezoid, which is at right angles with a smaller facet for the scale-like mc. II on the distal face of the bone. The trapezoid is in its proportions and outlines more nearly like that in *Oxydactylus* than in *L. huanaco*. The facet for the trapezium is of the same relative size as in the former and the convex articular surface for the scaphoid meets the latter facet at an open angle on the posterior face of the trapezoid. The magnum possesses a relatively greater antero-posterior diameter than in *Lama huanaco*, which is chiefly due to the relatively larger palmar hook in the present genus. This hook is much compressed laterally and the articulation for the third metacarpal extends well back on its distal face quite like that in *Oxydactylus*. The unciform is comparatively narrow and deep; its palmar hook, though proportionately somewhat lighter than in *Oxydactylus*, is, nevertheless, similar to it. The bone as a whole is more nearly like that in *Oxydactylus* than in the recent forms. The

FIG. 8. Anterior and radial views of fore foot of *Stenomylus gracilis*. Type No. 1610. ½ nat. size. *tm*, trapezium.

latter have the postero-ulnar angle of the unciform greatly enlarged in order to furnish support for the laterally expanded pyramidal above, and the head of mc. IV below.

The second metacarpal is not present in the type, but the small excavation on the postero-radial angle of the third metacarpal together with the articular facets on the trapezium, trapezoid, and the proximal end of mc. III, make it quite evident that there was a short scale-like mc. II in the manus of *Stenomylus gracilis*. On the postero-ulnar angle of mc. IV are two small facets which indicate the presence of a rudiment of mc. V. The unciform also has a very minute facet at the base of the palmar hook which articulated with this scale-like metacarpal. The third and fourth metacarpals are coössified one half the distance of their length, with the distal ends very slightly diverging. The head of the canon-bone is very little expanded transversely. On the dorsal face immediately below the articular facets there are prominent tubercles for muscular attachment, which are quite similar to those in *Camelus bactrianus*, though somewhat more prominent. The anterior face of the shaft is very convex, the lateral faces less so, and posteriorly the two bones meet to form a deep narrow groove, which extends down the shaft two thirds of its length. Distally the diverging shafts of the canon-bone show a more oblong outline in cross-section, having the transverse diameter greater than the antero-posterior. The distal trochleæ of the individual bones (mc. III and IV) are very little more expanded transversely than the shafts, and are in this respect identical with *Oxydactylus*, while in the recent forms the distal ends have a greater expansion laterally. The carina is damaged in the type, but enough is present to indicate that it was of considerable development, but confined entirely to the plantar face of the trochlea. All the phalanges of the manus are unfortunately not present in the type specimen.

Measurements.

	mm.
Greatest length of humerus	195
Length of humerus from head to distal end	181
Antero-posterior diameter of proximal end of humerus[3]	52
Greatest transverse diameter of head of humerus	37
Transverse diameter of distal end of humerus	33

[3] The proximal end of the humerus has received some crushing laterally, which, in part, may be due to the great diameter antero-posteriorly.

Antero-posterior diameter of distal end of humerus	27
Greatest length of ulno-radius	254
Greatest length of radius	225
Transverse diameter of head of radius	32
Greatest transverse diameter of distal end of ulno-radius	30
Greatest antero-posterior diameter of distal end of ulno-radius	20
Greatest height of carpus	22
Greatest transverse diameter of carpus	26
Greatest length of mc. III	184
Greatest length of mc. IV	182

Hind Limb. — The femur is proportionately short when compared with that of *Lama huanaco*, and especially so with that of *Camelus bactrianus.* It is relatively but very little longer than in *Oxydactylus longipes.* In the type specimen the greater and lesser trochanter and the rotular trochlea are broken away and lost, and the shaft of the bone has also received considerable crushing. The head and distal end are, however, quite perfect. The former is well rounded and the pit for the round ligament is rather small and located on the posterior half of the head on the tibial angle. The bridge from the head to the greater trochanter is compressed antero-posteriorly and the digital fossa is probably of the same relative size as in *Oxydactylus.* The lesser trochanter is damaged, but enough is present to indicate that its relative position and size are the same as in *Oxydactylus; i. e.*, its superior limit is on a line with the lower margin of the digital fossa as in *Lama*, and higher than in the camel. The shaft has a considerable forward arch, and the internal and external supracondylar ridges are fully as well developed as in the *Lama*, but the linea aspera is apparently of relatively less development. The distal end is not much expanded transversely. The internal condyle is smaller than the external and is placed obliquely to the long axis of the bone. The intercondylar notch is shallow, and, as in *Oxydactylus*, narrow and oblique.

The tibia is long, slender, and straight, with enlarged proximal and distal ends. The antero-posterior diameter of the proximal end is especially conspicuous when compared with the tibia of the recent forms. The articular facets for the femur are nearly equally divided by the prominent bifid spine; the external facet is slightly wider than the internal, and terminates in a prominent process on the postero-fibular angle. On the posterior face of the shaft, immediately below the head, the external and internal borders are much less developed than in *Oxydactylus*, and the fossa below the popliteal notch is consequently very much shallower and more nearly like that found in the llama and the camel. The external face has a deeper fossa, which is

FIG. 9. Anterior and tibial views of femur of *Stenomylus gracilis*. Type No. 1610. ½ nat. size.

FIG. 10. Fibular view of tibia of *Stenomylus gracilis*. Type No. 1610. ½ nat. size.

bounded above by the overhanging border of the head, posteriorly by the external border, and anteriorly by the cnemial crest ; distally the fossa very soon fades away on the fibular face of the shaft. The cnemial keel is very prominent, but proportionally shorter than in *Oxydactylus;* a character which again more nearly approaches the recent forms. The distal end is considerably expanded transversely. The articular facets for the astragalus are nearly in a straight fore-and-aft direction, as in the recent forms, and are divided by a prominent ridge much as in these. The fibula, or external malleolus, is not present in the type specimen.

Tarsus. — The tarsus is very high and narrow and in general proportions quite similar to that in *Oxydactylus longipes.* The shaft of the calcaneum in *Stenomylus gracilis* is thinner along the plantar border than in *Oxydactylus.* There is also a more decided prominence on the plantar angle immediately back of the facet for the cuboid, which causes a greater antero-posterior diameter of the calcaneum at this point than in the latter genus; otherwise there is little or no difference, except in the size of this bone, in the two genera. The astragalus is high and narrow. The external condyle is larger and higher than the internal, which gives a slight asymmetry to the proximal trochlea. The internal portion of the facet for the navicular is slightly less convex transversely than in *Oxydactylus* and the recent forms, but the distal trochlea is otherwise similar to the camels generally. The cuboid, as in *Oxydactylus longipes*, has a large plantar hook. This gives to the bone an unusually great antero-posterior diameter, while the transverse diameter is small. The proximal face is taken up by the facets for the calcaneum and astragalus in a more nearly equal proportion than in *Oxydactylus.* In the latter the plantar portion of the astragalar facet terminates in an ascending hook, which is forced farther inward than in the genus here described. In the recent form (*Camelus bactrianus*) the cuboid has no plantar facet for the astragalus, as the ascending hook, represented in the older genera, has become entirely separated from the calcaneal facet by a deep excavation, and the hook is lateral and has an articular facet for the navicular on the tibial face. The general proportions of the navicular are very similar to that in *Oxydactylus longipes* and the only noticeable difference is a

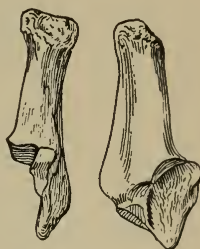


FIG. 11. Anterior and tibial views of calcaneum of *Stenomylus gracilis.* Type No. 1610. $\frac{1}{2}$ nat. size.

smaller development of the large[4] and rugose tubercle which takes up a considerable portion of the tibial face of the bone in the latter genus. In the recent forms, especially *Camelus bactrianus*, the tibial face of the navicular is much enlarged, which is due to a still further development of the large and rugose protuberance in the older forms referred to above. The ecto-meso-cuneiform has a rather small antero-posterior (13 mm.) diameter, while the transverse (10 mm.) is relatively greater than in *Oxydactylus* and the recent camels. On the fibular face the facet for the cuboid takes up the anterior half of the bone and is proportionally of greater size than the corresponding facet in *Oxydactylus* or the llama. The ecto-meso-cuneiform in *Stenomylus* differs from that in *Camelus bactrianus* by the absence of the prominent tubercle on the fibular side which abuts against the cuboid. The ento-cuneiform is of irregular triangular outline, compressed laterally, and of considerable expansion antero-posteriorly, especially in the distal half of the bone, where a prominent tubercle is located on the fibular angle, which articulates with the plantar process on mt. IV in the same manner as in *Oxydactylus longipes*.

The second metatarsal is represented only by a small bony nodule adhering to the postero-tibial angle of mt. III, and has an articular facet on the superior face for the entocuneiform. The third and fourth meta-

FIG. 12. Anterior and tibial views of hind foot of *Stenomylus gracilis*. Type No. 1610. $\frac{1}{2}$ nat. size. *ec*, Entocuneiform; *mt II*, metatarsal II.

[4] In my description of *Oxydactylus longipes* (*Annals Car. Mus.*, Vol. II, No. 3, p. 465, 1904, seventh line from the top) the word "small" tubercle is inserted, which should read "large" tubercle.

tarsals are more completely fused than the metacarpals. They are also somewhat longer and slenderer. Metatarsal III is slightly heavier than mt. IV, although the shaft of the latter has a greater antero-posterior diameter in the middle region, causing an asymmetrical appearance of the posterior face of the canon-bone. The head of mt. III rises slightly above that of mt. IV and has a larger facet for the tarsals than the latter. The plantar processes are as prominent as in *Oxydactylus* and carry the articulations for the entocuneiform and the cuboid in a similar manner. The minute trace of an articular surface on the postero-fibular angle of the cuboid and a correspondingly small facet on the postero-fibular face of mt. IV would seem to indicate that there might have been present a rudiment of a fifth metatarsal in the type specimen.[5] As in the metacarpals the distal end of the canon-bone is not much expanded, and the trochleæ of the individual bones are very little wider than the shafts. The carina is confined to the plantar face and is somewhat narrower, though of about the same relative development as in *Lama huanaco.* The proximal row of the phalanges are present in the type. They are long and slender, though proportionally shorter than in *Lama huanaco*, and in this respect more nearly like those in *Oxydactylus.* As in the latter genus the proximal articulations are more widely separated by the deeper grooves for the metapodial keels than is seen in the recent genera, and the shafts are more nearly cylindrical. The greater portion of the distal articulation for the second row of phalanges is on the plantar face of the bone ; a distinctively *Tylopodan* character.

MEASUREMENTS.

	mm.
Length of femur from head to distal end	205
Transverse diameter of head of femur	19
Antero-posterior diameter of head of femur	19
Transverse diameter of distal end of femur	34
Greatest length of tibia	248
Greatest antero-posterior diameter of head of tibia	53
Greatest transverse diameter of head of tibia	38
Greatest transverse diameter of distal end of tibia, fibula not included	30
Greatest antero-posterior diameter of distal end of tibia	20
Height of tarsus from top of external condyle of astragalus to distal articular face of cuboid	45

[5] In another specimen (No. 1340, Car. Mus. Cat. Vert. Foss.), referred to the same species, the second and fifth metatarsals are present and the two are of about the same size.

Transverse diameter of tarsus at proximal portion of cuboid	23
Greatest length of calcaneum	60
Length of tuberosity of calcaneum from sustentacular facet to the free end	38
Antero-posterior diameter of calcaneum at the fibular facet	28
Greatest height of astragalus	30
Greatest transverse diameter of astragalus	18
Greatest antero-posterior diameter of astragalus	17
Greatest length of the metatarsals	198
Greatest length of proximal phalanx of third digit	44

Summary.

Having carefully compared the above described type with *Oxydactylus longipes* and the recent camels, it is very plain that we are (1) dealing with an animal which is descended from the early *Tylopodan* stem and which (2) branched off in the Tertiary (perhaps in the late Eocene) to form (3) one of the most curious combinations of characters yet discovered in the numerous genera and species representing that family in geological times. The chief peculiarities are in the cranial structure, which have already been discussed in the present article and elsewhere, and are well shown in the accompanying illustrations and also on Plate XII of this volume.[6] The osteological structure, outside of certain portions of the skull, is altogether more nearly similar to that in *Oxydactylus* than the recent forms. In fact were it not for the good fortune of finding the skull connected with the rest of the type specimen I should perhaps not have ventured to suggest a generic name, since the characters of the different bones of the skeleton so much resemble the Miocene camels generally. That the habits of this animal were different from those of most Miocene camels is quite evident, judging from the cranial characters enumerated above. It would seem that *Stenomylus* should be regarded as the type of a new subfamily, the erection of which, however, would better be postponed until a thorough systematic study of the whole group is made. The type above described is of much interest and furnishes a very forcible evidence of the attempt at survival of many diverging lines representing the Camelidæ in the late Tertiary time.

Carnegie Museum, Pittsburgh, Pa.
January 24, 1908.

[6] On the legend of this Plate (XII) read ⅔ for "½."

XVIII. BRIEF DESCRIPTIONS OF SOME NEW SPECIES OF BIRDS FROM COSTA RICA AND A RECORD OF SOME SPECIES NOT HITHERTO REPORTED FROM THAT COUNTRY.

By M. A. Carriker, Jr.

Genus **FORMICARIUS** Boddært.

Formicarius castaneiceps sp. nov.

Type, No. 28203, Carnegie Museum, adult ♂, from Juan Viñas, Costa Rica. Collected May 7, 1907, by M. A. Carriker, Jr.

Similar to *Formicarius rufipectus* Salvin, but upper parts very dark olive ; top of head and nape dark chestnut, sharply contrasted with the back ; and with a distinct superciliary stripe of black.

Above rich dark olive ; rump tinged with chestnut ; upper tail coverts deep chestnut ; wings and tail dusky black, the former with a band of fulvous at the base of the inner webs of the remiges ; under wing coverts black, basally bright fulvous ; lores, superciliary stripe, sides of head, chin and throat black ; crown, hind neck, sides of neck, breast, and under tail coverts, rich chestnut, the crown darkest, the chestnut of the breast paling into rich fulvous posteriorly, which color extends medially to the vent ; sides of the abdomen and flanks clove brown ; "iris hazel ; feet dark brown ; bill black." Measurements of type : length (in flesh), 208 mm.; wing, 90 mm.; tail, 57 mm.; exposed culmen, 23 mm.; tarsus, 42 mm.

Genus **SPOROPHILA** Cabanis.

Sporophila crissalis sp. nov.

Type, No. 28966, Carnegie Museum, adult ♂, from Buenos Aires de Térraba, Costa Rica, collected August 23, 1907, by M. A. Carriker, Jr.

Above dull grayish olive, the secondaries and tertials edged with the same color ; primary coverts black ; primaries dull black, edged with ashy, the inner ones buffy white at the base of the outer webs, forming a speculum ; tail dull black, indistinctly edged with olive ;

beneath pale dull olive, the breast more brownish, the throat dull grayish white; middle of the abdomen white; under tall coverts buffy; "iris hazel; feet olive; bill blackish horn." Measurements of type: length (in flesh), 126 mm.; wing, 61 mm.; tail, 40 mm.; exposed culmen, 9 mm.; tarsus, 12.5 mm.

NEW RECORDS FROM COSTA RICA.

Dendrocygna viduata (Linnæus). This beautiful duck, hitherto only recorded from South America and the West Indies, was occasionally met with at Bebedero, Guanacaste.

Geotrygon lawrencii Salvin. The range for this bird is supposed to be the Pacific coast of Panama; but an adult male in full plumage, which agrees exactly with Mr. Salvin's description, was taken at Carrillo in the northeastern part of Costa Rica.

Morphnus guianensis (Daudin). The most northerly record for this magnificent hawk is Lion Hill Station, Panama R. R. A fine male was taken near Cuabre, on the Rio Sicsola.

Myiophobus fasciatus furfurosus (Thayer & Bangs). This Panamanian flycatcher was taken for the first time in Costa Rica at Buenos Aires de Térraba.

Junco vulcani (Boucard) Previous records show this rare Junco to have been taken only on the Volcanoes Irazu and Chiriqui, but on April 25, 1907, one was secured on the Volcano Turrialba.

Aimophila botterii sartorii (Ridgway). A single male in good condition was taken on the Volcano Miravalles, Guanacaste, which, though not agreeing in all respects with the description of *A. b. sartorii*, is provisionally referred to that form.

Sporophila minuta minuta (Linnæus). The most northerly record given for this form is Lion Hill Station, Panama R. R. A single immature male referable to this species was taken at Buenos Aires de Térraba.

CARNEGIE MUSEUM,
February 15, 1908.

INDEX.

CONTENTS.