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W. J. HOLLAND, *Editor*

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ERRATA AND CORRIGENDA

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p. 232. First line from top, for "submarmortum" read *submarmoratum.*

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p. 294, footnote 3; for 305, read 301.

p. 299, third line from top; for Pl. X, read Pl. IX.

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p. 300, ninth line from top; for Pl. XI, read Pl. X.

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p. 307, fourth line from bottom; foot-note for dagger appears on p. 308.

Vol. XX, Art. XVI

p. 337, 8th line from the bottom; for inflated read inflected.

Vol. XX, Art. XVII

p. 341, 10th line from bottom; for M_4 read M^4.

p. 347, in legend for fig. 4; for $^2/_3$, read $^1/_2$.

p. 349, in legend for fig. 5; for $^6/_{10}$, read $^2/_3$.

p. 349, in legend for fig. 6; for $^8/_{10}$, read $^4/_5$.

p. 350, 6th line from top; for pollux read pollex.

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ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME XX, NO. 1

Editorial Notes.

On Wednesday, June 18th, Dr. A. Avinoff, the Director of the Carnegie Museum, sailed from New York on the S. S. "Aquitania" for a brief visit to Europe, which he has not seen since the end of the World War. Meanwhile he has become an American citizen and has endeared himself to a host of friends in the land of his adoption. His great learning, his versatility, his accomplishments as a linguist, and as an artist of distinction, his unusual executive ability, have won their respect; but he has bound them to their hearts by his unfailing kindness, his tact, and the grace of his winning personality. Their best wishes attend him on his journey.

Dr. Avinoff is accompanied by his sister, Madame Elizabeth Schoumatoff, who has commissions to execute in England portraits of a number of persons of distinction. He will visit many of the European museums, renewing his acquaintance with scientific friends and correspondents. He will attend the sessions of the British Association of Museums at Cardiff, having been appointed an official delegate by the American Association of Museums at their annual meeting in May.

The bronze tablets, or labels, which are to be placed upon the pedestal supporting the body of the diplodocus, recently installed in replica in the National Museum of Natural History in the City of Mexico, have been finished. The work was executed in beautiful manner by the firm of Jas. H. Matthews and Company. Before they were shipped to their destination the Editor had the satisfaction of

showing them to his genial friends, Señor Don Alfredo Baños, the Mexican Consul at Pittsburgh, and Señor Don Eduardo Malvido, who, by-the-by, is a nephew of former President Calles of Mexico. Both gentlemen expressed themselves as greatly pleased with the design and execution of the tablets.

The sympathy of the Editor and his entomological associates, goes out to their friend and fellow worker, Mr. Frederick Marloff, who on June 4, 1930, laid away to rest "all that was mortal" of his good father, who on May 31, 1930, died in the ninety-first year of his age, honored by all who knew him. "Father Marloff," as he was known by his neighbors, took a deep interest in the entomological pursuits of his son, whose superb collection of the microlepidoptera of Western Pennsylvania, through the generosity of Mr. George H. Clapp, recently was added to the entomological treasures of the Carnegie Museum.

Mr. Ottmar von Fuehrer has returned from Florida, bringing with him numerous photographs and sketches in oil together with a large quantity of material to be used in the construction of "The Jungle Group," destined to be one of the ornaments of the Gallery of Plants. Mr. Fuehrer reports that the great hurricane which devastated Florida some time ago, left such havoc in easily accessible places, that it was with some difficulty that he was able to find localities, which in appearance and floral content met the requirements of his search. But he was successful.

The American Association of Museums at its annual meeting in Buffalo June 4-7, adjourned to meet again in Pittsburgh next year.

The second meeting of the Association was held at the Carnegie Institute in Pittsburgh in the Lecture Hall of the Museum in 1907. There was a large attendance. The third meeting was held in Chicago at the Art Institute in 1908. At this meeting the writer, who at the time was absent in Europe engaged in setting up a Diplodocus which had been presented to Kaiser Wilhelm II by Mr. Carnegie, was elected President of the Association.

Though engaged in fathering many enterprises of one kind and another, no undertaking in which the Editor of these Annals has engaged has afforded him on some accounts greater satisfaction than

the efforts which he put forth, at first on his own initiative, later with the help of others, to bring about the existence of the present Association, which has had a fruitful career. With the continuous establishment of museums throughout the vast territory of the United States, the Museums Association is certain to be useful. It supplies a bond of communication between the various institutions and individuals who are interested in the establishment, maintenance, and development of museums throughout not only the United States, but the two Americas.

It was established with large hope of usefulness, which must not be disappointed.

An agreement has been entered into between the Carnegie Museum and Mr. Ralph Pulitzer of New York City, by which he is to be accompanied on his proposed hunting trip to Angola, Africa, by Mr. Rudyerd Boulton of the Ornithological Staff of the Carnegie Museum.

Mr. Boulton is more or less familiar with Angola, having collected there in times past. The collections made by the Pulitzer Expedition to Angola will all come to the Carnegie Museum. When Mr. Pulitzer has reserved the specimens he desires to preserve as trophies of the chase, the rest of the collection will be at the disposal of the Carnegie Museum either to be incorporated in its own collections, or after consultation with Mr. Pulitzer, to be bestowed upon other similar institutions.

I. TWO NEW NORTH AMERICAN BUTTERFLIES.

By W. J. Holland.

Family RIODINIDÆ.

Calephelis wrighti Holland, sp. nov.

W. G. Wright in his "The Butterflies of the West Coast," describes, p. 204 and figures Pl. XXVIII, figs. 303, 303a, an insect which he called *Calephelis nemesis* Edwards. A careful comparison with the type of *nemesis* and a long suite of specimens of that species which I possess reveals that the insect figured by Wright has been misidentified by him, a fact which is confirmed by examination of the identical two specimens photographed on Wright's plate, for the loan of which I am indebted to Dr. E. P. Van Duzee of the California Academy of Sciences.

The insect figured by Wright can also not by any chance be assigned to the other species, which is common in California, *C. australis* Edwards. I have carefully studied the literature of the subject and, so far as I am able to discover, the insect figured by Wright has not been described by any other author. I therefore designate it as *Calephelis wrighti*, and append the following description.

♂. *Upper side. Fore wing*, pale reddish fulvous, clouded with fuscous at the base of the fore wing and at the base and inner margin of the hind wing. In the cell of the fore wing there are three black spots; the innermost fusing with the dark fuscous shade at the base of the fore wing; the next spot being small and obscure, o-shaped; the third having the form of a parenthesis. There is a narrow dark black bar at the end of the cell. Below the cell there are in the interspaces small faint dark spots forming continuations toward the inner margin of the series of spots in the cell and at its end. Beyond the cell there is a postmedian series of faint dark spots succeeded by another series of small faint spots approximately parallel to the first. The ground-color between these two bands is lighter than the remainder of the wing. There is a dark submarginal band parallel to the outer margin. Between this band and the outermost of the two parallel bands just mentioned there are minute dark spots on the interspaces most noticeable near the inner angle. The fringes are dark fuscous.

Hind wing: This wing is of the same tint as the fore wing, slightly redder externally. The dark basal, mesial, and post-mesial bands of the fore wing are continued across the hind wing being composed of more or less broken spots, the post-mesial band being strongly curved outwardly opposite the end of the cell. The dark submarginal band of the primaries is continued evenly around the outer margins; the fringes, as in the fore wing, are dark fuscous.

Under side. Throughout both wings are very pale, somewhat lustrous pinkish fulvous. The markings of the upper side are repeated on the under side, as minute dark points, but so much reduced as to be almost invisible to the naked eye. The post-median and submarginal dark bands of the upper side reappear on the under side as bright silvery spots, which are only apparent in certain lights. Expanse: 22-24 mm. The smaller specimen, the underside of which is shown on Wright's plate is two millimeters less in expanse of wings than the larger specimen, the upper side of which is shown.

The thorax is concolorous with the wings; the upper side of the abdomen is paler, grayish.

Type and paratype: ♂♂ the two specimens in the California Academy of Sciences used by Wright and shown by him on his plate, above cited.

Family LYCÆNIDÆ.

SUBFAMILY CHRYSOPHANINÆ.

Chrysophanus charlottensis, sp. nov.

♂. Larger than *C. epixanthe*, but on the upper side somewhat recalling the appearance of that species; dark purplish fuscous, with the characteristic spots blackish. On the *under side* of the fore wings the ground-color is light pale reddish shading outwardly into pale yellow with all spots and markings distinctly defined. There are two round black spots in the cell and a black bar at the end succeeded by a subapical bar beyond the cell running from the costa outwardly and succeeded below the cell by a bar composed of three black spots located beyond the cell in the submedian interspaces. There are two round black spots immediately below the two round spots in the cell located in the space between the inner vein and the first median nervule. There is a regular curved submarginal band of crescents, one in each interspace between the nervules from the costa as far as the inner vein. This band is succeeded outwardly by a series of small greenish crescents; fringes greenish gray, interrupted with darker gray at the ends of the veins. The ground-color of the hind wing is prevalently rich maroon, dusted toward the base and the inner margin with greenish

scales. On the costa near the base is a subcircular creamy-white spot defined by a narrow ring of black. Beyond this near the outer angle is a similar suboval creamy spot succeeded by a smaller spot; these two spots are also defined outwardly and inwardly by dark shades. In the cell near the base is a small light greenish spot followed toward the end of the cell by a larger cream-colored spot. Below these spots near the inner margin and below the cell are two minute dark brown spots, the outermost of which is succeeded externally by a linear light green dash. Just beyond this, occupying the spaces between the median nervules, is a band of cream-colored, or whitish spots, forming a line at right angles to the inner vein. These spots increase in width from the inner vein as far as the third median nervule. External to this light bar of spots is a series of very minute pale greenish spots pupilled with dark. On the outer margin is a series of light greenish spots. The fringes, as on the fore wing, are greenish, interrupted at the tips of the nervules by fuscous.

♀. Differs from the male in having the ground color of the fore wings on the upper side red with the dark markings of the under side appearing as black spots on the red and the outer margin broadly bordered with dark blackish brown. The hind wings are darker than the fore wings, but faintly reproduce the light spots and markings of the under side especially the marginal series, which are deep red. Expanse: ♂, 25 mm.; ♀, 27 mm.

Antennæ black, ringed with white; palpi black above, lighter below. Body and upper side of abdomen concolorous with the wings; lighter greenish-gray below.

Holotype, ♂; allotype, ♀; paratype, 1 ♂, collected by Dr. B. Green on Queen Charlotte Island, August 1, 1912. In collection of W. J. Holland.

II. THE VEGETATION OF THE FORT RELIANCE SAND-PLAIN.

By Hugh M. Raup.*

(Pls. I-VI)

CONTENTS

ACKNOWLEDGMENT

The writer is deeply indebted to Dr. O. E. Jennings and to Professor Henry Leighton of the University of Pittsburgh for their advice and criticism during the preparation of this paper. He also wishes to express his thanks to Mr. G. H. Blanchet of the Topographical Survey of Canada, whose first-hand knowledge of the Fort Reliance region has been freely given, and to Dr. I. P. Tolmachoff of the Carnegie Museum of Pittsburgh who very kindly read and criticised the manuscript. The identifications of the plants were made by the writer, with the exception of the *Gramineæ* and the *Carices*, which

*Submitted in 1928 to the Graduate School of the University of Pittsburgh in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

were determined, respectively, by Professor A. S. Hitchcock of the United States Department of Agriculture, and Mr. K. K. Mackenzie of Maplewood, New Jersey.

I. INTRODUCTION

General Description of the Vegetation

The Fort Reliance sand-plains are located at the eastern extremity of Great Slave Lake, in northwestern Canada. The eastern arm of the lake is divided into two main parts, which are connected by the small strait known as the Taltheilei Narrows. The more northeasterly of these two parts is McLeod Bay. Only one large tributary enters McLeod Bay, Lockhart River. It enters a subdivision of the main bay known as Charlton Bay at the northeastern end of the latter.

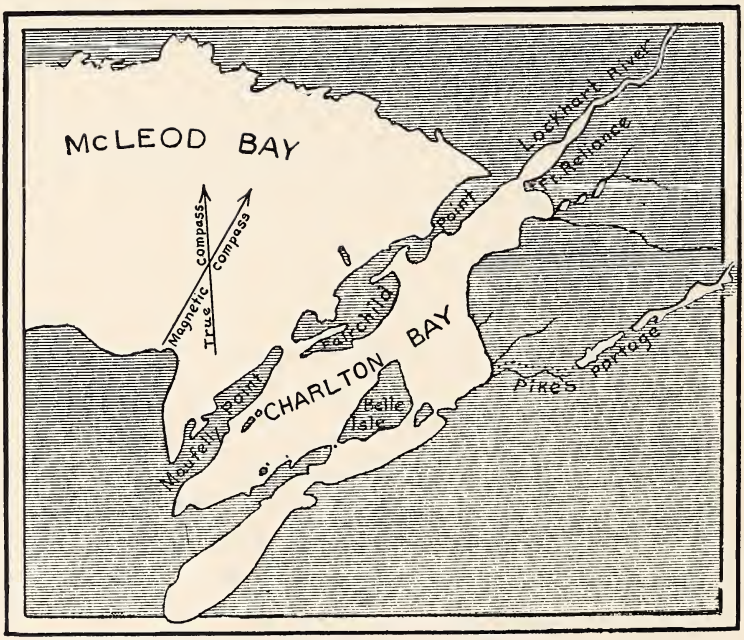


Fig. 1. Map of Vicinity of Fort Reliance.

The Lockhart River rises in a lake district in the high Laurentian plateau to the northeast. It flows through Aylmer, Clinton-Colden, Casba, and Artillery Lakes, and finally discharges into the Slave Lake

Basin through a narrow, broken gorge, where there are many rapids and falls.

The site of the abandoned Fort Reliance is a large deposit of sand where Lockhart River enters the bay. The deposit is on both sides of the river and extends back from it, at higher levels, to the bordering rocky walls of the lake and river-basin.

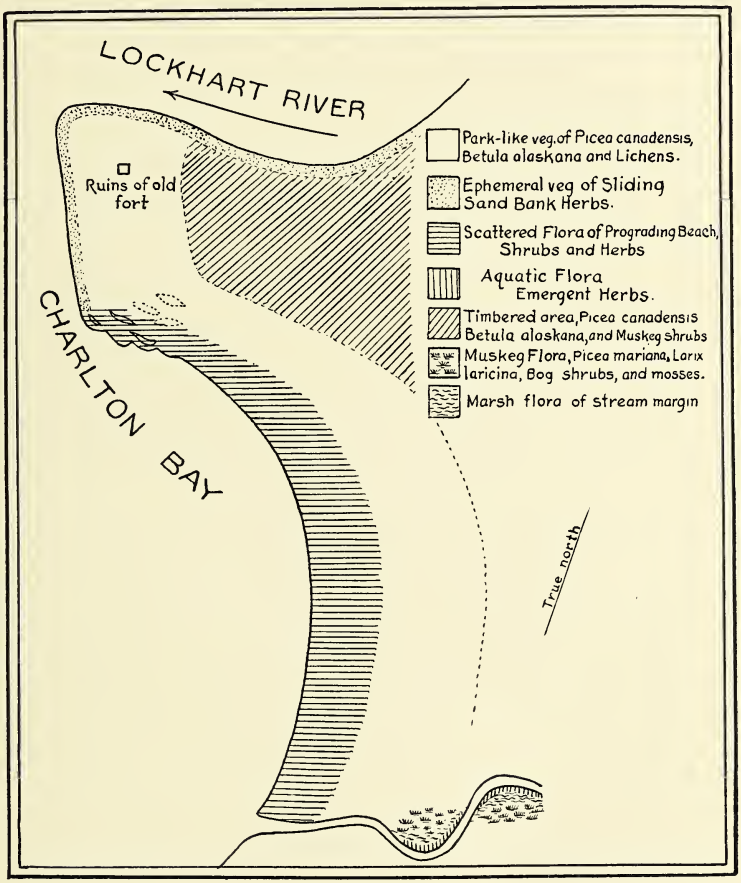


Fig. 2. Distribution of Vegetation.

The general outline of the distribution of the vegetation is shown on the accompanying diagram (Fig. 2). The old fort is on a gently sloping plain which has an open park-like vegetation. This open association is the most striking feature of the newer sand-plains and

predominates over a considerable area. The dominant species of trees are *Picea canadensis* and *Betula alaskana*. There is no close shrub association, but the ground is largely covered by a dense mat of lichens (*Cladonia* sps. and *Cetraria* sp.). Smaller mats of brighter green are due to colonies of the trailing *Empetrum nigrum* and *Arctostaphylos Uva-ursi*.

In going over the sand-plain away from the lake, one passes to higher levels by way of a series of rather steep terraces. There is a gradual change in the vegetation at these higher levels. The same species of trees predominate, but are present in much greater numbers. The ground layer changes from the lichen association to one more mesophytic, consisting of muskeg plants, such as *Vaccinium uliginosum*, *Ledum grœnlandicum*, *Vaccinium Vitis-Idœa*, and various lichens and mosses.

The marginal flora along the lake and streams is more variable. The steep sand-bank of Lockhart River and of a part of the lake front has a very scanty flora, consisting mostly of a sage (*Artemisia canadensis*) and a small sedge (*Carex supina*) which grows in tufts.

On the long curved beach to the south of the plain there is a scattering vegetation consisting of a greater number of species, gradually forming denser cover from the actual shore-line up to the level of the sand-plain.

In places along this beach there are small lagoons with aquatic vegetation. Where these occur farther back from the shore they are dry and contain a flora similar to that of their surroundings.

At the southern end of the long beach, near the point where it meets the rocky hills, a small stream flows into the lake. It was sluggish at the time this survey was made, and its waters did not seem to be in motion at all, at least in its lower course. A short distance from the lake it shows intrenched meanders. The outsides of its curves are steep banks of sliding sand, while the inner sides show deposits with low ridges. There is a pond-like marginal vegetation, gradually changing to muskeg conditions a short distance back from the river. There is a steep sandy escarpment between this small muskeg and the neighboring sand-plain.

The problems involved in this discussion are related to the distribution of the vegetation on the deposit of sand and to the developmental history of the vegetation.

The explanation of conditions seems to lie in large measure in the

physiographical development of the area, which will be considered first, together with the main features of the local geology.

II. GEOLOGIC AND PHYSIOGRAPHIC FEATURES

A. PREGLACIAL GEOLOGY

The map of Great Slave Lake (Pl. I) shows the general distribution of the surface formations. The eastern arm of Great Slave Lake lies almost wholly within the Precambrian "shield" of northern Canada. The north shore is composed largely of Laurentian granites and gneisses, which rise rather abruptly from the shore to form the southern margin of the interior upland to the north. They show a rolling contour. The south shore of McLeod Bay and many of the islands in the eastern arm are composed of softer sedimentary rocks, variously altered, and revealing intrusions of volcanic materials.

The country around Fort Reliance is underlain by more or less altered limestones, shales, and sandstones. These rocks have, in general, a gentle dip to the southward. They form high cliffs or escarpments in many places along the shore.

There is an increase of relief from the west to the east throughout the territory in which is the eastern arm of the lake.

The waters of the eastern arm are remarkably clear and free from sediment. They are probably quite deep, though no accurate soundings have been made. The water of McLeod Bay is about 10° Fahr. colder in summer than that of the other parts of the lake. There is a strong current flowing southward through Taltheilei Narrows.

It is difficult to mentally picture the preglacial geography, since the whole area has been so profoundly modified by glaciation. The basin of the eastern arm probably existed in preglacial time as a valley traversed by a stream.

B. GLACIAL AND POSTGLACIAL GEOLOGY

Glacial grooves and striæ are commonly found in the vicinity of Fort Reliance, and indicate that the main mass of the ice moved across the area in a westerly direction, originating in the great Keewatin center west of Hudson Bay. The rocky hills and headlands throughout the region show the effects of tremendous glacial erosion. Plucking, grooving, and striation are everywhere in evidence.

In many places about the shores of the lake there are ancient beaches or other shore-marks which are far above the present level of the lake. These ancient shores are often finely preserved, giving a record of successive changes in the levels of the shore-lines. The relative heights of the ancient beaches above the present shore-line were noted by Robert Bell[1] in 1900, as follows: "Old shore lines, showing higher levels of the water, were distinctly visible in various parts of the lake. The ancient beaches were found at higher levels in the eastern parts than opposite Slave river, indicating a tilting of the lake towards the west of southwest accompanied by a greater lowering of the water at the northeastern extremity." G. H. Blanchet[2] records sand-beaches at six hundred feet above the present lake in the valley of Lockhart River above Fort Reliance.

The Keewatin glacier probably advanced westward and southwestward over the regions of Great Slave and Athabasca lakes. A. E. Cameron[3] outlines three main lobes of the glacier. One occupied the valley of Hay River, a southern tributary, of Slave Lake. A second filled the valley of Peace River, south of the Caribou Mountains, while a third occupied the valleys of Athabasca Lake and Athabasca River. As these lobes receded, the drainage waters from the western mountains were impounded by ice-dams, forming glacial lakes. J. B. Tyrrell[4] named such postglacial lakes by adding the prefix "Hyper-" to the name of the modern representative.

Cameron observed ancient lake-bottoms in the valleys of Peace, Athabasca, Wabiskaw, Hay, Buffalo, and Slave rivers, and so correlated them as to outline five distinct levels at which Hyper-Great Slave Lake has stood in postglacial time. Extinct shore-lines on the lakes and recessional moraines in the valleys of Hay and Buffalo

[1]Bell, Robert. "Preliminary Report of Explorations about Great Slave Lake in 1899." *Summary Report of the Geological Survey (Canada) for the year 1899. Part A.* Ottawa. 1900.

[2]Blanchet, G. H. "*Great Slave Lake Area, Northwest Territories.*" Department of the Interior, Northwest Territories and Yukon Branch. Ottawa, 1926.

[3]Cameron, A. E. "Post-Glacial Lakes in the Mackenzie River Basin North West Territories, Canada." *Journal of Geology*, Vol. XXX, No. 5, July-August, 1922.

[4]Tyrrell, J. Burr, assisted by D. B. Dowling, "Report on the country between Athabasca Lake and Churchill River with Notes on Two Routes Travelled between the Churchill and Saskatchewan Rivers." *Geol. Surv., Can., Ann. Rept., Vol. VIII*, 1896, *pt. D.*

Rivers are further evidence. These levels, measured above the sea, are; 1600 ft., 1100 ft., 800 ft., 700 ft., the present level being about 500 feet.

This author thinks that at the 1600 ft. and 1100 ft. levels the present lake area was still covered by the ice. At the 800 ft. level the ice still covered McLeod Bay, while at the 700 ft. level the lake had acquired very much of its present form. There was a large southern arm that has since been silted full by the deposits of Slave River.

As the ice receded there was probably a pronounced isostatic readjustment on hinge-lines which have not been determined, and the eastern part of the lake was raised more than the western part.

The Mackenzie River was probably open for drainage of the Slave Lake basin when the latter stood at the 700 ft. level, at least through part of its course. Cameron points out that the position of the drainage outlet at the western end of the basin would tend to cause a rapid drainage of the lake. Differential uplift in the east and northeast would tend to supplement the normal rate of lowering due to the opening drainage channel, by "spilling" more and more water down the Mackenzie valley. This is a different state of affairs from that found in the Athabasca lake-basin, where the drainage is to the north by Slave River. Here the uplift has had a tendency to close the outlets, keeping the water ponded back.

These conclusions are based upon rather scanty data, and much work remains to be done in the study of the glacial and postglacial geology of the region. It may be that the advance and retreat was not a single performance, but was broken up by interglacial stages. Such conditions would complicate the investigation a great deal.

However, it seems fairly well established that the ancient beaches and sand-plains on the shores of the lake, especially at the eastern end, furnish a record of relatively rapid postglacial elevation of the land and lowering of the shore-line. The process has undoubtedly taken place at intervals of greater or less magnitude, as shown by the beach-ridges and erosion-terraces which exist on the slopes of the basin.

The more recent of these sand-plains and terraces, as found at Fort Reliance, are the subject of the present survey.

C. PHYSIOGRAPHY OF THE FORT RELIANCE SAND-PLAIN

The map (Pl. II), with its sectional diagrams, shows the main topographical features of the sand-plain. It has been discussed

briefly in the description of the floristic characters, and will be entered into again only so far as is necessary in a discussion of the development of the present physiographic conditions.

The original source of the sand was probably the Athabasca Sandstones, a series of Precambrian rocks, which are common in the locality. It has been worked and reworked into terraces and short ridges at all the successive levels of the lake.

There is little doubt, from the foregoing remarks, that the terraces are ancient wave-cut shores similar to the one that is being actively eroded at present. W. H. Fitton gives a geological note, published in the Appendix to Captain George Back's narrative[5], in which he describes the area very well. He says: "The sandy place, where the house, or "Fort" was erected was about 3 miles broad, and hemmed in, on the east and west, by two rivers, which ran respectively along the bases of the parallel ranges of granitic hills. The sand was comparatively level; and in the space of half a mile there were two more platforms, with embankments rising gradually towards the rocky valleys which led to the barren lands. It seemed as if the water of the Great Slave lake had once been so high as to have the upper embankments for its boundary, and had since subsided."

South of the level areas about the old fort, the land back of the long beach is more broken by ridges and broad, intervening level areas. This is evidently an area of shore-building.

The plain at the old fort has a gentle slope upward to the north, so that the erosion terrace, A.-D, (Pl. II) is much higher at the northern end than at the southern. The terrace A-B, (Pl. II) is higher in its upstream portion than at A, the rise, however, not being gradual, but by steps, which mark old eroded terraces.

There seem to be two sets of forces at work tearing away the present terraces. These are the Lockhart River and the waves of the lake. The river is eroding the northeastern, higher terraces and carrying a great part of the sand out into the lake where the waves are using it in building operations about the river-mouth and to the southward. Part of the river-born sand is being deposited in the form of bars in the wider parts of the channel, but these do not appear to be

[5]Back, George, *Narrative of the Arctic land expedition to the mouth of the Great Fish river and along the shores of the Arctic ocean in the years 1833, 1834, and 1835.* London, 1836.

permanent, and at no point have they acquired size and stability sufficient for the growth of permanent vegetation.

The waves most effective in changing the contours of the shores are caused by wind-storms in the open season. These appear to be northwest or west winds blowing off of McLeod Bay. Being such, they do not strike the erosion terrace A-D at right angles, but rather in such a way as to make a long-shore current to the southward.

As is characteristic of such eroded terraces, the sand removed from the bank is being built into a submerged terrace which often reaches out to quite a distance. These submerged sand-banks may become sand-plains in the future.

The long-shore current must affect not only the sand of the shore A-D, but also the deposit of the sand brought down by the current of the river. This is particularly true since the current is slow at this point. The effect of such a movement of the river-born sand would be to change the slope of the submerged terrace in process of being built, and make it higher at the northern end, with a gradual slope to the southward. Another cause for the slope of the plain may be the tendency of the river at its mouth to form a levee. No accurate verification of these theories was made in the field, but from hurried observations it seems to be the case that the submerged shore is highest near the mouth of the river. If the river has stood in the same relation to the plain through the past few periods of uplift, then the southward slope of the present plain would be satisfactorily explained. As will be seen later, there is evidence that the general configuration of the area has not changed during this time.

The erosion terrace is terminated at its southern end, D, (Pl. II) by a rather abrupt bend to the eastward. The effect of this has been a large deposit of sand just beyond the bend, and reaching from there around the wide curve of the beach. D. W. Johnson[6] says in this relation, "Beach-drifting in but one direction along a shore line which suddenly changes its trend will cause an excessive deposit of sand just beyond the angle, in case the shore bends backward, because wave action upon the more protected shore around the bend is not sufficiently vigorous to remove all the debris deposited there."

The immediate result of the angle is the formation of a series of cusp-like bars that eventually inclose small lagoons on the sandy shore.

[6]Johnson, D. W. *Shore Processes and Shore Line Development.* p. 408. Yale University Press, 1920.

The position of these is shown on the map (Pl. II). The fronts of the waves seem to be bent as they strike the angle, and parts of them strike the shore of the lagoon from the southwestward. The lagoons are shallow and of peculiar form, as shown. They take the same curves, in general, as the neighboring shore-lines.

There is a series of these lagoons extending up the beach. Only those near the shore have any water in them. Those farther back are dry and remain as depressions without outlets. They all stand in about the same relation to their surroundings as do the newer lagoons, which indicates that the angle has been in existence during the more recent elevations of the land. Furthermore, it indicates that the shore A-D has stood in about the same position with relation to the prevailing winds throughout the period.

Large quantities of sand from the erosion terrace and from the river are being carried farther southward and deposited in the wide shallow bay or on its prograding beach. The ridges of the beach here formed are highest and steepest in the northern portions. Farther south, near the mouth of the small stream shown on the map, they are low and broad. Such a condition is consistent with their relatively greater distance from the source of materials and with the weakened action of the waves on their shores. The broad bay is shallow enough to cause the waves to break far out and deposit their sand.

The fact that far back of the prograding beach the topography is much like that of the beach itself is further evidence that the shores stood in about the same relation to each other and to the lake in earlier times.

An examination of the profile of the prograding beach along the line indicated on the diagram (Pl. II) shows it to consist of two distinct parts. There is a series of ridges and more or less level intervening areas extending back from the shore for about twenty or twenty-five yards, which is nearly half of the width of the whole. Then there comes a series of larger ridges, closer together. The first series is low, while the second leads abruptly to the higher plains and ridges. Beyond the second series the topography is more nearly on a level and resembles that of the first series of the beach. The second series, then, seems to represent a period of greatly increased prograding activity, which took place while the land was rising at a more rapid rate than it is at present, or was, when the higher plains were formed.

If the shores have stood in the same relation to each other in the

past as they do now, there should be a corresponding period of greatly increased beach-cutting activity in the vicinity of the old fort. Such a thing exists in the present erosion terrace, and in the elevation which produced it. That the erosion has been going on here for a long time is shown by the large size of the offshore terrace. During a period of rapid uplift, much more of the eroded sand would be carried away by the longshore currents than at times of relative stability, because the new terrace would not yet be formed and there would be no shallow water off shore to break the waves and cause immediate deposit. This sand would go into the rapidly forming ridges of the prograding beach.

No investigations of the nature of the uplift of the shores of Great Slave Lake have been made. That the elevation has not taken place at a constant rate is evident from the succession of terraces and beach-ridges above indicated. Accurate studies of postglacial shores and bent water planes have been made on the shores of Green Bay, Lake Michigan by J. W. Goldthwait[7] and by W. H. Hobbs.[8] Precise methods of leveling were used on the ancient beaches and the work was extended over long distances. The results show that uplift did not take place in one continuous movement through the whole territory, but rather by a series of smaller differential elevations. The ancient water-planes were found to be bent along a series of hinged lines. Between lines where large tilting had taken place were found other minor lines indicating a series of lesser uplifts. These results correlate with the observed terrace formations on the beaches. If such a set of movements has taken place in the eastern arm of Great Slave Lake the result would be much like what is seen at Fort Reliance.

There appears to be some sort of periodic rise and fall of the level of the lake, taking place over a series of years. However, no accurate records of the phenomenon have ever been made, so that neither the magnitude of the variation nor the length of the period are known. If such a variation were very great it might seriously change the course of the evolution of the sandy shores. A rise and fall of the water of two or three feet would only have the effect of causing temporary

[7]Goldthwait, J. W. "Abandoned Shore-lines of Eastern Wisconsin." *Wisconsin Geological and Natural History Survey.* Bulletin No. 13. 1907.

[8]Hobbs, W. H. "The Late Glacial and Postglacial Uplift of the Michigan Basin." *Michigan Geological and Biological Survey.* Publication No. 5. Geological Series No. 3. Annual Reports. 1910.

changes in the topography and vegetation close to the shore. No serious changes would occur on the erosion terrace, since it is much higher than three feet at nearly every point. The lowest lagoons would be submerged, but the higher ones would either remain dry or they would acquire a temporary aquatic or marsh vegetation. The prograding beach would probably not be affected above Zone 4.

There is evidence that two or three feet is the maximum change. From studies of shore-line vegetation on Athabasca Lake in the summer of 1926, and of verbal reports of residents in that region, it appears that the water in Athabasca Lake is now at one of its lower stages, if not at its lowest. The rather scanty data indicate that the maximum rise is approximately eight feet, and that the water rises to this maximum after periods of from ten to fourteen years. If the water is now at low stages in Athabasca Lake, there is little question that it is also low in Great Slave Lake, since they are subject to similar conditions as to their source. The same type of evidence on the shores of Slave Lake indicates that the high water mark is only two or three feet above the present level.

The traversing stream was not studied along its whole course. The points shown on the map (Pl. II) are the only ones observed. The stream appears to have kept pace with the rising surface of the land by cutting through the sand in much the same manner as Lockhart River has done. It is carrying the sand out into the lake, where it is being transported and redeposited by the waves. Just what currents are involved on this part of the beach is uncertain. Some shallow lagoons have been formed on the broad sandy shore near the outlet, but the nature of their development was not studied.

Certain phases of the work of this small stream are significant in a study of the vegetation. On the inside shores of its meandering curves it has been actively depositing material which shows the effect of some sort of variation in the shore-level. The vegetation on these ridges indicates that they are not seasonal, since a longer time would be required for the growth of the shrubs and small trees that occur on them. They may represent sand-bars formed at successive stages of the rise of the land during the most recent emergence. There is a gentle slope, by way of these ridges, with their intervening swales, to a sort of muskeg shore. The rather dry muskeg is of small extent and is bordered on its landward side by a steep sand-bank, which leads up to the neighboring sand-plain.

III. THE DEVELOPMENT OF THE VEGETATION

Physiographic changes are bringing into existence new barren areas which are open to colonization by plants. The prograding beach, the new beach-lagoons, the developing margins of the traversing stream, and the erosion-terraces are such areas. Having shown that these areas are representative of those which have appeared in the development of older portions of the land, it is reasonable to believe that, so far as the physiographic factors are concerned, if the development of the vegetation on the new land can be traced, that of the whole vegetation can also be traced.

A fifth type of bare area is possible in the extended development of the terraine. When the present terrace is elevated to form a broad plain, it will show a succession of vegetation, which seems to have no representative at the present time. It is reasonable to suppose, however, that the succession would not differ materially from that of the upper parts of the prograding beach. This will be discussed further in another place.

A. SUCCESSIONS ON THE PROGRADING BEACH

The prograding beach was laid off in zones as shown on Pl. II. An outline of the succession will be found on Pl. V, fig. 1. See also Pl. III, figs. 1, 2, and Pl. IV, figs. 1, 2.

ZONE 1.

This is the open water of the bay. It contains no macrophytic flora in the vicinity of the section. Nearly the whole front of the beach is subject, to some extent at least, to the action of storm-waves. As already pointed out, however, the shallowness of the water far out from the shore serves to break the main force of the waves. There was only a gentle breeze on the day the survey was made, yet the pebbles and particles of sand on the bottom near the shore-line were constantly being moved back and forth. The instability of the substratum and the varying shore-line are the critical factors in preventing the growth of vegetation. There is a variation of several inches in the level of the water which takes place within short periods, such as days or weeks. Such variation may change the soil of the immediate shore from a submerged condition to a very dry one in a short time.

Plants could not be expected to adapt themselves to such a different set of conditions.

ZONE 2.

Primary species: *Artemisia borealis* Pall.
Secondary species: *Salix* sp. (Seedling);
Oxytropis splendens Dougl.;
var. *Richardsonii* Hook.;
Epilobium latifolium L.

The first low ridge of the beach contains only a sparse flora. It was necessary to examine a great deal of territory before the primary species was determined. The substratum is of fine damp sand with only a few pebbles. There is a small amount of drift-wood on the upper part of the zone. The same determining factors act here as in the substratum of Zone 1, but conditions are not quite so rigorous, making possible the very open association outlined above. The sand is moved by the waves only in periods of storm or high water.

ZONE 3.

Primary species: *Epilobium latifolium* L.
Secondary species: *Oxytropis splendens* Dougl.;
var. *Richardsonii* Hook.;
Artemisia borealis Pall.

Behind the low ridge of Zone 2 is a shallow depression about four yards wide. Its vegetation is even more sparse than that of the ridge. The secondary species occurs in very small numbers, while the primary species is present only in loose patches. The zone is not consistent all along the beach. It contains relatively more pebbles than does the ridge, and contains less small driftwood. Its more difficult life conditions are probably due to the much greater dessication of the sand, and its resultant capacity for being blown about by the wind. The deposit is so young that dunes have not yet had time to form. Extremely high water may affect it by rising over the shore ridge. In periods of high wind much of the sand of the area is probably blown away.

ZONE 4.

Primary species: *Salix alaxensis* (And.) Cov.;
Empetrum nigrum L.

Secondary species: *Picea canadensis* (Mill.) B.S.P.;
(Few young trees)
Juncus balticus Willd.;
Occasional grasses;
Populus balsamifera L. (Seedling);
Stellaria longipes Goldie;
var. *læta* (Richards.) Wats.;
Oxytropis splendens Dougl.;
var. *Richardsonii* Hook.;
Epilobium latifolium L.;
Artemisia borealis Pall.

The second ridge of the beach is more prominent than the first, due to its greater size and larger vegetation. A part of the height is probably due to the growth of dunes about the plants that occur there. The sand is as dry as powder and blown about a great deal. Not a little small drift-wood is caught in the sand or entangled in the scraggly willows. The most prominent plant is the willow, while *Empetrum* is listed as a primary species, because of its dune-forming properties. Smaller dunes form about the grasses and other small plants. This ridge probably had a younger stage, similar to that of Zone 2. The greater opportunity for perennial plants to take root and get a start in the first ridge accounts for the fact that the second ridge shows such an increase of vegetation over the neighboring inter-ridge areas. With plants once started, the sand is held at least to a certain extent when the wind attacks it. The depression of Zone 3 seems to have had its origin in a barren shore, like that of the very margin of the beach, where no plants could get a start.

A further increase of mesophytism in the ridge-area of Zone 4 is shown by the presence of Canada Spruce and Balsam Poplar, the former of which becomes a primary species on the higher ridges.

ZONE 5.

Primary species: *Populus balsamifera* L. (Saplings);
Empetrum nigrum L.

Secondary species: *Picea canadensis* (Mill.) B.S.P.;
(Occasional, small)
Juniperus communis L. var. *montana* Ait;
Poa pratensis L.;
Festuca ovina L.;
Agropyron violaceum (Hornem.) Lange;
Salix alaxensis (And.) Cov. (Few);

Stellaria longipes Goldie;
var. *læta* (Richards.) Wats.;
Oxytropis splendens Dougl.;
var. *Richardsonii* Hook.;
Arctostaphylos Uva-ursi (L.) Spreng.;
Artemisia borealis Pall.;

Lichens on loose sand;
Stereocaulon paschale (L.) Ach.;

Lichens on firm sand;
Stereocaulon paschale (L.) Ach.;
Cetraria islandica (L.) Ach.;
C. cucullata (Bell.) Ach.;
C. nivalis (L.) Ach.

Zone 5 is a broader depression, eight to ten yards wide, with a comparatively level floor. The sand is very dry, somewhat pebbly, and is forming a few dunes where there are plants to hold them. The floor seems to be protected from the direct action of winds by the vegetation of the neighboring ridges, but there is evidence that there are eddying currents which do move a good deal of the sand. There are rounded piles of spruce-cones, which could only have been formed by such eddying currents of air. The flora is sparse, and it is difficult to designate any one plant as of primary importance. *Empetrum nigrum* has been so listed because of its dune-forming qualities, which probably play the most important part in bringing about more mesophytic conditions. *Populus balsamifera* has been considered as primary, because of its importance in stabilizing the sand and because of its prevalence in this zone all along the beach.

The presence of the Balsam Poplar is particularly interesting, because it is at the very margin of its geographic range. In the great flood-plain deposits of such rivers as the Athabasca, Peace, and Slave it forms heavy timber of good quality. In those regions it is practically limited to the more mesophytic parts of the flood-plains. On the sandy beach at Fort Reliance it is a scraggly shrub, nowhere reaching a height of more than four or five feet. Why it should be found establishing itself in this particular part of such a beach is a question.

ZONE 6.

Primary species: *Picea canadensis* (Mill.) B.S.P.;
Empetrum nigrum L.;
Stereocaulon paschale (L.) Ach.

Secondary species: *Juniperus communis* L. var. *montana* Ait.;
Poa glauca Vahl;
Populus balsamifera L.;
Comandra livida Richards;
Saxifraga tricuspidata Rottb.;
Oxytropis splendens Dougl.;
var. *Richardsonii* Hook.;
Vaccinium uliginosum L.;
V. Vitis-Idæa L. var. *minus* Lodd.;
Arctostaphylos Uva-ursi (L.) Spreng.;
Epilobium angustifolium L.;
Artemisia borealis Pall.;

Lichens on loose sand;
Stereocaulon paschale (L.) Ach.;

Lichens in firm mats on sand;
Stereocaulon paschale (L.) Ach.;
Cetraria nivalis (L.) Ach.;
C. cucullata (Bell.) Ach.;
C. islandica (L.) Ach.;
Peltigera canina (L.) Hoffm.;
Cladonia pyxidata (L.) E. Fries;
C. sylvatica (L.) Hoffm.

Above Zone 5 there is a series of ridges and depressions following at closer intervals than those of the other zones. They seem to be the result of some more active period of emergence of the land than is going on at present. Since no distinct zonation of vegetation could be detected among them, they have been grouped together as Zone 6. There are indeed varying vegetational types in the area, but they are found in patches rather than in regular zones.

The sand has many pebbles in it and is dry. Where not over-grown by a mat of vegetation, it has a tendency to form itself into small dunes. The same evidence of the action of eddying winds is shown here as in Zone 5.

Hummocks and the tops of ridges are usually occupied by fairly large trees of *Picea canadensis*. Smaller hummocks and intervening areas composed of loose sand have a very sparse vegetation, or have low dunes on them. *Empetrum nigrum* is still the most important sand-holding agent, but *Arctostaphylos Uva-ursi* has become commoner than in the lower zones. Depressions and more stable areas have the most abundant growth of lichens and mosses on them. As indicated in the list of primary species the lichen *Stereocaulon paschale* plays an important part in stabilizing the loose sand. It forms extensive mats

in which its fruticose thallus is fairly impregnated with drifting sand. In areas of loose sand *Vaccinium Vitis-Idæa* is a common plant, appearing in small sprigs.

There is a gradual increase in mesophytism throughout the zone, and the higher ridges show much the same flora as the sand-plain which follows. But the sand is not yet sufficiently stable, nor is there a sufficient accumulation of humus to bring about the establishment of the flora of the plains.

ZONE 7.

Primary species: *Picea canadensis* (Mill.) B.S.P.;
Betula alaskana Sarg.;
Cladonia rangiferina (L.) Web.;
C. alpestris (L.) Rebh.;
Cetraria islandica (L.) Ach.

Secondary species: *Juniperus communis* L. var. *montana* Ait.;
Calamagrostis purpurascens R. Br.;
Salix Bebbiana Sarg.;
Betula fontinalis Sarg.;
Pulsatilla ludoviciana (Nutt.) Heller;
Saxifraga tricuspidata Rottb.;
Comandra livida Richards.;
Empetrum nigrum L.;
Epilobium angustifolium L.;
Arctostaphylos Uva-ursi (L.) Spreng.;
Vaccinium uliginosum L.;
V. Vitis-Idæa L. var. *minus* Lodd.;
Pedicularis euphrasioides Steph.;
Solidago multiradiata Ait.

The sand-plain back of the prograding beach really consists of a series of small ridges with rather broad intervening level areas. The flora over the whole is practically the same, no matter what the minor topographical features. It is a part of the park-like area, which has been described above, and forms one of the most beautiful vegetations in the whole region. It has for many years been a favorite camping site for both Indians and white men. The photographs on Pl. IV give a better idea of it than words can supply. The commonest trees are *Picea canadensis* and *Betula alaskana*. The ground is closely covered by a mat of lichens and trailing shrubs. The lichens are the "reindeer mosses," *Cladonia rangiferina*, *Cladonia alpestris*, and *Cetraria islandica*. There are rounded mats of *Empetrum nigrum* and *Arctostaphylos Uva-ursi*. Whatever shrub-layer occurs is very much scat-

tered and consists of the low *Juniperus communis* var. *montana* and the shrubby *Betula fontinalis*. The herbaceous vegetation is merely occasional.

The plain appears to be of the same age, and to have the same vegetation as the more level tract where the old fort is located. The series of ridges in Zone 6, or at least those in its upper part, probably indicate the period of emergence which brought into being the terrace escarpment, A-D, (Pl. II). Zones 1 to 5 and possibly the lower part of Zone 6 may show the younger stages of such a vegetation as that of Zone 7.

The diagram of the successions, Pl. VI, shows the general tendencies of the development. The ridges, due to the start they had in their incipient stages at the margin of the lake, show a more rapid development than their adjoining low-ground areas. That they continue this to the upper part of Zone 6 is shown by the fact that the complete flora of the sand-plain first gets its start on them at that level, and not in the depressions. The depressions have a somewhat similar, though slower, development. The initial stage in both cases is probably characterized by the same association of *Artemisia borealis*.

B. SUCCESSIONS IN THE BEACH LAGOONS (Pl. V)

LAGOON 1.

Growing in the water:
- *Poa alpina* L.;
- *Poa glauca* Vahl.;
- *Calamagrostis canadensis* (Michx.) Nutt.;
- *Deschampsia cæspitosa* (L.) Beauv.;
- *Juncus balticus* Willd.;
- *Salix alaxensis* (And.) Cov. (Seedling);
- *Stellaria longipes* Goldie var. *læta* (Richards.) Wats.;
- *Epilobium latifolium* L.;
- *Artemisia borealis* Pall.;

Growing at the margin:
- *Juncus balticus* Willd.;
- *Sagina nodosa* (L.) Fenzl.;
- *Artemisia borealis* Pall.;
- Moss.

This is the youngest type of lagoon studied. It has a very much scattered, but nevertheless distinctive, vegetation. It is probable

that the lagoon came into existence after some of the plants of the lower zones of the beach had already received their start. *Artemisia*, *Epilobium latifolium*, *Salix* and *Stellaria longipes* var. *læta* are notably xerophytic types which could hardly have started in the bottom of a lagoon. On the other hand the occurrence of such perennial plants as *Poa* sps., *Calamagrostis*, *Juncus*, and particularly *Deschampsia cæspitosa*, which are more hydrophytic forms, and which could not have developed within a few weeks, indicates that the lagoon was in existence at least one season before the survey was made. That it has not been there long enough to develop a distinct marginal vegetation is shown by the fact that what occurs is of practically the same composition as that growing in the water. *Sagina nodosa* was growing in only one spot and in very small quantity. The moss was also very scarce. The sandwort (*Stellaria longipes* var. *læta*) showed an abnormally rich growth of rather flaccid stems and leaves. In the outline of the succession this lagoon association is indicated by *Deschampsia cæspitosa*, since this is the most prominent plant there, and is probably the most distinctly aquatic type.

Lagoon 1 is separated from the lake by a low ridge bearing the same vegetation as that of Zone 2 of the prograding beach. A short distance back of the lagoon is the prominent ridge of Zone 4, bearing its association of scraggly willows and other plants. Pl. V, fig. 1 is a photograph of the area.

A small lagoon near the bend of the shore is shown on the map (Pl. II). It is somewhat smaller than Lagoon No. 1, but has very similar vegetation and appears to be of about the same age.

LAGOON 2.

Growing in the basin:
- *Carex* sp.;
- *Equisetum* sp.

Growing at the margin:
- Grasses;
- *Juncus balticus* Willd.

Lagoon 2 is higher on the beach and consequently older. Its bottom held no water at the time I made the survey, though it probably does at very high levels of the lake, or after heavy rains. The entire basin is dominated by the tall *Carex*; the *Equisetum* being of low stature and present in no great quantity. The marginal vegetation is

made up of a rather thick growth of *Juncus balticus* and various grasses. The flora gives evidence of what hydrophytic growth is possible in these pools, and seems to be about the most advanced stage in such a vegetation.

Higher on the beach, and also on the upper sand-plains, as indicated previously, are small depressions without outlets. These often have the characteristic shape of those at the shore, showing a close similarity in origin. But they are quite dry and devoid of any hydrophytic vegetation. Such evidence indicates that while the lagoons are low enough on the shore to be affected by waves or to be kept moist by nearness to the water-table, they develop a hydrophytic flora; but as soon as they are high enough to be drained by the lowering water-table, they lose this flora and develop a more xerophytic flora, like that of their surroundings. Even at the lower levels the influence of the water is not felt very far away from the actual margin of the pool.

The fact that the older depressions possess the same flora as that of the surrounding plain, indicates that no great amount of humus had accumulated during the hydrophytic stage. If it had, it would reveal the fact in the more recent vegetation. Just what the process of change from hydrophytic to xerophytic is was not observed. Indications are that the change is rather complete soon after the pools are drained, and that the succession from then on is much the same as that on any other part of the dry beach.

The lagoons contribute very little to the vegetation of the sand-plain, but they serve to demonstrate the regularity with which the process of development has been going on in the area during the recent periods of emergence.

C. SUCCESSIONS ON THE MARGIN OF THE TRAVERSING STREAM

ZONE I.

The open water in the channel of the traversing stream did not appear to be in motion at the time of the survey. It seemed to be supporting some sort of algal growth, which turned it green. None of the algæ were collected. Old logs and other drift material lay on the bottom, which appeared to be composed of sand and decaying

vegetation. There was no emergent vegetation away from the shore. The stream is perhaps ten yards wide at this point and comparatively shallow.

ZONE 2.

Primary species: *Carex aquatilis* Whal.
Secondary species: None.

The *Carex* stands in water about six inches deep at the outer margin of the zone. This gradually shallows to the margin of Zone 3, and is about four yards wide. *Carex aquatilis* is very common throughout the region on shallow shores or in quiet water. The margins of ponds and the bottoms of deep bays are its principal habitats.

ZONE 3.

Primary species: *Carex* (*aquatilis* Whal. ?)
Calamagrostis sp.
Secondary species: *Salix* sp. (Seedling);
Myrica gale L.;
Sagina nodosa (L.) Fenzl.;
Mosses.

This is the first zone of solid soil, and appears to be composed largely of compact sand. The area seems to be in a transitional stage, so far as its vegetation is concerned. It is low in elevation and fairly level, and appears to have been recently under water. There is no rich growth of any plant, only a mat of dead haulms. What green there is, is largely due to the non-fruiting *Carex*, which is evidently the same species as that of Zone 2, and a few stalks of *Calamagrostis*. The latter species has been included as a primary species, because it seems to be increasing, and seems to be a fore-runner of a stage to follow. *Sagina nodosa* was found growing in small amounts at the wet outer margin of the zone.

ZONE 4.

Primary species: *Salix* sp.;
Myrica gale L.;
Alnus sp.
Secondary species: *Picea canadensis* (Mill.) B.S.P.;
Larix laricina (Du Roi) Koch;
Betula alaskana Sarg.;
Ledum grænlandicum Oeder;

Vaccinium uliginosum L.;
V. Vitis-Idæa L. var. *minus* Lodd.;
Various mosses.

Zone 4 is the first ridge area and is dominated by a rather close growth of young shrubs as listed above. Seedlings of the muskeg shrubs and trees are fairly common and indicate the future change which the ridge will undergo. There is considerable humus and a mossy covering which resembles that of the muskeg.

ZONE 5.

Primary species: *Calagrostis* sp.;
Seedling muskeg shrubs.
Secondary species: None listed.

This is a depression about two yards wide. It bears close resemblance to Zone 3, except that it has a thicker covering of plants. The soil is quite damp, but there is no standing water. Its chief difference lies in the greater amount of the tall grass, *Calamagrostis*, and in the greater growth of shrubs. Some of these shrubs were present in Zone 3 as seedlings, but here they are a little taller and of greater variety. Most of the species represented on the neighboring ridges are present.

ZONE 6.

Primary species: *Larix laricina* (Du Roi) Koch;
Salix sp.
Secondary species: *Picea canadensis* (Mill.) B.S.P.;
Myrica gale L.;
Betula alaskana Sarg.;
B. glandulosa Michx.;
Alnus sp.;
Vaccinium uliginosum L.;
V. Vitis-Idæa L. var. *minus* Lodd.;
Ledum grænlandicum Oeder;
Mosses.

Zone 6 closely resembles Zone 4, except that the trees and shrubs are taller and *Larix laricina* has taken its place as a dominant over species of *Alnus* and *Myrica*, more characteristic of the margin of streams. The zone shows another stage in the development of the muskeg flora of Zone 8.

ZONE 7.

Primary species: *Ledum grænlandicum* Oeder;
Myrica gale L.;
Larix laricina (Du Roi) Koch;
Picea canadensis (Mill.) B.S.P.
Secondary species: Muskeg mosses and lichens
(See Zone 8 for list)

The flora of the last depression outside the muskeg seems to rather closely resemble the ridge vegetation of Zone 4. The shrubs and small trees show a mixture of muskeg and forms peculiar to the margins of streams growing to about the same height as those in Zone 4. The stream-margin types, however, are not so prominent as in the latter zone. The depressions seem to be considerably behind the ridges in the development of a mesophytic flora. This may be due simply to their relation to the water-table, or to spring flooding, which would greatly shorten the growing season for them. The latter explanation is probably the more plausible.

ZONE 8.

Primary species: *Picea canadensis* (Mill.) B.S.P.;
Larix laricina (Du Roi) Koch;
Ledum grænlandicum Oeder.
Secondary species: *Equisetum* sp.;
Habenaria obtusata (Pursh) Richards;
Tofieldia palustris Huds.;
Alnus alnobetula (Ehrh.) Koch;
Vaccinium uliginosum L.;
V. Vitis-Idæa L. var. *minus* Lodd.;
Muskeg mosses and lichens.

This rather typical muskeg is of small extent, covering the area between the margin of the stream and the steep sand-bank which marks the edge of a former channel. At the steep bank there is a very abrupt transition to the more or less xerophytic flora of the sand-plain.

The ultimate fate of such small muskeg areas is undoubtedly much the same as that of the floras of the beach lagoons. Subsequent elevations of the surface of the land will tend to drain the water away and leave a semi-xerophytic flora similar to that of the sand-plain. The relatively greater accumulation of humus here, however, will probably influence the succession, when it occurs. The resulting flora will

probably show a semi-muskeg association like that on the more ancient sand-plains, to be described below.

The two lines of development of the muskeg, on the ridges and in the depressions, are indicated on the diagram of the successions (Pl. VI). The last stages of both types show that they merge with the true muskeg in much the same way, while the earlier stages probably indicate that they both had their origin in some such type of emergent aquatic association as that of *Carex aquatilis*.

D. THE VEGETATION OF THE SANDY EROSION-TERRACE

Primary species: *Artemisia canadensis* Michx.;
Carex supina Whal.

Secondary species: *Calamagrostis canadensis* (Michx.) Nutt.;
C. purpurascens R. Br.;
Poa glauca Vahl;
Festuca ovina L.;
Stellaria longipes Goldie, var. *læta* (Richards.) Wats.;
Saxifraga tricuspidata Rottb.; (Appears to have fallen from above)
Empetrum nigrum L.; (Appears to have fallen from above)
Epilobium angustifolium L.;
E. latifolium L.;
Vaccinium Vitis-Idæa L., var. *minus* Lodd; (Appears to have fallen from above).

The collection above indicated does not form an entirely complete list of the flora of the erosion terrace, but it is fairly representative. The vegetation is very sparse and makes almost no contribution to that of the sand-plain. Its most important function probably lies in its slightly retarding action upon the erosion of the bank.

The sand is continually being undercut and carried down to the lake. It presents a very precarious habitat for plants, and only those which are able to stop the movement by their root systems and to stand the extreme dessication of the sand may survive. A few, as indicated, are not properly growing on the bank, but are merely making a last and futile stand after being carried from their normal habitat on the sand-plain. *Saxifraga tricuspidata*, *Empetrum nigrum*, and *Vaccinium Vitis-Idæa* are examples of these. *Stellaria longipes* var. *læta* and the small sedge, *Carex supina*, seem to be doing especially

well in holding the sand. A seedling alder was collected at the very base of the lower area of the beach. It was probably a stray representative of a shore flora, which will appear there in future time.

It has been mentioned above that there may probably arise a fifth type of succession, of which there is no present representation. This is involved in the production of the vegetation on the nearly level plain about the old fort. At the pronounced emergence of the land surface, the lake-bottom in front of the terrace will form a new plain such as exists above at the present time. From the studies of successions on the dry sand-beaches, it is reasonable to expect that the new flora of this plain will have a very similar development. Small dunes will form out of the newly dried sand and the usual processes of fixation and increasing mesophytism will ensue. On the present plain there are small knolls which probably had such an origin.

On sand-plains, which are older than the one upon which the old fort now stands, there is a change in the vegetation which seems to be due entirely to edaphic conditions. The arboreal flora remains practically the same in its floristic characters, but there is a much thicker growth. The shrub- and ground-layers show the greatest growth. A distinct shrub-layer of *Vaccinium uliginosum*, *Ledum grœnlandicum*, *Ledum palustre*, and *Alnus alnobetula* appears. The lichen association of *Cladonia* sps. and *Cetraria islandica* is largely replaced by one of mosses, and other lichens, such as *Peltigera canina*. A more mesophytic herbaceous flora appears, with *Equisetum pratense*, the small orchid, *Lysiella obtusata*, the gentian, *Gentiana plebeia*, the broad-leaved chickweed, *Moehringia lateriflora*, and *Tofieldia palustris*. The association will be designated as that of *Picea canadensis*, *Betula alaskana*, and *Ledum grœnlandicum*. It seems to be the normal stage following the park-like association of the lower sand-plain.

It is well to note here that the Reliance area is nearly at the northern limit of arboreal growth. On Artillery lake, at a point about forty miles away, is the actual northern limit of trees. North and east of this line extend the northern plains. The presence of so rich a forest growth in the valley of Lockhart River is due to the protection which it receives from the surrounding hills. The cold winds of the plains do not reach beyond the margin of the Slave Lake basin, which is several hundred feet above Fort Reliance. The nearest rocky hills have an extremely scraggly and stunted growth of trees.

IV. SECONDARY SUCCESSIONS

There is no record of secondary successions in the region. There is evidence that the timber was burned off at one time, but when is uncertain. J. W. Tyrrell[9] described the area as follows: "Back of the buildings the land rises in regular and beautiful terraces to considerable elevation. These are thinly wooded with young white spruce trees, between which in many places the ground is covered with cranberries and blueberries. Here and there are to be seen the charred remains of large stumps, indicating comparatively recent destruction of the original forest, as well as offering an explanation for the disappearance of the old fort. The largest young trees, which showed 34 or 35 years of growth were from 4 to 6 inches in diameter 2 feet above the ground, and were not of stunted appearance." The figures would indicate that the timber has been undisturbed by fire for about 62 years, since there is no evidence of fire since 1900.

The area has been a favorite camping site for many years, and the question arises as to what effect the cutting of timber for buildings and firewood might have upon the appearance of the forest. Tyrrell[10] comments upon the parklike appearance of the place, which indicates that its general nature has not changed since his time. The first white man to use the site and describe it was Captain George Back, in 1834. His description is as follows: "The site of our intended dwelling was a level bank of gravel and sand, covered with reindeer moss, shrubs, and trees, and looking more like a park than a part of an American forest."[11] In another place he writes,[12] "Proceeding over the mossy and even surface of the sand banks . . . . etc."

These descriptions indicate that the vegetation about the site of the old fort had much the same aspect when Back first visited it, as it now has.

This region is the winter haunt of immense bands of caribou which migrate from the northern plains. Their grazing upon the lichens must retard the growth of the latter to a considerable extent. Tyrrell

[9]Tyrrell, J. W. "Exploratory Survey between Great Slave Lake and Hudson Bay, Districts of Mackenzie and Keewatin." *Ann. Rept.*, Dept. of the Interior, Canada. 1900-1901, pt. 3. Appendix No. 26.

[10]Tyrrell, J. W. *Ibid.*

[11]Back, George. *Narrative of the Arctic Land Expedition to the Mouth of the Great Fish River and along the Shores of the Arctic Ocean.* London 1836 p. 190.

[12]Back, George, *Op. cit.*, p. 181.

noted the effects of their presence in 1900.[13] "One of the most striking features of the lovely natural park is the occurrence of numerous broad, winding, well-beaten roadways, leading from nowhere to nowhere. Upon inspection, not a wheel or even a shoe mark can be detected, but only innumerable tracks of the caribou, occasionally followed by that of a prowling timber wolf." That the caribou do not permanently arrest the development of the vegetation is shown by the more mesophytic vegetation on the higher terraces, which must have once stood in the same position as the lower ones of today. As is well known, the caribou change their routes of migration after periods of years. During the winter of 1926-27 there were scarcely any at Fort Reliance, while in the few years previous they were very abundant there. Their movements may be governed by the growth upon certain types of soil of the lichens, on which they feed, and may be timed by the relatively slow rate of growth of the lichens.

V. THE CLIMATE

Very few data as to climate have been gathered. Sufficient notes have been made, however, to indicate that the growing season is very short, and that freezing temperature may occur at almost any time during the summer. The relative amount of light during the summer months is very large, due to the high latitude.

A significant condition is the relatively short open season on the lake. The ice does not leave it at Fort Reliance until between June 25 and July 5, while the shore-ice sets again anywhere from October 1 to 20.[14] This gives as a maximum, about four months of the year when the lake-shores are subject to the action of the waves. When compared with more southern lakes, this is a very short time, and relatively less work is done in altering shore-lines each year than would otherwise be the case. The sand-beaches at Fort Reliance are, therefore, being formed at a much slower rate than are such beaches in other climates. The succession of vegetation is also proceeding very slowly due to the relatively slow decay of organic matter and the slow accumulation of humus in the soil.

[13]Tyrrell, J. W. "Report of an Exploratory Survey between Great Slave Lake and Hudson Bay." *Ann. Rept. Dept. of the Interior, Canada.* pt. 3, Appendix 26.

[14]Blanchet, G. H. *Great Slave Lake Area, Northwest Territories.* Dept. of the Interior, Canada. 1926.

The former climates of the region can only be conjectured. Those immediately following the glacial epoch and for a considerable time afterward were undoubtedly much more severe than the present. The earliest Fort Reliance sand-plains must have had a different flora from that which now exists there. The plants required to be much better adapted to arctic conditions.

Whatever work is done in the investigation of the rate of change in the shore-levels and beach-formations must take into account the effect of changing climates. The earlier shore-terraces must have been much slower in forming than the later ones, for the open season on the lake would then have been shorter than in recent times.

VI. SUMMARY

A survey of the park-like vegetation on the Fort Reliance sand-plains, at the eastern end of Great Slave Lake, was made in August, 1927.

Ancient lake-bottoms, glacial moraines, and extinct shore-lines show that in post-glacial time there was a series of "Hyper-Great Slave lakes" in the basin of the present lake. At the withdrawal of the ice there was probably a differential isostatic readjustment of the surface of the land and a lowering of lake-levels due to the opening of drainage channels, so that these ancient beaches and lake-bottoms now lie at varying heights above the present level. Those at the eastern end of the Slave Lake basin are the highest ones, those at Fort Reliance being six hundred feet above the present lake.

The Lockhart River, in its lower course and at its entrance into the lake, has cut its way through the ancient beaches which are there composed of sand. The Fort Reliance area is at the mouth of this river, where the sand is being eroded away and redeposited by the river and by the waves of the lake. A series of sand-terraces is being formed in one place, and a series of prograding beaches in another. This process is bringing into existence new ground upon which vegetation may grow. Since it is evident from the configuration of the shore and the topography, that the local land-forms have come into existence in very much the same manner as new land is doing now, if the development of the vegetation on the new areas can be outlined, that on the older areas can also be outlined.

Four types of new habitats are being formed: 1, the prograding

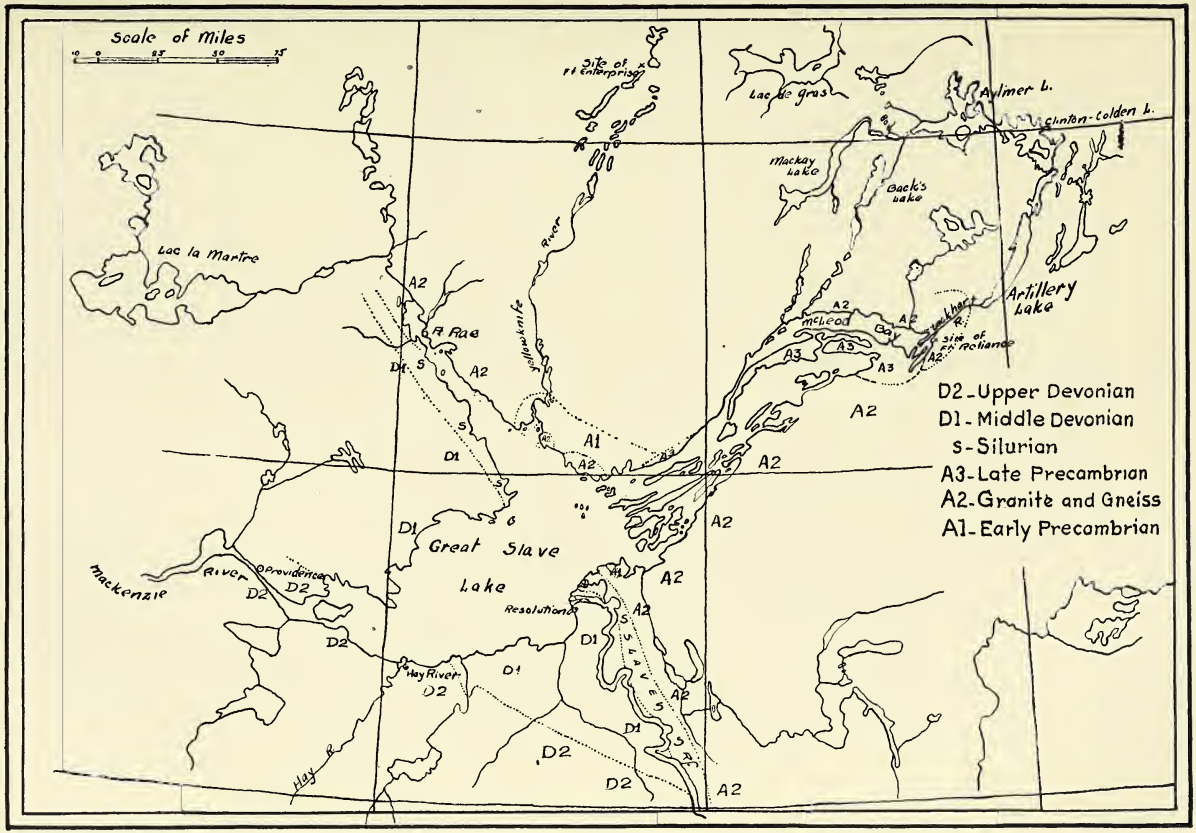
beach; 2, the beach-lagoon; 3, the margin of the traversing stream; 4, the sliding sand of the erosion terrace. The first of these is the only important one in the production of the park-like vegetation of *Picea canadensis* and *Betula alaskana*, with its ground-cover of *Cladonia* and *Cetraria*. The successions involved take place upon the ridges and the inter-ridge areas of the prograding beach. The plant associations of the beach-lagoon and stream-margins start as hydrophytic successions; but become xerophytic, like that of the prograding beach, after the emergence of the land has lowered the water-table in the soil. The vegetation of the sliding bank is ephemeral, and has little significance, except for its retarding effect on the movement of the sand. A fifth type of succession is not represented at present, but probably may occur during periods of more or less rapid uplift, when the terrace now building off shore is raised. A more or less level plain would then be exposed, and a plant association would develop in a succession probably not materially differing from that of the present prograding beach.

The xerophytic nature of the more recent sand-plains seems to have been altered on those, which are older and higher, by the accumulation of humus and by the increased capacity of the soil to hold water. The arboreal growth becomes denser, and a distinct layer of muskeg shrubs appears.

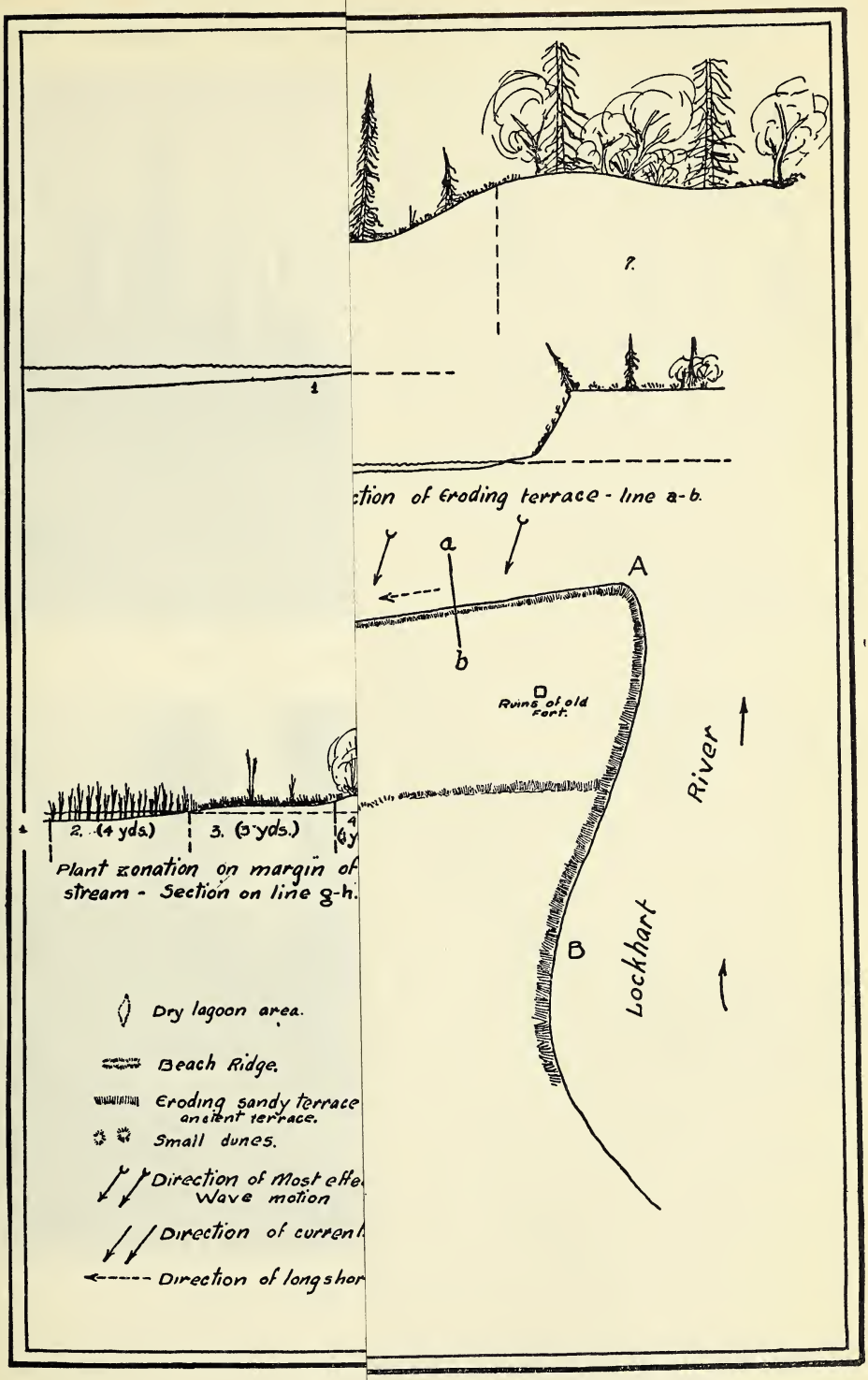
There is no evidence of fire in the timber during the past sixty-two years. Biotic influences, including those of man, do not seem to have been of great importance in governing the present nature of the vegetation.

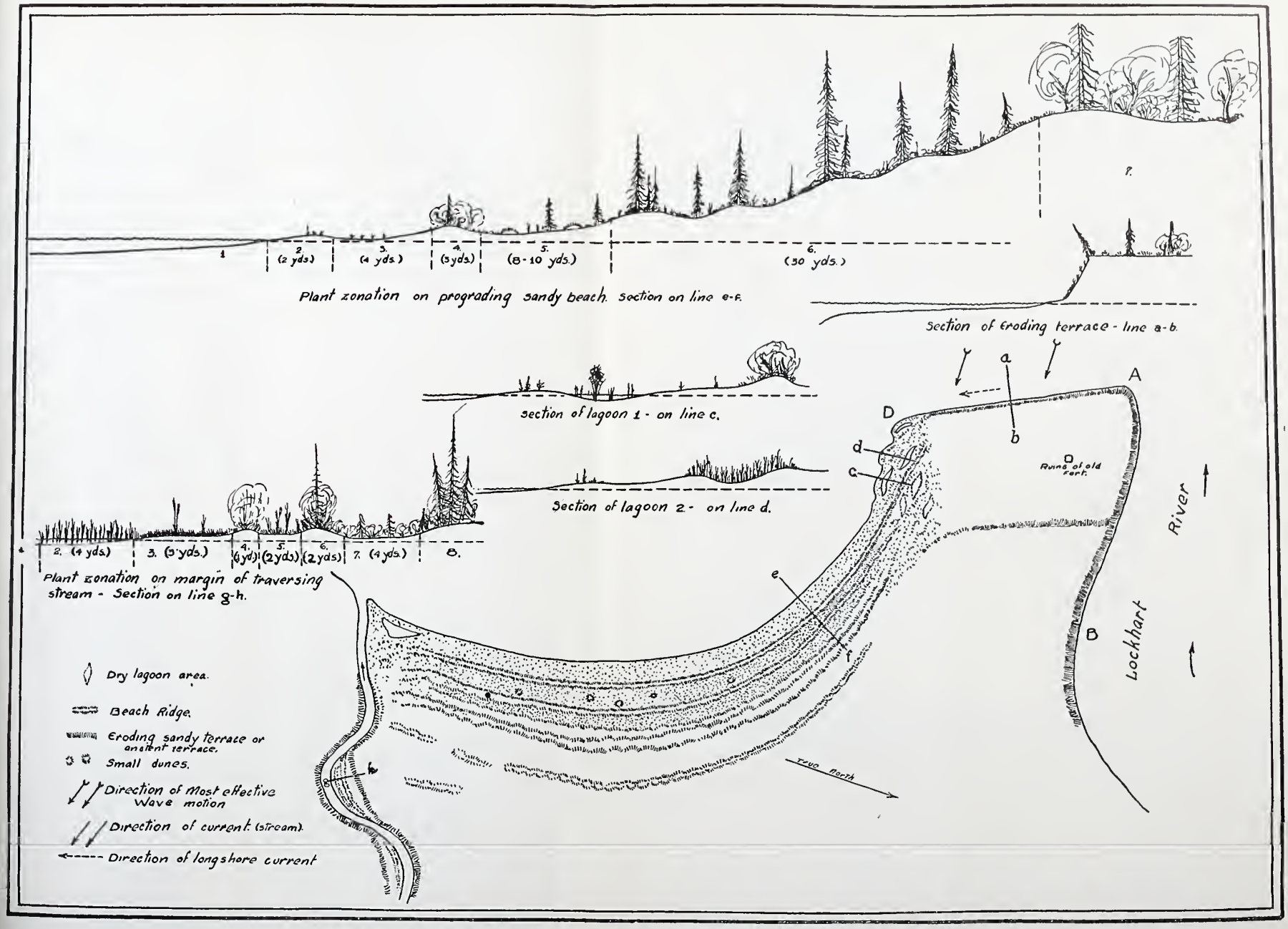
The rate and manner of the changes, both physiographic and vegetational, have probably been much altered in post-glacial time due to climatic changes. A progressively longer open season since the recession of the glacier may gradually increase the rate of change.

NOTE: The word "prograde," used by Raup, was apparently coined by Dr. W. M. Davis, and is frequently used by Douglas W. Johnson in his works. Contrasted with the words "aggrade" and "degrade" it refers to an advancing shoreline. O. E. JENNINGS.



Map of the Great Slave Lake Area


7.
1
ction of Eroding terrace - line a-b.
a
b
A
Ruins of old fort.
River
Lockhart
B
2. (4 yds.)
3. (3 yds.)
Plant zonation on margin of
stream - Section on line g-h.
Dry lagoon area.
Beach Ridge.
Eroding sandy terrace
ancient terrace.
Small dunes.
Direction of Most effe
Wave motion
Direction of current
Direction of longshor



Topographic Map of the Fort Reliance Area, Showing Sections of the Shores and Details of Plant Successions

FIG. 1. The Prograding Beach, Lower Part.

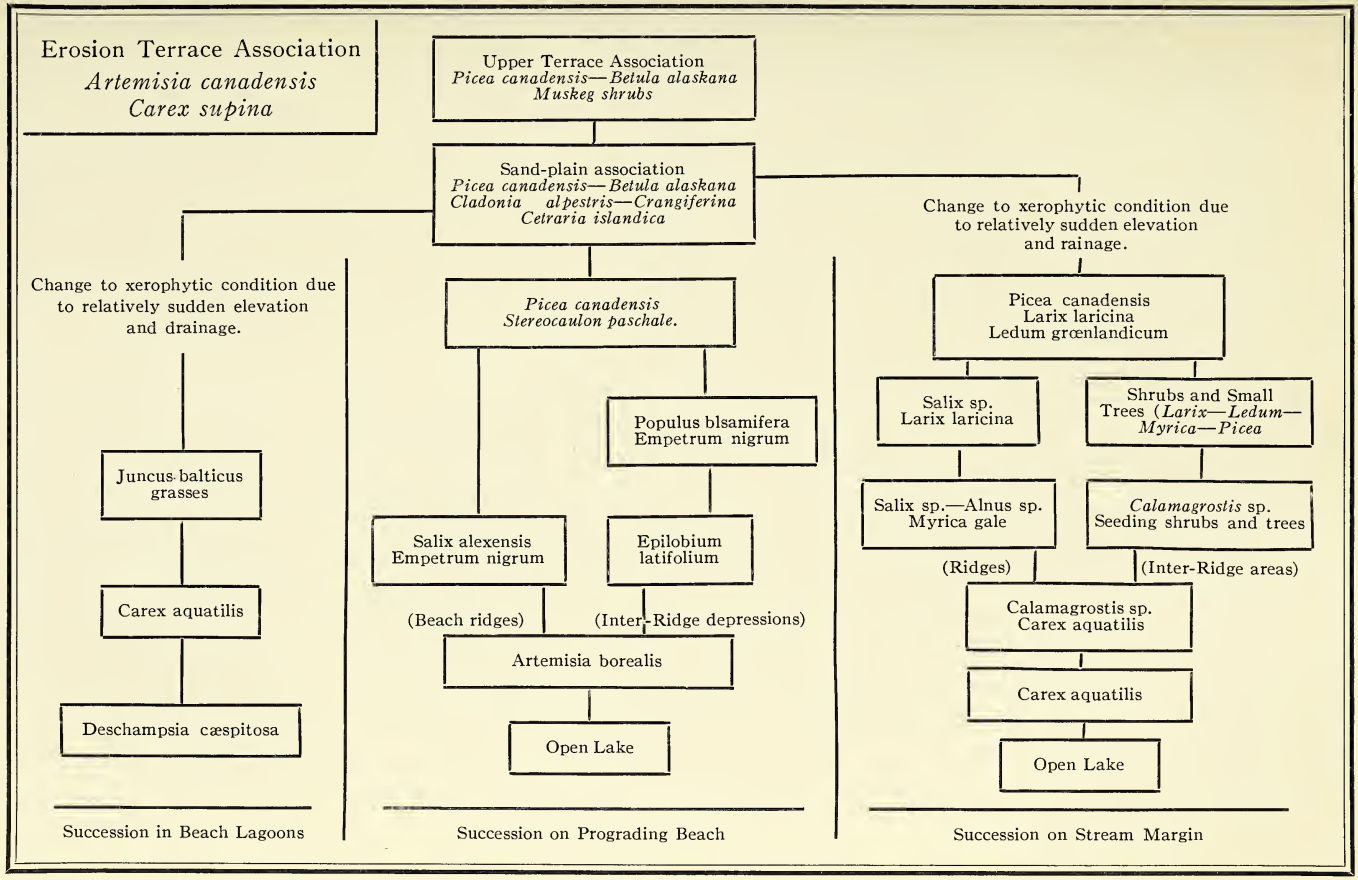
FIG. 2. The Prograding Beach, Upper Part.

FIG. 1. Park-like Vegetation of *Picea canadensis*, *Betula alaskana*, and Bunch Lichens.

FIG. 2. Typical Ground-cover in the Park-like Area.

FIG. 1. Lagoon No. 1.

FIG. 2. Lagoon No. 2.


Erosion Terrace Association
Artemisia canadensis
Carex supina
Upper Terrace Association
Picea canadensis—Betula alaskana
Muskeg shrubs
Sand-plain association
Picea canadensis—Betula alaskana
Cladonia alpestris—Crangiferina
Cetraria islandica
Change to xerophytic condition due to relatively sudden elevation and drainage.
Juncus balticus grasses
Carex aquatilis
Deschampsia cæspitosa
Succession in Beach Lagoons
Picea canadensis
Stereocaulon paschale.
Populus blsamifera
Empetrum nigrum
Salix alexensis
Empetrum nigrum
Epilobium latifolium
(Beach ridges)
(Inter-Ridge depressions)
Artemisia borealis
Open Lake
Succession on Prograding Beach
Change to xerophytic condition due to relatively sudden elevation and rainage.
Picea canadensis
Larix laricina
Ledum grœnlandicum
Salix sp.
Larix laricina
Shrubs and Small Trees (Larix—Ledum—Myrica—Picea
Salix sp.—Alnus sp.
Myrica gale
Calamagrostis sp.
Seeding shrubs and trees
(Ridges)
(Inter-Ridge areas)
Calamagrostis sp.
Carex aquatilis
Carex aquatilis
Open Lake
Succession on Stream Margin

III. NOTES ON SOME AMERICAN BUTTERFLIES MAINLY RELATING TO CLASSIFICATION AND NOMENCLATURE.

PART 2. NYMPHALIDÆ, ETC.

(Continued from Vol. XIX, p. 204)

Subfamily Nymphalinæ.

Genus Argynnis Fabricius.

The "Tentamen-name" *Dryas*, substituted in error for *Argynnis* by some authors in recent years, must be discarded. Leaving out of sight the fact that the International Commission on Zoölogical Nomenclature has very properly decided that the "Tentamen" of Hübner was not published as a "zoölogical record," it is well known to all students, who have taken the pains to investigate the subject with care, that Hübner did not use the terms proposed by him in his circular letter of inquiry, sent out under the above name, in a generic sense, but as the name of a higher group, which he called a "Stirps." The name "*Dryas*" used in a generic sense cannot be attributed to Hübner, but must be attributed to Tutt, Barnes & Benjamin, and their followers. It is a pure synonym for *Argynnis*.

1. **Argynnis electa** Edwards.

On the occasion of a visit, which Dr. J. H. McDunnough, then associated with Dr. William Barnes of Decatur, Ill., paid to the Carnegie Museum a number of years ago, he detected in the long series of specimens labelled "*electa*" by Edwards a couple of dark specimens, identical with *A. cornelia*, the series of which was located in the same drawer. Subsequently he wrote (Contrib. Nat. Hist. N. A. Lep., Vol. III, No. 1, p. 75) as follows:

"A. ELECTA Edw.

This species was described from 12 ♂ 4 ♀, some taken in N. Colo. by Mead in 1871, others in S. Colo. by Morrison in 1877; it is evident by the description that the specimens showed considerable variation and a recent examination of the series in the Edwards' Collection has confirmed our suspicion that several forms at least (if not species) were included under the one name. A ♂ in the series labelled 'Colo. Mead, 71' is marked type and as the label clearly

shows it must have been one of the type lot we consider that it would be advisable to restrict the name to this specimen. The type of *cornelia* Edw. from Ouray, Colo., proves to be absolutely identical with the type of *electa* [when thus restricted by McDunnough, W. J. H.] and *cornelia* will therefore sink as a synonym. The species is well illustrated by Holland (Butt. Book, Pl. XI, fig. 8); we do not know what his figure of so-called *electa* (*l.c.* Pl. X, fig. 8) represents; it looks more like a *lais* or *aphrodite* form."

I have always regretted that on the occasion of his unheralded and hurried visit I had only a few moments in which to converse with Dr. McDunnough. Had we had time to compare with each other, he might have been led to different conclusions than some of those, which he reached. He seems to have entirely disregarded the fact that in the great suite of specimens labelled "*electa*" by Edwards there were numerous specimens labelled exactly in the same way as the specimen which he selected and "restricted" as the type, ticketted "Colo. Mead, '71, type," as well as some ticketted "So. Colo., Morrison, '77, type." In fact the original specimens upon which Edwards based his description are all in the collection together with many others collected by Mead, which Edwards had returned to his son-in-law, the collector, labelled by Edwards in his well-known handwriting "*electa*." These are all of the form, which Barnes & McDunnough say "we do not know." If Dr. McDunnough had looked a little more closely he would have found the identical specimen figured in The Butterfly Book, Pl. X, fig. 8, bearing in Edwards' handwriting the label "*electa* ♂, Morr. So. Colo." and across it written by the same hand in red ink the word "type." This specimen also carries a printed label reading as follows: "Butt. Book, Pl. X, fig. 8." I am sorry I did not have an opportunity to explain to Dr. McDunnough all about these things, but my time was taken up by pressing duties and he was left to the care of one of my valued assistants, who really only in a most general way had knowledge of the collection. The "so-called *electa*" figured on Plate X of The Butterfly Book, which Barnes and McDunnough say "we do not know," is that one of Edwards' original types, which, when I wrote the book, I decided agreed most closely with the original description, and represents the vast majority of Edwards' really long suite of *A. electa*. The specimen designated or "restricted" by Dr. McDunnough as the "type" of *electa* is one of three stray specimens of *A. cornelia*, which Edwards had mixed up with his long suite of *electa*, and later, when he described *A. cornelia*, had inadvertently failed to

remove to their proper place. I have since remedied the matter and have transferred these three specimens of *A. cornelia*, including the specimen which Dr. McDunnough arbitrarily "restricted" as the type of *electa*, to their proper place in the set of *A. cornelia*, where they belong, leaving the original labels intact, but affixing my own label, designating them as *A. cornelia*.

To cut a long story short: "the so-called *electa*," which Barnes and McDunnough (*l.c.*) say "we do not know," is represented in The Butterfly Book by the true type of that species, which is exactly matched by twenty-three other specimens, all bearing the name "electa" in the handwriting of W. H. Edwards, *A. electa* is a valid species, as species go in the genus *Argynnis*, and is not identical with *A. cornelia*, Dr. McDunnough to the contrary notwithstanding. This is one of numerous cases in which the so-called "fixation of a type" has left things "in a fix." *A. electa* is a member of the "*Lais*-group" of North American Argynnids.

2. **Argynnis coronis** Edwards.

There is another case in the Genus *Argynnis* in which in the light of facts and with all the evidence before me I am compelled to differ from the finding of Messrs. Barnes and McDunnough. This is the case of *A. coronis* Edwards (Behr *in lit.*).

This species was originally described by Dr. Behr as "Argynnis No. 2" in a paper read by him before the Lyceum of Natural History of San Francisco, and published in the Proceedings of the Cal. Acad. Nat. Sci., Vol. II, 1862, p. 173. In this paper Behr designated eight species of *Argynnis* by numerals, without applying specific names. In a paper published the next year Behr applied specific names to seven of the eight species, and still left "No. 2" without a specific name. W. H. Edwards wrote to Behr suggesting that the specific name *coronis* should be given to "No. 2." Behr wrote to Edwards assenting to the proposal. Meanwhile Behr had sent to W. H. Edwards colored drawings of the eight species which he had originally designated by numbers and not by names. From these drawings Edwards informs us he was able to ascertain the identity of the eight species, including "No. 2."

In 1864 W. H. Edwards published in the Proceedings of the Entomological Society of Philadelphia, Vol. III, pp. 434-436, a paper entitled "Notes on the Argynnides of California," in which he reprints

Behr's original diagnoses and cites the second of Behr's species as follows: "No. 2. *Argynnis Coronis* Behr *in lit.*"

Under the well-known rule which governs all such cases, the specific designation *coronis* must be attributed to Edwards, as he was the first to publish it.

Edwards took all pains to correctly identify Behr's "No. 2" which he named *coronis*, and was assisted in this work by Dr. Behr himself. Until quite recently no one has questioned the identity of *coronis* Edwards (Behr MS.).

Strecker in his "Butterflies and Moths of North America, etc." 1878, p. 112, listed the species as follows:

"202. Coronis, Behr, Proc. Cal. Acad. Nat. Sc., II, p. 173, n.2, (1858-1862); W. H. Edwds., Proc. Ent. Soc., Phil., III, p. 435, (1864); Kirby, Cat., p. 158, (1871); Scud., Buff. Bull., II, p. 260, (1875).
Arg. Juba, Bdl., Lep. Cal., p. 60, (1869)."

Strecker in his work indicates that the species is in his collection. *A. liliana* Hy. Edw., which he lists immediately before *A. coronis* as No. 201, he designates by a dagger (†) as "unknown to him in nature," and by an asterisk (*) as "wanting in his collection." He does not prefix a double dagger (‡), indicating his possession of the author's types, to the species *coronis*, nor to any other species named by Behr, although in 1900 in his "Supplement No. III" to his "Lepidoptera Rhopaloceres and Heteroceres," p. 22, he tells us that in 1876, two years before he published his "Synonymic Catalogue," he had received from Dr. Behr "all of his Argynnides." In 1878 Strecker appears to have been unconscious of having received Behr's types. In 1900 Strecker claims the possession of some of them received in 1876. This is a point worth remembering, since Strecker on the first page of his Catalogue (1878) says that 'all species, the types of which he possesses, have a double dagger prefixed to the name.'

In 1916, forty-two years after Edwards with the assistance of Dr. Behr had established the identity of Behr's "Argynnis No. 2" = *A. coronis* Edwards, and the species had been beautifully figured by Edwards in his Butterflies of North America, Vol. III, Pt. 2, April, 1887, and figures of his designated "types" had been reproduced by color-photography by the writer in The Butterfly Book, Pl. XI, figs. 10 and 11, comes our friend, Dr. J. H. McDunnough, printing the

following in *Contributions to the Nat. Hist. Lep. N. A.*, Vol. III, No. 2, Decatur, Ill., Dec. 5, 1916:

"A. CORONIS Behr.

In the Strecker Collection is a pair purporting to be the type of this species and regarding these and other Argynnis types of Behr's describing Strecker states (Lep. Rhop. Het. Suppl. 3, p. 22) that they were sent him by Dr. Behr in 1876 along with other typical examples with a letter saying 'I send you *all* my Argynnides in their doubtful state and with your better collections and literature you can do far more than I with my limited opportunities.' Under these circumstances we see no adequate reason why we should not accept these specimens as the types. Edwards first applied the name *coronis* Behr with Dr. Behr's consent to the species 'No. 2' of Behr's paper in Proc. Cal. Acad. Sci. II, 173, 1862 (Proc. Ent. Soc. Phil., III, 435); the species figured by Edwards as *coronis* in Butt. N. Am. III, Argynnis IV was determined as such by him from a colored figure received from Dr. Behr and this conception of the species has evidently been generally accepted since then.

We have examined the Strecker types extremely carefully, comparing them with a long series of specimens and find them absolutely identical with the species known as *liliana* Hy. Edw. and *not* the same as the species figured by Edwards. One of the main points of distinction is the *narrowness* of the yellow subterminal area on the underside of the secondaries which in Edwards' figures is relatively broad. Dr. Behr in the original description states that the species is very similar to *callippe* Bdv. but actually differs in the lack of the pale markings of the upper side and this statement is perfectly true as *callippe* possesses the same narrow band on the underside as does *coronis* (*liliana*), which is additional proof that the Strecker 'types' are more to be relied upon than Edwards' determination from a figure. The species is said by Dr. Behr to frequent several localities near the bay of San Francisco and this would therefore be in the same general region as the type locality of *liliana* Hy. Edw., which is St. Helena, Napa Co."

From the conclusion reached by Dr. McDunnough I thoroughly dissent. Behr's original type, if it had any label, was labelled "*No. 2.*" That Behr divested himself of all his Argynnids, including the types, is extremely doubtful. He left his collection containing many Argynnids to the California Academy of Sciences, in the possession of which it was at the time of the San Francisco earthquake and fire, when it unfortunately was destroyed. The specimens in the Strecker collection are said by Dr. McDunnough to be "a pair purporting to be the types." That they are Behr's types is to my mind to the last degree questionable. As I have pointed out, Strecker did not in 1878

cognize the existence in his collection of any of Behr's types, although in 1900 he said he had received them in 1876. Some of us who knew the old man most familiarly are aware that he had very little regard for the sanctity of labels. The identity of *Argynnis coronis* was fixed by W. H. Edwards with care and with the assistance and approval of Dr. Behr himself, who did not dissent, as he might well have done, from the work of his friend and fellow-laborer Edwards, had Edwards made an error. The first describer of "Argynnis No. 2" and W. H. Edwards, who gave the name *coronis* to the species, were in full accord. Nobody for forty-two years questioned the identity of the species until Dr. McDunnough discovered the two specimens in the Strecker collection, which are very dubiously to be considered as the types of Behr's "No. 2," and certainly are not the types of *A. coronis* Edwards, which exist in the Edwards collection in the same condition in which they were when he wrote Vol. III of *The Butterflies of North America*, fully described them, designated them as the "types," and published their figures. The synonymy originally given by Herman Strecker in 1878 I think holds good today, and I adhere to Edwards and Strecker in the premises, as have all other authors, except those of the "Decatur School," Messrs. Barnes and McDunnough and their followers.

The identity of *A. juba* Boisduval with *A. coronis* Edwards is absolutely proved, as was pointed out by Edwards, by the type of *juba*, which Boisduval in great kindness himself sent to Edwards, and which is still preserved in the Edwards Collection marked by Boisduval in his own handwriting as "type." *Juba* was published in 1869, whereas the name *coronis* was published in 1864 and therefore has absolute priority.

Genus MELITÆA.

The genus *Melitæa* was erected by Fabricius (Illiger's Magazine, VI, 1807, p. 284). He included in the genus as species *lucina* (a Riodinid, since removed), *didyma*, *cynthia*, and *maturna*. Scudder following the Merton Rules designated *didyma* as the type of *Melitæa* Fabricius, but made the statement that "the name . . . falls because preoccupied through *Melitea* (Pér.-Les., Acal., 1809)." An examination of the work of Péron and Lesueur shows that it did not appear until 1809, the date correctly given by Scudder himself. The name is used for Acalephs by Lamouroux and subsequent authors as *Melite*.

According to Scudder's own statement and the dates he gives, *Melitæa* has precedence in time over *Melitea* (or *Melite*), and the name, therefore, is not "preoccupied," Scudder to the contrary notwithstanding. He having erroneously accepted Hübner's "Tentamen" as a zoölogical record and misconstrued it, and further led astray by his own oversight as to dates, proposed the "Stirps-name" *Lemonias* of Hübner to replace *Melitæa*. Some compilers of check-lists have followed him in his error. Hübner in his "Verzeichniss," p. 29 (1816?) erected the genus *Cinclidia* under which he lists as species *phœbe* Schiff., *athalia* Esper, and *orthia* = *dictynna* Esper. But these species listed under *Cinclidia* by Hübner are strictly congeneric with the species listed by him under *Melitæa*. *Cinclidia* is a pure synonym of *Melitæa*.

In 1872 Scudder erected the genus *Euphydryas* with *phaëton* Drury as the type. The first species named by Hübner under *Melitæa* is *phaëton* coupled with *maturna* Linn., *cynthia*, and *artemis* D.S. = *aurinia* Rott., the latter name having priority. The species listed by Hübner in the "Verzeichniss" under *Melitæa* are strictly congeneric with *Euphydryas* Scudder. *Euphydryas*, like *Cinclidia*, is a pure synonym of *Melitæa*. If *Euphydryas* were accepted as valid, nearly all palearctic species would come under it, and great confusion would follow. At best under the most charitable construction, *Euphydryas* and *Cinclidia* have only subgeneric or "group" value.

Genus ANTHANASSA Scudder.

The genus *Anthanassa* was erected by Scudder (Bull. Buff. Soc. Nat. Sci., Vol. II, 1875, p. 268) with *Eresia cincta* Edwards as the type. The original types of *Eresia cincta* Edw. have unaccountably disappeared from the W. H. Edwards Collection and are not in my possession today. Who stole them I do not know.

The genus *Anthanassa* is founded upon rather trivial characters, mainly the outline of the wings. It is not recognized, or is merely alluded to, by recent revisers of the great group of which the species included in it form a part. At best it is a subgenus of *Phyciodes*, covering a group most of which are found in Central America and southward.

Genus POLYGONIA Hübner.

The substitution of the generic name *Polygonia* Hübner for *Grapta*

Kirby, which has become an accepted usage in recent years, seems to be justifiable.

Genus AGLAIS Dalman.

The use of the generic name *Aglais* Dalman for the group of species with *urticæ* as type, including such species as *l-album* (Esper) of Europe, *j-album* (Bdv. & Lec.), *californica* (Bdv.), *milberti* (Godart), and *antiopa* (Linnæus), is apparently justifiable. The application of the generic name *Hamadryas* to this group, *Hamadryas* being a "Tentamen-name," by Barnes and Benjamin is an error. *Hamadryas* Boisduval is the generic name which is properly applied to a group of Indomalayan insects, closely related to the Ithomiids of the new world. *Tellervo* Kirby is a synonym of *Hamadryas* Boisd.

Genus VANESSA Fabricius.

The type of the genus *Vanessa* Fabricius is indisputably the species *atalanta* (L.), the genus having been erected by Fabricius in 1807 and Latreille in 1810 having designated *atalanta* as the type. The species *cardui*, as stated by Scudder, is absolutely congeneric with *atalanta* and is so recognized by Lindsey. *Pyrameis* of Hübner sinks as a synonym of *Vanessa*. The facts were definitely and correctly stated by Scudder in his *Historic Sketch of Generic Names*, 1875. Lindsey speaks of "Scudder's peculiar reasoning" in this case. I see nothing but "plain common sense" in Scudder's reasoning.

Genus CYNTHIA Fabricius.

The substitution by Barnes and Lindsey, and Barnes and Benjamin of the generic name *Cynthia* for *Vanessa* is most unfortunate. The argument in defence of this procedure, which can only be based upon the action of Stephens in 1827 and of Horsfield in 1828 has no weight whatever. Stephens in his *Illustrations of British Entomology* in 1827 restricted *Cynthia* to *cardui*; Horsfield in his *Descriptive Catalogue of the Lepidoptera in the Museum of the British East India Company*, 1829, on one of his Plates prints the name *Cynthia cardui*. The action of Stephens and of Horsfield, long after the fixation of the type of the genus *Vanessa* by Latreille, must be disregarded, as pointed out by Scudder. Horsfield and Moore in their later and complete Catalogue (bearing the same title as the incomplete work above cited) and published in 1857 place the species *cardui* in the genus *Pyrameis*, and use *Cynthia* for *arsinoë* and its congeners. The type

of the genus *Cynthia*, as all students of oriental lepidoptera well know, is *arsinoë*, as stated by Scudder. In 1833, nearly one hundred years ago, Erichson (Nova Acta, Ac. Nat. Cur., XVI, Suppl. Pl. L, figs. 2, 2a) described under *Cynthia* a species which he named *deione*, strictly congeneric with Cramer's *arsinoë* figured by him in 1779. Since 1833 all lepidopterists have recognized *Cynthia* as the generic name properly applied to the oriental insects *arsinoë*, *deione*, etc. To have the generic name of this well known and huge Asiatic butterfly suddenly appearing in our lists as the generic designation of our common Thistle Butterfly is startling, to say the least, to a lepidopterist who knows the butterflies of the world. Its employment in this manner is a positive and most singular error.

Genus ATHENA Hübner (1818).

(Type, *Papilio thetys* Fabr. = *Papilio petreus* Cramer).

Synonyms: *Tymetes* Boisd. (*Timetes* auct.) 1836, type *merops* Boisd., *Megalura* Blanchard, 1840, type *coresia* (Godart).

What is the correct generic name of the Dagger-wings? In common with many other authors I assigned them to *Timetes* in the first edition of The Butterfly Book. By Seitz they have all been classified under the generic name *Megalura*. Some authors make a distinction between species belonging to the *Coresia*-group and those belonging to the *Petreus*-group.

A careful investigation leads me to the conclusion that the proper name to apply to the whole complex is *Athena* Hübner. There is no structural difference between the butterflies of the *Coresia*-group and the *Petreus*-group, except that in the latter the hind wings have the inner tail near the end of vein two, a little longer than in the *Coresia*-group. Genera founded upon such slight distinctions as this are certainly unnecessary refinements.

It is quite evident that Hübner's name *Athena*, type *Thetys* (Fabr.) = *Petreus* (Cram.) has priority in time over both *Tymetes* (*Timetes*) of Boisduval and *Megalura* of Blanchard.

Genus ASTEROCAMPA Röber (1916).

Synonym: *Celtiphaga* Barnes and Lindsey (1922).

(The Hackberry Butterflies)

The North American species belonging to this group have been shifted about from one genus to another for years, having been as-

signed now to the genus *Apatura*, now to *Chlorippe*, and strangely enough to *Doxocopa*. The latter genus, the type of which, according to Scudder, is the species *polyxena* (*epilais*) would then be equivalent to the genus *Charaxes*, with which these things have absolutely nothing to do. Röber claims that the type of *Doxocopa* is *erminea*, an oriental insect, selected by others as the type of the oriental genus *Apaturina*. I recognize the fitness of the generic name *Celtiphaga*, proposed by Barnes and Lindsey, but unfortunately the name *Asterocampa* Röber has priority and must replace it. In reality the distinctions between *Apatura*, *Chlorippe*, and *Asterocampa* are not very great, founded upon the shape of the hind wings in the males, distinctions in the style of coloration, and doubtful genitalic differences alleged by Fruhstorfer to exist. The North American species, including the Central American species, *argus* Bates, form a group which does not show much of the iridescent blue and purple of the European species of *Apatura*, and the even more brilliant iridescence of the American species, which have been herded by authors in the genus *Chlorippe*, to which I assigned these insects in the first edition of The Butterfly Book. In the forthcoming second edition I shall follow Röber, and employ the generic name *Asterocampa*, of which *Celtiphaga* Barnes and Lindsey is, I am sorry to say, a synonym.

Genus HISTORIS Hübner.
(Type *Papilio odius* Fabricius).

Synonym: AGANISTHOS Boisd. and Leconte.

Hübner included in his genus *Historis* two species, *Papilio odius* Fabr. and *Papilio marthesius* Cramer.* The latter is a true *Siderone*. Its removal leaves *odius* as the type of *Historis*, which has priority over *Aganisthos* Boisduval and Leconte.

**Papilio marthesius* Cramer has been and still remains a great rarity in collections. The figure given by Cramer is an excellent representation both of the upper and the under sides of this magnificent insect, and is only defective in that it does not show the short tail at the end of the anal angle, having evidently been drawn from a specimen defective in this respect. Cramer figures a female from Surinam. We have a female from Kartabo, British Guiana, which exactly matches Cramer's figure, so far as the latter goes; and a female from Bolivia, collected by Steinbach, bearing the note "*am hæchsten selten*." These two females are tailed and are orange reddish on the light spots of the upper surface, as shown in Cramer's figure. We have another female taken at S. Paulo de Olivença, Brazil, by Klages, together with males, which on the under side agree with Cramer's figure, but upon

Barnes and Benjamin in their "List of Diurnal Lepidoptera, &c." star *Historis odia* (Fabr.) thus querying its occurrence in the United States. Boisduval and Leconte, p. 196, cite it as from "la Florida." It has not often been taken there, but some years ago one of my correspondents living at Miami, sent me by mail a small box containing a chrysalis. Upon the arrival of the box the butterfly had already emerged from the chrysalis, and I discovered a badly crippled specimen of *H. odia*. That is proof positive that Boisduval was not in error.

Genus COEA Hübner.

Barnes and Benjamin in their Check-list place *C. acharonta* Fabricius in the genus *Historis* (type *odius*) (*recte odia*). The two insects are so unlike in structure that this procedure cannot be justified. The insect is starred by Barnes and Benjamin, thus questioning its occurrence in our fauna. I confess I have seen no specimens, which I can be sure were caught within the United States, but it may occur as a straggler on our southern border. It is common in the Antilles.

Genus SMYRNA Geyer.

Smyrna karwinskii Geyer.

The occurrence of this common neotropical species in the United States is queried by Barnes and Benjamin. They may be right, but it has long been listed as found in this country. Its occurrence in Texas, or even in Florida, is not improbable, though I have no specimens which I can affirm came from these states. It does occur just across the Rio Grande, and is quite common in Mexico.

SUBFAMILY SATYRINAE.

In the genus *Neonympha* (= *Euptychia*) Barnes and Benjamin adopt the specific name *areolatus* Smith and Abbott, prefixing a double

the upper side have the ground-color brilliant crimson. This is plainly a dimorphic form.

The males which we associate with these females, are the insect, which is figured by Seitz (Gross-Schmett., Amer. Tagfalt., Pl. 116, b) as *S. mars* Bates. The synonymy of the species is as follows:

Siderone marthesia (Cramer)

♀. *Papilio marthesius* Cramer, Pap. Exot., II, Pl. 191, ff. A, B (1779) *Type*.

♀. *Nymphalis marthesius* Godart, Enc. Méthod., IX, 1823, p. 371.

♀. *Siderone marthesia* Bates, Proc. Ent. Soc. Lond., 1865, p. 343.

♂. *Siderone mars* Bates, Proc. Ent. Soc. Lond., 1860, p. 112; Röber, in Seitz, Gross-Schmett., Amer. Tagfalt., p. 478, Pl. 116, b.

dagger before *phocion* Fabricius as an "unavailable name." This I maintain is an error. Fabricius used the specific name *phocion* in the genus *Papilio* under the subdivision "*Satyri*," publishing the name in the *Entomologia Systematica*, Vol. III, Pt. 1, p. 218, in 1793. It was not until 1797 that Smith and Abbott published the same species under the name *areolatus*. The fact that Fabricius in the *Species Insectorum*, Pt. 2, p. 138, No. 642, 1781, under the "*Plebeji urbicolæ*" had designated a species by the name *phocion* does not make the Satyrid *phocion* a homonym of the African *phocion*, which Fabricius in the *Entomologia Systematica*, Vol. III, Pt. 1, p. 354, distinctly locates in *Hesperia*. The designation by the same specific name of a Satyrid from North America and a Hesperid from Africa does not convert *phocion* the Satyrid, into a homonym of *phocion*, the Hesperid. Fabricius placed the two forms in quite different groups. All butterflies were named *Papilio* in those days, as is well known, but the designation of the American insect as a Satyrid before Smith and Abbot published gives *phocion* as a specific name priority over *areolatus*. To deny the availability of the name to designate a Satyrid, because it had previously been used as the specific name of an Hesperid, is pushing matters to an unwarranted extreme in the judgment of the writer. I have numbers of both species in my cabinets, and never have been troubled by their having the same specific name. They are "miles apart" from the standpoint of a modern lepidopterist, as they were to Fabricius, who named them.

Genus OENEIS.

Œneis semplei Holland, sp. nov.

♂. On the upper side there is a faintly indicated subapical ocellus, which does not occur in *semidea* (Say), to which this species is somewhat nearly related. On the under side the males have a superficial resemblance to the same sex of *Œ. semidea* (Say), but the white spots on the costal margin of the fore wing differ in their direction from those on the fore wing of *semidea*, which are inwardly oblique to the costa, while in *semplei* they are at right angles to the costa. Furthermore in *semplei* the black submarginal dark band which appears in *semidea* below the apex of the wing is entirely absent, and the clouded mark at the end of the cell is less diffuse in *semplei* than in *semidea*. On the under side of the hind wings of the male in

semplei the basal and median areas are lighter than in typical *semidea*, and the marginal dark spots are more pronounced and regular.

♀. The female is lighter in color on the upper side than the male, with a faint fulvous tint. The subapical ocellus on the fore wing is well defined in this sex, and a less definitely marked ocellus appears on the hind wing below the end of the cell. The wings on the under side are prevalently fulvous in their ground-color, and are thus quite different in their general appearance from the females of *Œ. semidea* (Say).

The types, males and one female, were collected in July 1926, by the John B. Semple Expedition of the Carnegie Museum, on the western coast of Labrador, at the point where the Little Cape Jones River discharges into Hudson Bay. I take pleasure in naming the species in honor of my friend, Mr. Semple, who accompanied the expedition, and who has so generously financed a number of our adventures into the far north.

Œneis gibsoni Holland, sp. nov.

What I take to be the insect, the female of which is figured as a form of *semidea* (Say) by Gibson in *The Report of the Canadian Arctic Expedition*, Pl. II, fig. 7, is represented in my collection by a female and three males taken in the Kuskokwim Valley by Rev. Mr. Stecker some years ago. That the males must be associated with the female is beyond doubt, as the female was taken in consort with one of the males. The two sexes differ in that in the male there is a well defined dark mesial band, which in the female is very diffuse and not at all well defined. Figures of the male and female types will shortly appear on one of the plates of the Revised Edition of The Butterfly Book.

I name the insect in honor of Dr. Arthur Gibson, who has contributed much to our knowledge of the North American species of the genus *Œneis*.

Family RIODINIDÆ.

Genus CALEPHELIS Grote and Robinson.

My excellent friend, Dr. A. W. Lindsey, in the Annals of the Entomological Society of America, Vol. XV, 1922, p. 93, says:

"According to Opinion 14 of the International Rules, the type of this genus must be *cæneus* Linn. as specified by Grote and Robin-

son, and not *virginiensis*, which they erroneously placed as a synonym of *cæneus*, and which has been cited as the type by later writers. We are unable to find any other described genus which is applicable, and would suggest the anagram LEPHELISCA, type *Erycina virginiensis* Guer. to take the place of *Calephelis* Auct."

With all due respect for the learning of my friend, I must register my dissent. The case dealt with in "Opinion 14," does not seem to me to be strictly analogous. In the second place there is not the slightest doubt as to the identity of the insects which Grote and Robinson intended to include in their genus *Calephelis*. It is true that recent researches have shown that the insect called *cæneus* by Linnæus belongs to the genus *Emesis*, and was erroneously applied to the species, which Grote and Robinson had before them, but the citations in the synonymy, which they give, leave it beyond a shadow of a doubt that they designated as the type of their genus the "Little Metal-mark," originally designated as *virginiensis* by Gray and Guérin-Méneville, then subsequently figured by Boisduval and Leconte as *Nymphidia pumila* (Lep. Ann. Sept., 1837, figs. 6, 7). This species, the identity of which is clearly established by the descriptions and figures which Grote and Robinson cite and the true name of which is *Calephelis virginiensis* (Gray) is what Grote and Robinson speak of as "our caenius" (sic). At the time they wrote all writers and collectors had accepted the opinion that The Little Metal-mark of the southeastern United States should be known as "*cæneus* L." The species stood thus labelled in every list, and so ticketted in every cabinet. In 1898 I figured and wrote about this insect under this name in the first edition of The Butterfly Book.

The language used by Grote and Robinson in this connection is most explicit and decisive. After speaking at some length of the characteristics of what they, following Doubleday and Hewitson, called *cæneus* L., but identified as being the same as *virginiensis* Guer. and *pumila* Boisd., and after pointing out the fact that the species, which they themselves had named *borealis*, was congeneric with what they called *cænius*, they say: "For the group so characterized and of which our *cænius* is typical, we propose the name *Calephelis*." Nothing could be clearer. They intended to erect a genus *Calephelis* for two strictly congeneric insects, one of them The Little Metal-mark, the other the Northern Metal-mark. The identity of the two species they intended to include in their new genus is not open to question. The fact that they erred in common with all the writers of their time,

in identifying *cæneus* (L.) as being the same as *virginiensis* Gray does not affect the matter.

I presume that Dr. Lindsey must have been in his work affected by the, to me at least, nomenclatorially heretical position announced by Dr. Barnes and F. H. Benjamin, who in the Introduction to their List of the Diurnal Lepidoptera of Boreal America, &c.," say: " In one factor, however, we have deviated from most of the previous work, and that is in considering a *specific name rather than a specific organism as the genotype.*" (The italics are mine. W. J. H.). In other words the type of a genus is not an insect, which exists in nature, but a name which may have been correctly or incorrectly applied. But what is a name? It is a vocable applied to designate persons and things. The person or the thing intended is central in all study or discussion. The "specific organism," under whatever name it may have been designated, is the real thing, the identity of which must be ascertained in the nomenclatorial court. I am, as are all true zoölogists, with Abelard, a "Conceptualist," and hold that the terms of science are "concepts, which while existing in our minds, express real similarities in things themselves." In my philosophy as a naturalist, I am not a follower of Thomas Aquinas or Albertus Magnus. The word *logotype* has no place in my vocabulary. I protest against the novel attitude assumed in this matter by my excellent friend, Dr. Lindsey, and I am in thorough accord with Dr. Stichel, the latest and most careful revisionist of the *Riodinidæ*, who accepts *Calephelis* Grote and Robinson as the real name for a group of real things in nature clearly pointed out by Grote and Robinson. I am compelled by my convictions to reluctantly sink *Lephelisca*, the anagrammatic "alias" ingeniously invented by Lindsey, in the limbus of synonyms.

Family LYCÆNIDÆ.

I am in disagreement with the course pursued by Barnes and Lindsey in substituting the generic name *Lycæna* for *Chrysophanus*.

The generic name *Lycæna* was first applied in 1807 by Fabricius to a medley of forms, including "Hair-streaks," "Blues," and "Coppers."

In 1815 Oken in his Lehrbuch, Vol. I, p. 717, separated the "Hair-streaks" and the "Blues" from the "Coppers." As is correctly stated by Scudder in his *Historic Sketch of Generic Names*, Oken removed

from the genus *Lycæna* "the Coppers," the "Röthlinge," or "Dukatenfalter," and included in this category the species *hippothoë*, *virgaureæ*, and *phlæas*. In his great work, *Allgemeine Naturgeschichte*, thirteen volumes of text, and folio atlas of one hundred and fifty-eight plates, he follows up his work begun in his *Lehrbuch* and gives, pp. 1389 *et seq.*, the same classification. The action of Oken, the greatest German naturalist of his day, the friend of Gœthe, Professor of Anatomy and Zoölogy in the Universities of Weimar, Jena, and Munich, is lightly dismissed by Barnes and Lindsey, who say: "If we follow the International Rules . . . Oken's action is not recognized as a valid restriction." Scudder (*l.c.* p. 209) did not thus lightly brush the work of the great German naturalist aside. Nor have others for many years. The subdivision of these butterflies into "the Hair-streaks," "the Blues," and "the Coppers" has continued from the days of Oken to the present time, with but few exceptions, through the whole literature of our science. It even antedates Oken and is well defined by Geoffroy and Denis & Schiffermueller.

But, setting the action of Oken to one side, it is incontrovertible that Dalman in 1816 set up the genus *Heodes*, definitely removing from the genus *Lycæna* Fabricius the species *virgaureæ* and *phlæas*. By Scudder *phlæas* was accepted as the type of the genus *Heodes*; Hemming on the basis of "page priority" says *virgaureæ* is the type. It makes no difference; both are "Coppers."

In 1818 Hübner in his "Zutræge" cites under the generic name *Chrysophanus* the two species *mopsus* Hbn. (=*titus* Fabr.) and *circe* Schiff. In his "Verzeichniss," 1822, he includes *circe* under *Chrysophanus* and transfers *mopsus* to the genus *Strymon* as not congeneric with *circe*. *Circe* Schiff. must therefore be recognized as the type of *Chrysophanus*. In the genus *Chrysophanus* Hübner lists the following species: *phlæas* (L.), *amphidamas* (Esper), *timeus* (Cram.), *helle* Hübner, *thersamon* (Esper), *xanthe* Hübner, *gordius* (Sulzer), *hyllus* (Cram.), *hipponoë* (Esper), *chryseis* (Schiff.), *eurybia* (Ochsenheimer), *euridice* (Hübner), *virgaureæ* (L.), *hippothoë* (L.), and *circe* (Schiff.). He eliminates *mopsus*, a "Hair-streak," from the complex.

The genus *Chrysophanus*, as thus constituted by Hübner, is a well defined group, the species of which are today regarded by the best authorities as congeneric. The species *phlæas* is the type of *Heodes* Dalman; *circe* Schiff., must be accepted as the genotype of *Chrysophanus* Hübner.

Probably unaware of these facts, or overlooking them, Curtis in his British Entomology (1824) designated *phlæas* as the type of *Lycæna*. But *phlæas* had been definitely removed from the genus *Lycæna* by Dalman and by Hübner. Curtis was in error, and Barnes and Lindsey are in error in following him, as are a few others, who might be named.

Unfortunately Capt. N. D. Riley is also in error (See Journal Bombay Nat. Hist. Soc. XXXVIII, pt. 2, 1922, p. 467) in designating *mopsus* Hübner as the type of *Chrysophanus*. Hübner kept *circe* Schiff. in *Chrysophanus* in 1822, but transposed *mopsus*, a "hair-streak" to *Strymon*, as already shown. Riley in 1922 cannot reverse the action taken by Hübner in 1822, a hundred years ago. Hübner had a perfect right to make the change.

It follows from the incontrovertible facts above set forth, that "the Coppers" having been removed from the heterogeneous assemblage of species set up by Fabricius under the name *Lycæna*, and the "Hair-streaks" having also been removed prior to 1822, one of "the Blues" must be accepted as the type of the Fabrician genus. Doubleday in 1847 uses the generic name *Lycæna*, restricting it to "the Blues," and cites under it the species listed by Fabricius, *meleager*, *argiades*, *arion*, and others. Westwood in 1852 employed it for "the Blues," and from that date forward, *i.e.* for seventy-eight years, almost all writers, until we come to a quite recent date, have so used the generic name *Lycæna*. Scudder designates *meleager* (Esper) (according to Kirby the same as *endymion* W. V.) as the type of *Lycæna*. Nobody has taken exception to this arrangement and usage until a few years ago.

Ever since Dalman in 1816 set up his genus *Heodes*, that is for one hundred and fourteen years, the species *phlæas* has been out of the genus *Lycæna* according to law. To now make it the type of *Lycæna* on the strength of the error of Curtis and utterly upset the usage, which has been followed by almost all European authors and, with but one or two exceptions, by all American authors is unfortunate. This is a case in which in my humble judgment "the Blues," the *Lycæninæ*, and "the Coppers," "*Chrysophaninæ*" may be left as they have stood for years. Why change the usage of practically a century? What good end is subserved by such a change? None whatever!

In the new edition of The Butterfly Book I shall adhere in this case to established usage, knowing that all students will understand the terminology I employ.

(To be continued)

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Publications of the Carnegie Museum Serial No. 147

ANNALS

OF THE

CARNEGIE MUSEUM

Vol. XX, No. 2.

June, 1931

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ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME XX, NO. 2

Editorial Notes

His friends in the Carnegie Museum were delighted by the return in safety of Mr. George M. Sutton, who spent the winter of 1929-1930 and the following spring, summer, and fall of the latter year on Southampton Island in Hudson Bay. He paid especial attention to the study of the birds, making a large collection of the species encountered. He also collected and studied the mammals of the island. He did not overlook the invertebrates and the flora. The collections, which he made and brought back with him, through the generosity of Mr. John B. Semple, have become the property of the Carnegie Museum. Mr. Sutton is one of the most accomplished delineators of birds, and he made a large number of beautiful paintings of the birds of the region, showing them as they appear in life and action. Full accounts of the collections made by him may be expected to appear in the near future.

Southampton Island occupies an area in the northern part of Hudson Bay about half the size of the state of Pennsylvania. This is not the time or place for the Editor to say anything in detail about the fine work done by Mr. Sutton, except as an ardent lepidopterist, to mention the fact that he secured a fine collection of the diurnal lepidoptera, a paper upon which the Editor hopes shortly to publish in the Annals. We have before us long suites of the butterflies occurring upon the island. Among them are many specimens belonging to the genus *Colias*, including fine series of species, which have hitherto been regarded as rarities, such as *Colias boothi* Curtis and its varieties; *Colias hecla* Lefebvre; and a long series of *Colias nastes* Boisduval,

with many mutant forms, to some of which specific names have been given by authors in former times. The study of these collections suggests that *Colias hecla* Lefebvre may interbreed with *Colias nastes* Boisduval, and that *Colias boothi* and *Colias chione* may be hybrid forms. However, a full discussion of this subject will appear later in our publications, and the Editor at this time merely calls attention to the fact that it is possible that some of the so-called "species" of this genus in the far north interbreed, as is known to be the case with certain species in Central Asia.

The birds collected by Mr. Sutton are being classified, studied, and arranged in the Section of Ornithology; the skins of the mammals, which have been accessed, are being carefully tanned and treated for preservation; the invertebrates and the plants are being studied and arranged.

The Director of the Museum and the Director Emeritus have been delighted in recent days by the receipt of letters from Mr. Ralph Pulitzer, announcing his return from Angola, and the fact that he has generously supplied Mr. Boulton, who went with him from the Carnegie Museum, with the necessary funds to enable him to protract his stay for some time longer in Angola. The Pulitzer Expedition to Angola in the interest of the Carnegie Museum was eminently successful in many respects, and we are looking forward with agreeable anticipation to the arrival in the near future of the large collections of mammals, birds, and insects, which were made and which are still being accumulated by Mr. and Mrs. Boulton, the latter of whom did much of the work of preserving the birds obtained. It seems highly probable that some forms obtained in the remoter parts of Angola may be new to science.

The thirty-fourth celebration of Founder's Day occurred on October 15th. The speaker on that occasion was His Excellency Hon. Manuel C. Tellez, the Mexican Ambassador to the United States, who was welcomed by a large audience and in the most interesting manner spoke of the progress of art, science, and education in our sister republic of the south. There is every reason for Americans to rejoice in the progress, which is being made by Mexico, and for the rapid growth of kind relationships between that republic and our own. The Editor of the Annals brought back with him in the spring of last year in-

effaceable memories of the splendidly progressive and learned men whom he met in Mexico and it was a matter of deep regret to him that duty made it impossible for him to be present to extend his personal greetings to Dr. Tellez. One of the pleasant incidents of the celebration of Founder's Day was the receipt of a congratulatory telegram from Mr. Dwight Morrow, the American Ambassador to Mexico. Mr. Morrow, by the by, we claim as a Pittsburgher, who has become one of the leading citizens of the United States, loved by everybody in his own country and in the great republic of the south.

Through the kind action of the Carnegie Corporation of New York the necessary funds have been provided to enable the exhibition of contemporary Mexican art assembled under the supervision of Mr. Homer Saint-Gaudens to be widely displayed in the United States. It is at present on exhibition in the Department of Fine Arts of the Institute, having been brought here from the Metropolitan Museum in New York, where it was first displayed. It naturally attracts a great deal of attention. This collection represents to a large degree the work of the races of Indian origin in Mexico, rather than the work of those who are of Spanish descent. The aboriginal races in Mexico have to a certain degree perpetuated the tribal arts of pre-Columbian days and the present collection lays stress upon the work of this element in the population of Mexico rather than that of those who became the conquerors of New Spain.

On November 11th the Board of Fish Commissioners of the Commonwealth of Pennsylvania officially presented the Museum with a group for the making of which they had provided the necessary funds. It represents the Yellow Perch in the breeding season, and is a notable addition to the series of exhibits in the galleries of the Museum showing animals in their natural surroundings.

During a period of years Col. Roman Orbeliani, a member of the nobility of Georgia in the Caucasus, devoted himself to the prosecution of archeological researches in Egypt and made a large collection of pre-dynastic and early dynastic material. This collection numbering over fourteen hundred objects has just been acquired by the Carnegie Museum and Col. Orbeliani has recently been with us, engaged in unpacking and arranging it for accession, with the aid of his elabo-

rately descriptive catalog containing his field-notes. It adds very materially to the collections which we obtained a number of years ago through Sir W. Flinders Petrie, the well-known Egyptologist.

IV. CRAWFISHES OF THE SOUTHERN APPALACHIANS AND THE CUMBERLAND PLATEAU.

By Dr. A. E. Ortmann.*

As I have pointed out repeatedly (Ortmann, '05b, chiefly pp. 124, *et seq.*, and '13, chiefly pp. 381, *et seq.*), the crawfishes of the genus *Cambarus* offer in their geographical distribution many points of exceptional interest, which may be used in the study of the development of our drainage-systems and their faunas.

But the first requirement for such studies is a full knowledge of the taxonomic and chorological facts. In the region here discussed, information hitherto has been very fragmentary, but I have been able to considerably add to it through field-work done in more than the last ten years. The present paper is written for the purpose of presenting the facts thus ascertained, and to prepare the way for, and to contribute to, a final study of the zoögeographical problems.

The region covered is not very well defined. Generally speaking it forms the continuation of the area discussed in a previous paper (Ortmann, '13), lying to the south and west of it, *i. e.* covering the southern Appalachians south of Virginia and the Cumberland Plateau in the west. Yet attention to the region formerly treated cannot be avoided, for its crawfish-fauna is closely connected. The Piedmont Plateau at the eastern foot of the mountains has also been partially included. The main portion covered by the present study extends over the high Mountains in North Carolina and eastern Tennessee, the Great Allegheny Valley and the Allegheny Mountains in eastern

*The paper here printed was in the hands of the author at the time of his sudden and lamented death on January 3, 1927. He had informed the Editor that it was ready for publication and had promised to shortly submit it to him. The manuscript, however, had been so placed by the author that it was only discovered with difficulty among a mass of notes and papers with which his desk was filled. It was some time after his death that it was discovered. It is now posthumously published in the Annals. It may be proper to add at this point that there were numerous other subjects which Dr. Ortmann was engaged in studying and that, had he lived, there is no doubt he would have added many other papers to the long list of important contributions, which he made to science during his industrious life of research.

Tennessee, south to northern Georgia, and the Cumberland Plateau in Kentucky and Tennessee as far south as northern Alabama. The western limit is formed by the old shore of the Mississippi Embayment (roughly marked by the northward flowing Tennessee River in western Tennessee). In a northwesterly direction, the Ohio River forms the boundary.

In this region, three subgenera of the genus *Cambarus* are represented: *Ortmannicus*, *Faxonius*, and *Cambarus sens. strict.*

Genus CAMBARUS Erichson (1846).

Cambarus (*subgen.*) ERICHSON, '46, p. 88.
Cambarus (genus) GIRARD, '52, p. 87.

Type: Astacus bartoni Fabricius (Designated by Faxon, '98 p. 644).

A. bartoni having been designated as the type of the genus, the subgeneric name *Cambarus* belongs to that group which contains this species. This is *Bartonius* of Ortmann, which thus becomes a synonym of *Cambarus*. For the subgenus *Cambarus* Ortmann, a new name has been introduced, *Ortmannicus*. These nomenclatorial facts and consequent changes were first indicated by Fowler ('12 pp. 340, 341), and his views should be accepted.

Subgenus ORTMANNICUS Fowler (1912).

Cambarus (subgen.) ORTMANN, '05b, pp. 96, 97. (Type: *Astacus blandingi* HARLAN).
Ortmannicus FOWLER, '12, pp. 340, 341. (Type: *Astacus blandingi* HARLAN).

Characterized by the gonopods of the ♂, in which the outer and inner part are in close contact up to their tips. The tips are more or less blunt, the outer one with one to three horny accessory spines or tubercles. Male with hooks on third, or (mostly) on third and fourth peræopods.

This subgenus belongs largely to the coastal plains of the southern United States. Only one species has been reported from our region.

Cambarus (Ortmannicus) blandingi acutus (Girard) (1852).

Cambarus acutus HAGEN, '70, p. 35, Pl. I, figs. 1-5; Pl. II, figs. 106-127; Pl. III, fig. 143.
Cambarus blandingi acuta FAXON, '85a, p. 20.

The main species (*Cambarus blandingi* (Harlan) (1830)) is found

on the Atlantic Coastal Plain from New Jersey to South Carolina[1], the variety (*acutus*) from South Carolina over the Gulf Coastal Plain to Texas, and up the Mississippi Valley (and west of it) to Illinois, Indiana, Iowa, Wisconsin, and Michigan. Both are forms living in the still water of lakes, ponds, and sluggish streams, often (probably only at certain seasons) as chimney-builders, in holes. *C. blandingi acutus* has been reported from the lowlands of Alabama[2] and Mississippi, and from the Mississippi bottoms at Memphis, Shelby Co., Tennessee. I found it (Aug., '24) in the Reelfoot Lake Bottoms at Walnut Log, Obion Co., Tennessee, associated with *C. clarki* Girard. In northern Alabama it has invaded our region, and is known from places in the upper Alabama and Tennessee drainages, as follows: Blount Springs, Blount Co., Alabama (Faxon) (Black Warrior drainage); Cullman, Cullman Co., Alabama (Faxon) (Black Warrior drainage); Decatur, Morgan Co., Alabama (Faxon) (Tennessee drainage); Pond formed by overflow of Tennessee River, Bridgeport, Jackson Co., Alabama (Faxon).

These localities clearly indicate the route of migration from the Alabama (Black Warrior) drainage into that of the Tennessee. The species undoubtedly is in our region an immigrant from the southern Coastal Plain. How it was able to cross over the divide remains to be investigated.

Subgenus FAXONIUS Ortmann (1905).

Faxonius ORTMANN, '05, pp. 97 and 107 (Type: *Astacus limosus* Rafinesque).

Outer and inner tips of gonopods of male distinctly separated for a shorter or longer distance, outer part, in the male I, entirely transformed into a horny spine without accessory spines. Tips straight, divergent, or nearly parallel, or gently curved (not sharply curved at nearly a right angle). Male rarely with hooks on third and fourth peræopods, generally only on the third peræopod.

I have divided ('05b, pp. 108, 109) this subgenus into three sections, represented by *limosus*, *propinquus*, and *virilis*. Their chief differ-

[1]Faxon ('90, p. 619) records it from North River, Lexington, Rockbridge Co., Virginia, which is within the Allegheny Mountains. There is not the slightest doubt but that this record should be discredited, the ecological conditions being entirely adverse to the presence of the species in these parts.

[2]On the Gulf coast at Mobile, Mobile Co., (Hagen), and Montgomery, Montgomery Co., (Faxon), in the central part of the state. To this I am able to add the following locality: Holt's Ditch, Barachias, Montgomery Co., Alabama. (1 ♂, 3 ♀♀, Olivia Holt, April 12, '25).

ences are in the gonopods. In the *limosus*-section, their tips are separated only for a short distance; in the *propinquus*-section, they are separated for a greater distance, and mainly straight; in the *virilis*-section, they are also separated for a greater distance, but both are distinctly, although gently, curved.

All three sections are represented in our region, but the first one only by a single and very peculiar species.

SECTION OF C. LIMOSUS.

Gonopods of male short, rather thick up to near the tips, reaching to the coxopodites of the third peræopod. Tips separated for a short distance only, each tapering to a point. Males with hooks on third, or on third and fourth peræopods.

Undoubtedly a primitive group, forming a sort of connection between the more primitive species of the subgenus *Ortmannicus* and the more advanced forms of *Faxonius*.

The typical species of this section (*harrisoni*, *sloanei*, *indianensis*, and *limosus*) are not found in our region[3], but belong to the interior Basin; the first three to the Mississippi and lower Ohio drainages, the last one to the northern part of the Atlantic Coastal Plain. One very peculiar cave-species, however, is found on the Cumberland Plateau in Kentucky, the famous Blind Cave-crawfish of Mammoth Cave.

Cambarus (Faxonius) pellucidus (Tellkampf) (1844).

HAGEN, '70, p. 55, Pl. I, figs. 68-71; Pl. 3, fig. 148; Pl. 6;—Faxon, '85a, p. 40;—Hay, '96, p. 482, fig. 3;—Hay, '02a, p. 230;— Call in Hovey, '12, p. 109, fig. opp. p. 119.

With rudimentary eyes; carapace subcylindrical; chelæ subcylindrical. Male with hooks on third and fourth peræopods.

Type locality: Mammoth Cave, Edmonson Co., Kentucky. (Tellkampf) (Hagen) (Faxon) (Hay) (Call).

White cave, and other caves, Edmonson Co., Kentucky (Faxon).

In caves in Jefferson, Harrison, Crawford, Orange, Lawrence, and Bartholomew Cos., in southern Indiana (Cope) (Faxon) (Hay); and a variety, *C. pellucidus testi* Hay (1893) in Monroe Co., Indiana.

The range of this species is now cut in two by the Ohio River. It is morphologically and geographically a rather isolated species. Yet in the northern part of its range (in southern Indiana) there are two

[3] *C. sloanei* has been reported from Kentucky by Bundy, but this requires confirmation.

species found in surface waters (*C. sloanei* Bundy and *C. indianensis* Hay), which also belong to the *limosus*-section. The former (*C. sloanei*) is known from about the same parts in Indiana (Jefferson, Floyd, Crawford, and Orange Cos.), and also has been reported from Kentucky (by Bundy, without exact locality). The other (*C. indianensis*) is found a little more to the west, in Dubois and Gibson Cos., in southwestern Indiana (drainage of Patoka River to Wabash). The Carnegie Museum possesses specimens of *C. indianensis* from South Fork Saline River, Saline Co., Illinois (tributary to Ohio, below Wabash, in southeastern part of state).

These two are the species most closely allied to *C. pellucidus*, yet they are sharply distinct from it. They probably are the last remnants of the surface-stock from which *C. pellucidus* descended.

SECTION OF C. PROPINQUUS.

Gonopods of male shorter or longer, not thick, deeply split at the tips, tips slender, more or less straight, sometimes the outer one slightly recurved towards the end, but never both tips curved in the same direction. In the male, always the third peræopods with hooks (barring freaks).

This section is abundantly represented in our region, chiefly in the rivers of the Cumberland Plateau. It mainly contains typical river-forms, which in part are very variable and hard to distinguish. The following key will be useful for their distinction.

1. Group: (*propinquus*).

Tips of the gonopods of the ♂ I comparatively short, reaching only to the coxopodites of the third, rarely (in *erichsonianus*) to that of the second peræopods, with or without shoulder on the anterior margin. Outer tip not setiform, but regularly tapering from the thicker base to the end. The inner tip as long as, or very little shorter, than the outer.

a. Gonopods reaching to the third peræopods only, in the ♂ I with or without shoulder, (extralimital forms: *propinquus*, *sanborni*, *obscurus*, of which only *sanborni* aproaches the region under discussion; in West Virginia and eastern Kentucky).

a.′ Gonopods reaching to the second peræopods, in the ♂I without shoulder. *C. erichsonianus.*

2. Group: (*rusticus*).

Tips of gonopods of the ♂ I longer, reaching to the coxopodites of the second or first peræopods. Outer tip setiform, very little thicker

at the base; inner tip distinctly falling short of the outer, also in the ♂ II.

a. Gonopods reaching to the coxopodites of the second peræopods (with or with, out shoulder). Rostrum with margins elevated and thickened, concave, curved outward at base..... ..*C. rusticus.*

b. Gonopods of ♂I without shoulder, outer tip slightly recurved at end. Rostrum narrower, with long acumen, often with a slight median carina. Fingers of chelæ in adult males widely gaping, long, more or less subcylindrical.

c. Areola as long as, or slightly shorter, than one-third of the carapace, rather wide. Whole hand comparatively short and broad. *C. rusticus forceps.*

c′. Areola as long as, or slightly longer, than one-third of the carapace, narrower. Whole hand comparatively long and slender. *C. rusticus placidus.*

b′. Gonopods of ♂I with shoulder; outer tip slightly recurved or straight. Rostrum mostly somewhat wider, with shorter acumen, sometimes with a slight median carina. Fingers of chelæ in adult males only slightly gaping, not very long, not subcylindrical, but rather compressed.

c. Areola wide and short, shorter than one-third of the carapace. Lateral spines of carapace small or absent. Tubercles on hand and fingers very weak, obliterated. Outer tip of gonopods gently curved at end. *C. rusticus mirus.*

c′. Areola narrower and longer, longer than one-third of the carapace. Lateral spines of carapace generally present, but sometimes small. Tubercles of hand and fingers present, forming two distinct rows on inner margin of palm. Outer tip of gonopods curved or straight. *C. rusticus rusticus.*

a′. Gonopods reaching at least to the posterior margins of coxopodites of first peræopods, with shoulder in ♂I. Rostrum with the margins straight, subparallel (or slightly convergent anteriorly), not thickened.... *C. juvenilis.*

Cambarus (Faxonius) propinquus Girard (1852).

ORTMANN, '06, p. 358, Pl. 39, fig. 6a, 6b.

This species is of northern distribution. It has been found from Iowa, through Illinois and Indiana to Ohio in the interior drainage; and northward in the lake-drainage from Wisconsin to New York; and in Ontario and Quebec in Canada. It is not positively known from south of the Ohio River. There is one record given by Hay ('02a, p. 235) from Green River, Mammoth Cave, Kentucky. Since this is based upon "a few small specimens which *appear* to belong to this species," I seriously question the correctness of the identification. The characteristic species of Green River is *C. juvenilis.*

Cambarus (Faxonius) propinquus sanborni (Faxon) (1884).

ORTMANN, '06, p. 365.

This form exists in the Ohio-drainage of West Virginia (Ohio, Guyandot, Kanawha, and Little Kanawha) and of Ohio (Scioto, Muskingum), and crosses over into the Lake Erie drainage (Cuyahoga to Vermillion Rivers). The type-locality is Smoky Creek, Carter Co., Kentucky (Faxon). I have not been able to locate a creek of this name in Carter Co., (northeast Kentucky), but there is here a place called "Smoky Valley." This belongs to the drainage of Tygart Creek, a tributary to the Ohio just above the mouth of Scioto River (on the Ohio side). If the assumption is correct, that *C. propinquus sanborni* is found here, it should exist also in the drainage of Big Sandy River (forming the boundary of Kentucky and West Virginia), and this, indeed, is fully supported by Faxon's report ('14, p. 374) from Horse Creek, West Virginia. This is a small tributary of Tug Fork, Big Sandy, about three miles above Panther, McDowell Co.[4] Farther up in the Big Sandy drainage, in tributaries of Dry Fork in McDowell Co., *C. juvenilis* is found (which see). Going up in the Ohio drainage from the Big Sandy, *C. propinquus sanborni* is present in the next important affluent, Guyandot River. I found it myself in a tributary of this, Mud River, Milton, Cabell Co., West Virginia. Thence further on, in Big and Little Kanawha, this form is common, and it is also in the Ohio proper in this section.[5]

Thus *C. propinquus sanborni* just touches the northern part of our section, coming here in the Big Sandy drainage in contact with *C. juvenilis*, which is characteristic of the more western rivers in Kentucky (Licking, Kentucky, Green), and which passes southward into the drainages of the upper Cumberland and Tennessee (see below, under *juvenilis*).

Cambarus (Faxonius) erichsonianus Faxon (1898).

C. erichsonianus FAXON, '98, p. 659; Pl. 64, figs. 7-12;—HAY, '99, pp. 960, 964;—HARRIS, '03, p. 96;—FAXON, '14, p. 418.
C. spinosus HAY (not BUNDY), '02b, p. 439.
C. (*Faxonius*) *erichsonianus* ORTMANN, '05b, p. 112.
C. spinosus gulielmi FAXON, '14, pp. 375, 419.

[4]See Topographic Atlas (Sheet, Iaeger) West Virginia.

[5]See Ortmann, '13, p. 334. A new locality in this region is to be added: Pocatalico River, Raymond City, Putnam Co., West Virginia (1 ♂II, May 9, '13) (To Big Kanawha).

Type-locality: "Rip Roaring Fork, five miles northwest of Greeneville, Tennessee." (Faxon). According to the Topographic Atlas, (Sheet Greeneville), this should be given as follows: Roaring Fork, Greeneville, Greene Co., Tennessee, (tributary to Lick Creek and Nolichucky River).

KNOWN LOCALITIES FOR C. ERICHSONIANUS:

Tennessee drainage, below Walden Gorge.[6]

Small run tributary to Elk River, Fayetteville, Lincoln Co., Tennessee. (3 ♂♂ II, 2 ♀♀, Aug. 23, '23).

Tennessee drainage above Walden Gorge, and below Knoxville.

Stream from John Ross Spring, Rossville, Walker Co., Georgia. (Type locality of *C. gulielmi* (Faxon) to Chattanooga Creek and Tennessee River).

South Chickamauga Creek, Ringgold, Catoosa Co., Georgia. (1 ♂ II, 2 ♀♀, May 20, '15).

Hiawassee River, Austral, Polk Co., Tennessee. (1 ♂ II, Sept. 19, '15).

Eastanaula[7] Creek, Athens, McMinn Co., Tennessee. (Faxon) (to Hiawassee).

Matlock Spring Creek, Athens, McMinn Co., Tennessee. (Faxon) (not located on map, but in the same vicinity as the last locality).

Piney River, Spring City, Rhea Co., Tennessee. (2 ♂♂ II, 1♀, May 18, '15) (tributary to Tennessee from Walden Ridge).

Tennessee River, Concord, Knox Co., Tennessee. (2♀♀, Sept. 9, '14).

Clinch River, Black Fox Ford, Union Co., Tennessee. (1♀, Sept. 15, '15).

Clinch River, Clinch River Station, Claiborne Co., Tennessee. (1 ♂ II, 1♀, Sept. 11, '13).

Cove Creek, Caryville, Campbell Co., Tennessee. (1♀, Sept. 12, '15) (to Clinch).

Powell River, Combs, Claiborne Co., Tennessee. (1 ♂ I, Sept. 13, '15).

Little River, Rockford, Blount Co., Tennessee. (1 ♂ II, Sept. 4, '14).

[6]The locality: "Big Cahawba River, Alabama," given by Faxon ('98) is too vague to be considered. It only serves to show that possibly the range extends farther south than the other known localities would indicate.

[7]Oostanaula Creek on Topographic Atlas (Sheet Cleveland) but the natives call it Eastanaula!

French Broad drainage.

French Broad River, Boyd Creek, Sevier Co., Tennessee. (1 ♂ II, 1♀, Sept. 10, '14).
Little Pigeon River, Sevierville, Sevier Co., Tennessee. (1 ♂ II, Aug. 31, '14).
Nolichucky River, Chunn's Shoals, Hamblen Co., Tennessee. (1 ♂ I, Sept. 17, '13).
Nolichucky River, Chuckey, Greene Co., Tennessee. (1♀, May 19, '14).
Whitehorn Creek, Bulls Gap, Hawkins Co., Tennessee. (1 ♂ II, 1♀, May 18, '14) (to Nolichucky).
Roaring Fork, Greeneville, Greene Co., Tennessee. (Faxon, type-locality) (to Lick Creek and Nolichucky).

Holston drainage.

Holston River, Mascot, Knox Co., Tennessee. (2♀♀, Sept. 6, '14).
Big Flat Creek, Corryton, Knox Co., Tennessee. (1 ♂ I, May 12, '14) (to Holston).

Summary of Distribution.

The metropolis of this species apparently is in the Tennessee River, proper, and its tributaries above Walden Gorge, chiefly in the Hiawassee and French Broad in the Great Valley. In the Clinch and Holston it has been found only in the lower parts, and is absent in the headwaters of these. It is also in the Tennessee drainage below the Gorge, but so far only in a tributary to Elk River. It may be widely distributed in the latter region.

It is found in large rivers and in creeks, sometimes in rather small ones (Fayetteville, Whitehorn Creek, Big Flat Creek), living in the usual way of river-species, under rocks, etc. Males of the I form have been found in the months of September and May.

Taxonomic Remarks.

The essential characters of this species are found in the gonopods of the male, which are straight, and reach the coxopodites of the second peræopods (their posterior end or a little beyond), with the branches *nearly* of equal length[8]). This condition is not found in any other *Faxonius*-form of the same regions. In the *rusticus*-group,

[8]In the male I from Combs (Powell River), the outer tip is a little longer than the inner, but, for the rest, this organ is like that of *erichsonianus*, *i. e.* the outer tip is not setiform, and there is no shoulder.

where these organs have about the same length, the two branches are distinctly unequal, the outer being the longer.

In addition, in the male of the I form, the outer (horny) branch tapers gradually, as in the *propinquus*-group, and is not setiform, as in the *rusticus*-group. Finally there is no shoulder in *erichsonianus*.

For the rest, this species has no prominent or peculiar characters, so that females, without males, are very hard to identify. The female annulus ventralis is less sculptured than in the *rusticus*-group, yet it has two weak tubercles in front, and the posterior border also has a tubercle, which, in old females, may be even higher than the anterior ones. The median transverse furrow is shallow. In the shape of the annulus, *erichsonianus* differs from *juvenilis*, which in other respects is very similar. *Juvenilis* also has the anterior tubercles very strong, separated by a narrow cleft, and partly overhang the narrow and deep transverse fossa.

The rostrum of *erichsonianus* has nearly parallel, or somewhat convergent straight margins, which are not thickened. In the *rusticus*-group, the margins generally are somewhat concave and thickened. The acumen is well developed, also the marginal spines. The upper surface is gently concave, without a keel. The areola is moderately narrow, about as long as half of the anterior section of the carapace, sometimes a little shorter, rarely a little longer. The chelæ are of the general shape of those of other species of the *propinquus*-section, broad, slightly inflated, the fingers somewhat longer than the palm, a little gaping at the base in older specimens, chiefly old males, but meeting all along their margins in young specimens. The inner margin of the palm has a double row of distinct tubercles. The dactylopodite also has several rows of tubercles on the outer margin, and both fingers have longitudinal ribs.

Faxon gives for a male I the length of 70 mm. I have a male I (Corryton), 91 mm. long, and a female (Bulls Gap) of 84 mm.

C. spinosus gulielmi Faxon ('14) is founded upon the identical specimens called *C. spinosus* by Hay ('02), which are represented only by males of the II form, and females. It is undoubtedly this species, and it is rather strange, that Faxon did not recognize his own species. *C. spinosus* (=*putnami*=*juvenilis*, see below) differs essentially from *erichsonianus*, as well as from other forms of the *rusticus*-group, in the length of the gonopods, which reach to the coxopodites of the first peræopods. Faxon expressly states, under *gulielmi*, that the gonopods

are not of this type, and thus there is no reason whatever to connect *gulielmi* with *spinosus* (or *juvenilis*). In fact, the description of the gonopods, as well as the rest of the description of *gulielmi*, applies word for word to *erichsonianus*, with the exception, that Faxon emphasizes the presence of hairs on the carapace and chelæ, a character, of which he admits, however, that it "may be evanescent." This undoubtedly is correct. Moreover, I have found *erichsonianus* not very far from the type-locality of *gulielmi* (Rossville, Georgia) in Chickamauga Creek at Ringgold, Georgia.

Cambarus (Faxonius) rusticus Girard (1852).

GENERAL REMARKS.

I unite under *rusticus*, in a wider sense, several forms, which hitherto have been regarded as distinct species (*rusticus* and *forceps*), and, on the other hand, I distinguish under it several additional forms, which have not been properly recognized. The Cumberland-Tennessee drainages in the Great Allegheny Valley and the Cumberland Plateau seem to form the metropolis of this assemblage. Possibly this is its center of origin, whence it spread into the lower Ohio and the Interior Basin where it is represented chiefly by the typical form of *rusticus*. In the Cumberland and Tennessee are other forms, closely allied to *rusticus*, which I regard now as local races or varieties of it. These are *C. forceps* of the Tennessee drainage, *C. placidus*, chiefly of Cumberland and Duck Rivers, and a very peculiar new form, *C. rusticus mirus*, from the headwaters of Elk and Duck Rivers.

There is no question that *forceps* and *placidus* are more primitive than the true *rusticus*, as far as it concerns the shape of areola and gonopods. In the chelæ, however, they show a somewhat higher differentiation. *C. rusticus mirus* is even more primitive than these in the areola, and also has rather primitive chelæ, like typical *rusticus*. The latter appears as the most advanced form, although the chelæ are not so much specialized as in *forceps* and *placidus*.

The oldest name for all these forms is *rusticus*. The others, then, should be made varieties of it. *C. forceps* and *placidus* stand very near to each other. The differential characters of the areola and hand pass into each other, those of the hand not being well marked in young specimens. *C. placidus* is connected with typical *rusticus* by a form found in the Cumberland and Duck drainages which I call *rusticus*, but which inclines, in several particulars (gonopods and occasional

presence of keel on rostrum), toward *placidus*. *C. mirus* is practically the same as the Cumberland-Duck *rusticus*, except for the shorter areola, and an inclination of the rostrum toward the *placidus-forceps*-type. In the areola it is closest to *forceps* and more primitive than any other member of the group. In the frequently missing lateral spine of the carapace it resembles typical *rusticus* in which the spine is often small or obsolete, thus indicating again the most advanced phase of the whole group in this respect.

We see in this assemblage of forms that peculiar arrangement of characters often observed in other groups of closely allied forms: there are certain varying characters, some of which may show more primitive or more advanced stages (gonopods, areola, spinosity). In each of the various forms these features are irregularly mixed, each exhibiting different combinations, so that it is hard or impossible to point out a single form which is *the* most primitive. This, I think, has been brought out by what has been said in the preceding paragraph. The arrangement selected here takes account chiefly of the gonopods and areola where primitive and advanced phases are most easily recognized. Thus the sequence, *forceps-placidus-mirus-rusticus*, expresses to a degree the advance in specialisation. It must not be forgotten, however, that for other characters (chelæ for instance) this sequence does not hold good.

The common characters of all these forms, by which they differ from *erichsonianus* and *juvenilis*, are found in the gonopods which reach to the coxopodites of the second peræopods. These are deeply split, with the outer branch being setiform and distinctly longer than the inner, and rather straight, but sometimes gently recurved at the tip. The rostrum also is of a common type. It has the margins elevated and somewhat thickened, concave, and not straight. This is seen chiefly near the base of the rostrum where the margins diverge and curve outward. In *erichsonianus* and *juvenilis*, however, the posterior ends of the margins, although sometimes slightly divergent, do not *curve* outward, but are straight, continuing in the same direction as the rest of the margins.

Cambarus (Faxonius) rusticus forceps (Faxon) (1884).

C. forceps FAXON, '84, p. 133;—FAXON, '85a, p. 119, Pl. 5, fig. 4; Pl. 9, fig. 5;—FAXON, '85b, p. 461;—UNDERWOOD, '86, p. 369;—FAXON, '90, p. 633;—FAXON, '98, p. 660;—HAY, '99, pp. 960, 964;—HARRIS, '03, p. 98;—FAXON, '14, p. 418.
C. (*Faxonius*) *forceps* ORTMANN, '05b, p. 112.

Type-locality: Cypress Creek, Lauderdale Co., Alabama. (Faxon) (tributary to the Tennessee River at Florence).

KNOWN LOCALITIES.

Tennessee drainage below Walden Gorge.

Cypress Creek, Lauderdale Co., Alabama. (Faxon, type-locality).
Cypress Creek, Florence, Lauderdale Co., Alabama. (5 ♂♂ II, 3 ♀♀, Aug. 24, '24) (Topotypes).
Shoals Creek, Bailey Springs, Lauderdale Co., Alabama. (1♀, Aug. 25, '24).

Tennessee drainage above Walden Gorge.

Tennessee River, Concord, Knox Co., Tennessee. (1 ♂ I, 4 ♂♂ II, Sept. 9, '14).
Piney River, Spring City, Rhea Co., Tennessee. (4 ♂♂ II, 1♀, May 18, '15).
Clinch River, Walker's Ford, Claiborne Co., Tennessee. (Faxon).[9]
Clinch River, Clinch River Station, Claiborne Co., Tennessee. (2 ♂♂ II, Sept. 11, '13).
Clinch River, Fink, Russell Co., Virginia. (1 ♂ I, May 12, '13).
Cove Creek, Caryville, Campbell Co., Tennessee. (1 ♂ I, 2 ♂♂ II, 2♀♀, Sept. 12, '15) (to Clinch).
Powell River, Dryden, Lee Co., Virginia. (1♀, Sept. 7, '13).
South Fork Powell River, Big Stone Gap, Wise Co., Virginia. (1 ♂ I, 1 ♂ II, 1♀, May 15, '13 and 6 ♂♂ I, Sept. 6, '13).
Ball Creek, south of Tazewell, Claiborne Co., Tennessee. (Faxon).[10]
Dutch Valley Creek, Oakman, Grainger Co., Tennessee. (1 ♂ II, 1♀, Sept. 14, '15) (to Clinch).
Pistol Creek, Rockford, Blount Co., Tennessee. (1 ♂I, 4 ♂♂ II, 3♀♀, Sept. 4, '14) (to Little River).
Brook at Knoxville, Knox Co., Tennessee. (Faxon).
Holston River, McMillan, Knox Co., Tennessee. (2 ♂♂ II, 1♀, Sept. 16, '13).
Holston River, Mascot, Knox Co., Tennessee. (2♀♀, Sept. 6, '14).
South Folk Holston River, Pactolus, Sullivan Co., Tennessee. (1 ♂ II, May 20, '14).
South Fork Holston River, Barron, Washington Co., Virginia. (2♀♀, May 19, '13).
Middle Fork Holston River, Glade Springs, Washington Co., Virginia. (Faxon).

[9]Given as northwest of Tazewell, but is southwest of this place.

[10]Given as "Bulls Creek," but it is Ball Creek, going to Big Sycamore Creek and Clinch River, see: Topographic Atlas (Sheet Maynardville).

Middle Fork Holston River, Chilhowie, Smyth Co., Virginia. (1 ♂ II, May 20, '13).

French Broad River, Boyd Creek, Sevier Co., Tennessee. (1 ♂ II, Sept. 10, '14).

Little Pigeon River, Sevierville, Sevier Co., Tennessee. (1♀, Aug. 31, '14).

Nolichucky River, Chunn's Shoals, Hamblen Co., Tennessee. (1 ♂ II, Sept. 17, '13).

Nolichucky River, Erwin, Unicoi Co., Tennessee. (1 ♂ II, May 17, '14).

Bent Creek, Whitesburg, Hamblen Co., Tennessee. (2 ♂♂ I, 3 ♂♂ II, 5♀♀, Sept. 8, '15) (to Nolichucky).

Whitehorn Creek, Bulls Gap, Hawkins Co., Tennessee. (9 ♂♂ II, 2♀♀, May 18, '14) (to Bent Creek and Nolichucky).

SUMMARY OF DISTRIBUTION.

This form belongs to the Tennessee drainage, both below and above Walden Gorge. Below the Gorge, it is known only from the type-locality in Cypress Creek, and from Shoals Creek, not far from it. Above the Gorge it is in the Tennessee proper and its tributaries, Clinch, Holston, and French Broad, chiefly in the headwaters, going up into rather small streams, and being abundant there. It is a river-form, living in the usual way under stones, etc.

Males of the I form have been found in the months of May and September. A female with young was taken on May 15, '13 (Big Stone Gap).

TAXONOMIC REMARKS.

This form may be recognized chiefly by the absence of a shoulder on the gonopods, by the areola, which is slightly wider and shorter than in *placidus* (although there is very little difference), and by the peculiar conformation of the hand of the adult male.

The areola of *forceps* is 30 to 36 per cent of the length of the carapace (in *placidus*, 32 to 37 per cent), but it is, in the most cases, slightly shorter than one-third (less than 33 per cent), while in *placidus* it is usually slightly longer. It is a little wider, having room for from four to six rows of dots in its narrowest part (while *placidus* has two to four rows).

The fingers of the hand, in old males, are long, and the moveable finger is about two and one-half times as long as the inner margin of the palm. The fingers are not of the usual shape (compressed and tapering), but are subcylindrical, widely gaping at the base, and meet-

ing only near the tips. This gap is two, and even three times as wide as the width of each finger. The whole hand of *forceps* is rather broad, and comparatively shorter than in *placidus*, rarely two and one-half times as long as wide (the length being measured from the proximal end of the outer margin of the propodite). It is generally shorter, sometimes hardly longer than twice as long as wide (chiefly so in females and young individuals). In consequence of this, the old males have the anterior margin of the palm (between the fingers) transverse, running at about a right angle to the outer margin (see Faxon's figure, Pl. 5, fig. 4). In *placidus* this part is oblique.

Forceps and *placidus* are alike in the rostrum, the spines of the carapace, and in the shape of the gonopods. The rostrum is comparatively long and narrow with rather long acumen, and with the tip of the latter, and the marginal spines, more or less upturned. The upper surface is strongly concave, often (but not always) with a median carina. (In typical *rusticus*, the rostrum is broader, with shorter acumen, not so greatly concave, and rarely with a trace of a carina). The lateral spines of the carpace are generally well developed. The branchiostegal spine is obsolete, and the extraorbital angle is bluntly angular or rounded. In the males of both of the I and II forms of *forceps* and *placidus* the gonopods have the outer tip gently recurved at the end.

Of the spines of the carpopodite of the first peræopods, the median one on the internal margin, and the external one, are more or less developed. The inferior median spine of *forceps*, however, is generally absent, and this is an additional difference from *placidus*, where the latter spine is rarely obsolete.

Faxon seems to lay much stress on the presence or absence of a beard on the inner base of the immoveable finger of the hand. The general rule in all forms belonging to *rusticus* is that a beard is more or less developed in all young specimens and in females, while it is absent in old males of the I form. There are exceptions to this, and in typical *rusticus* this beard is mostly poor or absent. Traces of it may be seen sometimes in old males of *forceps*, and it may even be well developed.

I have collected topotypes of this form at Florence, Alabama, mostly young ones, but one male II, and one female are of fair size (respectively 55 and 50 mm.), and they agree very well with the specimens from the upper Tennessee.

In northern Alabama, in Shoals Creek, I have found *forceps* and

placidus associated, and it was very hard to separate them, especially the young ones and the females. In the case of the latter, I was largely guided by the shape of the hand, which is somewhat shorter and wider in *forceps*. In other cases the areola helped to distinguish the two forms. But there are still specimens in which the identification is somewhat doubtful. It seems that these two closely allied forms *intergrade* in this region, and thus they could not possibly be regarded as good species.

The maximum size, given by Faxon is: ♂ I 38 mm; ♀ 60 mm. My largest ♂ I (Rockford) is 64 mm. long. A ♂ II (Florence) is 55 mm. This form does not seem to grow very large.

Cambarus (Faxonius) rusticus placidus (Hagen) (1870).

C. placidus HAGEN, '70, p. 65, Pl. 1, figs. 76 and 79; Pl. 3, fig. 158;—SMITH, '74, p. 638;—FORBES, '76, pp. 4 and 19.

C. rusticus (*pro parte*) FAXON, '84, p. 148;—FAXON, '85a, p. 108;—FAXON, '85b, p. 361;—UNDERWOOD, '86, p. 361;—HARRIS, '03, p. 121;—FAXON, '14, pp. 375 and 418.

C. rusticus (= *placidus*) FAXON, '90, p. 632;—HARRIS, '00, p. 271.

C. (*Faxonius*) *rusticus* (*pro parte*) ORTMANN, '05b, p. 112.

Type-locality: Lebanon, Wilson Co., Tennessee. (Hagen). (Probably in a small tributary to Cumberland River, Barton, or Spring Creeks).

KNOWN LOCALITIES.

Cumberland drainage.[11]

Harpeth River, Kingston Springs, Cheatham Co., Tennessee. (1 ♂ II, 2♀♀, Aug. 31, '21).

Harpeth River, Belleview, Davidson Co., Tennessee. (5 ♂♂ II, 3♀♀, Aug. 28, '21).

Harpeth River, Franklin, Williamson Co., Tennessee. (Faxon).

West Fork Stones River, Murfreesboro, Rutherford Co., Tennessee. (4 ♂♂ II, 1♀, Aug. 30, '21).

Lebanon, Wilson Co., Tennessee. (Hagen, Type-locality) (in Barton or Spring Creek).

Pitman Creek, Burnside, Pulaski Co., Kentucky. (1 ♂ II, 1♀, Sept. 1, '24).

[11]Possibly specimens reported by Faxon ('14, p. 375) as *rusticus* from Richland Creek, Nashville, Davidson Co., Tennessee, belong here. I cannot find a "Richland Creek" near Nashville on the Topographic Atlas (Sheet Nashville). There is a Richland Creek farther South, tributary to Elk River. This might have been the one referred to, but it is not near Nashville. This form does exist in the Elk River drainage and in that of the Tennessee in northern Alabama. See below.

Duck River drainage.

Duck River, Centreville, Hickman Co., Tennessee. (3 ♂♂ II, 3 ♀♀, Aug. 29 and Sept. 4, '21).
Duck River, Columbia, Maury Co., Tennessee. (1 ♂ II, Aug. 26, '21).
Duck River, Shelbyville, Bedford Co., Tennessee. (2 ♂♂ II, Sept. 1, '22).
Duck River, Manchester, Coffee Co., Tennessee. (1 ♂ II, 1♀, Aug. 21, '23).
Buffalo River, Riverside, Lewis Co., Tennessee. (1 ♂ II, 1♀, Sept. 7, '22).
Big Bigby Creek, Mount Pleasant, Maury Co., Tennessee. (4 ♂♂ II, 1♀, Aug. 25, '21).
Rutherford Creek, Godwin, Maury Co., Tennessee. (3♀♀, Sept. 6, '22).
West Rock Creek, Lewisburg, Marshall Co., Tennessee. (2 ♂♂ I, 1♂ II, 2♀♀, Aug. 26, '23).
Garrison Creek, Wartrace, Bedford Co., Tennessee. (2 ♂♂ II, 1♀, Sept. 2, '22).
Little Duck River, Manchester, Coffee Co., Tennessee. (2 ♂♂ I, 1♂ II, 2♀♀, Aug. 21, '23).

Tennessee drainage.

Tennessee River, Florence, Lauderdale Co., Alabama. (1♂ II, Aug. 26, '24).
Shoals Creek, Bailey Springs, Lauderdale Co., Alabama. (1 ♂ II, 1♀, Aug. 25, '24).
Rock Creek, Tullahoma, Coffee Co., Tennessee. (1 ♂ II, Aug. 18, '23) (to Elk River).

Interior Basin.

Barren River, Bowling Green, Warren Co., Kentucky. (1 ♂ II, Aug. 11, '24) (to Green River).
Quincy, Adams Co., Illinois. (Hagen).

SUMMARY OF DISTRIBUTION.

The home of *placidus* is mainly in tributaries of the Cumberland River, and in the Duck River drainage, but it exists also in the Tennessee drainage below Walden Gorge (vicinity of Florence, Alabama, and headwaters of Elk River). The locality Quincy, Illinois, would indicate that it extends farther north, into western Kentucky, and beyond, but this is a region where our knowledge is very defective. A form probably belonging here is known only from the Green River drainage (Barren River), it may even go beyond the Mississippi, into

Missouri (see below). However, it might be that the single individual from Quincy is not the real *placidus*, although for a long time this had to be regarded as a paratype of the form, and was the only male of the I form known.

C. rusticus placidus lives exactly as other river-forms, in larger or smaller rivers and creeks, under stones, etc. I found males of the I form on Aug. 21 and 26, 1923, while I was not able to find such in August and September in 1921 and 1922.

TAXONOMIC REMARKS.

This form stands very close to *C. rusticus forceps*, and agrees with it chiefly in the shape of the rostrum, which is rather narrow and often has a carina; in the widely gaping and subcylindrical fingers of the chelæ of the adult male; and in the shape of the gonopods. It differs, however, in the following characters: Areola slightly shorter or longer than one-third of the carapace, but *mostly* slightly longer, narrower, with two to four rows of dots in the narrowest part (*forceps* has four to six rows). The three spines of the carpopodite of the first peræopods are usually well developed (rarely obsolete), and the hand has a shape somewhat different from that of *forceps*. The fingers are very long, the moveable one, in large males, is two and one half to three times as long as the inner margin of the palm (in *forceps* about two and one-half times as long, or shorter); it is curved, with the outer margin more or less concave, and the fingers meet only near the tips, but generally for a somewhat greater distance than in *forceps*. The whole hand is comparatively longer, and less wide; it is about two and one-half to three times as long as broad. This means, that the palm is not as wide as in *forceps*, and, in consequence of this, the inner basal margin of the immoveable finger (anterior margin of palm) is not transverse, but rather oblique. In young males and females, the fingers are much less gaping, or not at all so, but always the greater length of hand and fingers, as compared with *forceps*, is evident.

For the rest, *placidus* has the general characters of the *rusticus*-group. It differs from typical *rusticus* in the hand, rostrum, and gonopods. The immoveable finger, in *placidus*, is very often bearded (as in *forceps*), chiefly in young specimens and females, but in males of the I form it is generally naked. In typical *rusticus* a beard may be present, but generally it is absent, or poorly developed.

Of the few specimens collected in the vicinity of Florence, Alabama,

the males decidedly possess the hand of *placidus*, although the characters are not strongly expressed. The male from Shoals Creek agrees with *placidus* in the areola also, but in the one from the Tennessee at Florence the areola is wider, yet not distinctly shorter (it is exactly one-third or 33 per cent of the carapace). In both of these the median spine on the lower anterior margin of the carpopodite of the chelipeds is missing, and thus there is here an inclination towards *forceps*. The female from Shoals Creek has this spine, the areola is also normal, and the hand has rather long fingers. As has been mentioned above, in this region (Mussel Shoals), both *forceps* and *placidus* are found, and, according to what has been said, they seem to intergrade here. Unfortunately, males of the I form are not at hand.

From Barren River in Kentucky, I have a very strange form belonging here, and represented only by a male of the II form, 44 mm., long. In rostrum and areola it is *rusticus*, but the rostrum has a trace of a median carina. The lateral spines of the carapace are *absent*, a character sometimes found in the true *rusticus*. The gonopods have the outer part somewhat curved (as in the Cumberland-Duck form of *rusticus*). As to the presence or absence of a shoulder, nothing can be said. The chelæ, however, are very unlike to those of typical *rusticus*, and resemble rather those of *placidus*. They are long (nearly three times as long as wide), with long fingers (two and one-half times as long as the inner margin of the palm), which are subcylindrical, and decidedly gaping from the base to the tip, the gap being wider than the width of the moveable finger at its base. The sculpture of the hand is weak, and there is no beard at the base of the immoveable finger. The spine in the middle of the lower anterior margin of the carpopodite of the chelipeds is absent. It is much to be regretted that only this specimen is at hand: it seems to be normal (not a freak), and I have placed it with *placidus*, but it may be, that it represents a peculiar phase of *rusticus* in the Green River drainage.

My largest male I (Lewisburg) has a length of 74 mm., but I have a male II (Wartrace) of 84 mm. The largest females (one each from Kingston Springs and Lewisburg) are 78 mm.

As the type-locality of *placidus* we should take the one first given by Hagen (Lebanon, Tennessee). Quincy, Illinois, also is given, and "Texas," but the latter specimens probably do not belong here (see below).

The original description is not quite satisfactory in every detail, for

the reason that this form was mainly described in terms of comparison with *virilis*. However, most of the essential characters have been mentioned, either directly or implicitly, and good figures of the gonopods have been furnished (Hagen, Pl. 1, figs. 76 and 79). The narrower and more deeply excavated rostrum has been pointed out, and also the elongated and gaping fingers. The original material of Hagen has been re-described by Faxon (as form of *rusticus*), and according to him the specimens from Lebanon and Quincy agree with the specimens collected by myself, some of them not far away from the type-locality. Hagen's Texas specimens do not belong here, since the gonopods have a shoulder. However, we do not need to worry about the latter, since the locality is very vague, and they thus have no value for zoögeographical studies.

Of the specimens reported by Faxon ('90) as *rusticus* from Meramec (not Meramee) River, Dent Co., Missouri, from Osage River (rather Marais des Cygnes), La Cygne, Linn Co., Kansas, and Harpeth River, Franklin, Williamson Co., Tennessee, he says himself, that they correspond to *placidus*. This undoubtedly is correct with regard to those from the last locality, since I found this form in Harpeth River. But about those from Missouri and Kansas there is a good deal of doubt. Steele ('02, p. 28) gives *rusticus* for Missouri, and unites with it *neglectus* Faxon, with the suggestion that *medius* Faxon may also be conspecific. According to Steele's account, there is no doubt that these forms are closely allied, and possibly pass into each other in Missouri. It is to be regretted, however, that they have been simply lumped together, and no attempt made to study their geographical relations. No form has been mentioned by Steele, which would correspond to *placidus*, and thus it remains doubtful, whether the true *placidus* is found in this region, notwithstanding Faxon's record.

It is impossible to decide, what the Wisconsin-*placidus* is, reported by Bundy ('82, p. 181). Graenicher ('13, p. 118) does not mention it, and was unable to confirm the older records (Bundy) for *rusticus* from Wisconsin.

Of other localities recorded by Faxon ('98) for *rusticus*, some at least, located in Kentucky and Missouri, might also belong to *placidus*, but this cannot be decided without examination of the specimens. Thus I have omitted them, but that some *placidus*-like forms are present in the Green River drainage is shown by my specimen from Bowling Green (see above). It is also impossible to say, whether *C.*

rusticus placidus reported by Osburn and Williamson ('98, p. 21) from Hellbranch Creek, Franklin Co., Ohio (to Big Darby Creek and Scioto River) is the real *placidus*. In western Ohio (incl. Franklin Co.) the true *rusticus* is generally found.

Cambarus (Faxonius) rusticus mirus var. nov.

KNOWN LOCALITIES.

Elk River drainage.

Type-locality: Hurricane Creek, Cumberland Springs, Moore Co., Tennessee. (1 ♂ I, 3 ♂♂ II, 1♀, Aug. 20, '23).

Rock Creek, Tullahoma, Coffee Co., Tennessee. (2 ♂♂ II, Aug. 18, '23).

Taylor's Creek, Estill Springs, Franklin Co., Tennessee. (1 ♂ I, 1♂ II, 1♀, Aug. 19, '23) (below Estill Springs).

Spring Creek, Estill Springs, Franklin Co., Tennessee. (1 ♀, Aug. 19, '23) (above Estill Springs).

Duck River drainage.

Little Duck River, Manchester, Coffee Co., Tennessee. (1♀, Aug. 21, '23).

SUMMARY OF DISTRIBUTION.

All my specimens come from five localities, four of which belong to the same, rather limited, drainage system (headwaters of Elk River), while the fifth is in close proximity to these (headwaters of Duck River). All are in the region of the descent from the "Highland Rim" (Siliceous group of Lower Carboniferous, Tullahoma beds) to the Central Basin of Tennessee and its southern continuation (consisting largely of Ordovician rocks). I found this form in very small creeks, as usual under stones, etc. Males of the I form were found on Aug. 19 and 20.

DIFFERENTIAL CHARACTERS.

Rostrum moderately broad, moderately excavated, with a moderate acumen, and with or without a faint keel (standing in this respect between *forceps-placidus* on one hand, and typical *rusticus* on the other). Lateral spines of the carapace very small or absent. Areola rather wide and short, with five to seven rows of dots at the narrowest part, always shorter than one-third of the carapace (30-32 per cent of the length of the carapace). Chelæ comparatively broad and short, the whole hand two to two and one-half times as long as its greatest width. Fingers not gaping, or only slightly so in old males, the gap

never as wide as one of the compressed, tapering (not subcylindrical) fingers. Moveable finger from one and one-half to nearly two times as long as the inner margin of the palm (thus they appear here even shorter than in typical *rusticus*). Inner base of immoveable finger somewhat bearded, chiefly in the females and young. Tubercles of hand and fingers very weak, inner margin of palm and outer margin of moveable finger almost smooth, except for dots. Gonopods of the *rusticus*-type, with a distinct shoulder in the male of the I form; outer tip gently recurved at the end, longer than the inner.

Measurements (of type-set): ♂ I, about 48 mm.; largest ♀, 48 mm. I have a male I from Taylor's Creek of 55 mm., and a ♂ II from Rock Creek of 53 mm. Thus this seems to be a rather small form.

This is practically a *rusticus* with an unusually broad areola and comparatively smooth carapace and chelæ. In the development of the lateral spine it is variable. It is a local race of *rusticus*.

Cambarus (Faxonius) rusticus rusticus Girard (1852).

The synonymy given for *rusticus* by Faxon ('85a, p. 108) should be corrected according to the views advanced here; that *placidus* is a variety of *rusticus*, and that *juvenilis* does not belong here, but should be brought together with *putnami* and *spinosus* (see below). Thus the references to either *placidus* or *juvenilis* should be cut out. I add here the following quotations of papers published after Faxon's revision, which undoubtedly apply to the genuine *rusticus*.

C. rusticus (*pro parte*) FAXON, '85b, p. 361;—UNDERWOOD, '86, p. 372;—FAXON, '98, p. 658;—HAY, '99, pp. 960, 962, 964;—STEELE, '02, p. 28, Pl. 6, figs. 1-13; HARRIS, '03, p. 121;—FAXON, '14, pp. 375, 418.

C. rusticus FAXON in: KIRSCH, '95, p. 332;—HAY, '96, p. 503, fig. 14;—OSBURN and WILLIAMSON, '99, p. 48;—PEARSE, '10a, p. 74;—PEARSE, '10b, p. 17, Pl. 3.

C. (*Faxonius*) *rusticus* (*pro parte*) ORTMANN, '05b, pp. 112, 133.

Faxonius rusticus WILLIAMSON, '07, p. 753.

The following references should be left out as doubtful or positively not applying to the typical *rusticus*.

C. rusticus FAXON, '90, p. 632.—According to Faxon's own statement, these specimens belong to *placidus*. However, specimens from Missouri and Kansas are doubtful (see under *rusticus placidus*).

C. rusticus HARRIS, '00, p. 271.—After Faxon, referring to the Kansas-form, which may or may not be the real *rusticus*.

C. rusticus HAY, '02a, p. 235.—From Green River, Kentucky. Record founded only upon young specimens, not typical acording to Hay's own statement. The identification cannot be accepted without further confirmation.

Type-locality: Ohio River, Cincinnati, Hamilton Co., Ohio (Girard).

KNOWN LOCALITIES IN OUR REGION.

Cumberland drainage.

Harpeth River, Belleview, Davidson Co., Tennessee. (1 ♂ II, 1♀, Aug. 28, '21).

Harpeth River, Franklin, Williamson Co., Tennessee. (1 ♂ II, Aug. 27, '21).

Duck drainage.

Big Bigby Creek, Mount Pleasant, Maury Co., Tennessee. (2♀♀, Aug. 25, '21).

West Rock Creek, Lewisburg, Marshall Co., Tennessee. (1 ♂ I, 1♂ II, 2♀♀, Aug. 26, '23).

All of these specimens represent a peculiar phase of *rusticus*, not fully typical (see below). This form is restricted, thus far, to the region indicated by the above localities, *i. e.* to Cumberland and Duck drainages in the interior Basin of Tennessee.

DISTRIBUTION OF C. RUSTICUS RUSTICUS.

The real *rusticus* is positively known from the Ohio River northward, chiefly in the drainages of the Ohio from western Ohio down to the Wabash River. From the upper part of the Wabash drainage it has crossed over into the Great Lakes drainage (Maumee and western Lake Erie, in northern Indiana and northwestern Ohio). Beyond these states the distribution is somewhat uncertain. It has been reported as far west as Michigan, Wisconsin, Iowa, Missouri, and Kansas. Kentucky is also among the states where it is said to be found (Salt River drainage), but some of the records from Kentucky are to be positively referred to another species. The specimen from Barren River, mentioned above under *placidus*, possibly indicates the existence of a peculiar *rusticus*-form in this region which stands between *rusticus* and *placidus*. The older records of *rusticus* from Tennessee probably all belong to *placidus*. Yet I have found that there is, in the drainages of Cumberland and Duck Rivers, a form closely resembling typical *rusticus*, and different from *placidus* (with which it is found associated), which, to a degree, forms a connection between the two, but in a different way from that of the Barren River specimen.

CHARACTERS OF THE TYPICAL RUSTICUS.

(As found from the Ohio northward).

Rostrum wider, with shorter acumen, less concave above. Lateral spines of carapace present, but sometimes rudimentary. Areola

narrow and long, with two to four rows of dots in the narrowest part, and always distinctly longer than one-third of the whole carapace (34-37 per cent). Hand of chelæ comparatively short and wide, from two to two and one-half times as long as wide. Moveable finger somewhat shorter or longer than twice the length of the inner margin of the palm (on the average about twice as long). Immoveable finger generally naked at the inner base, rarely a little bearded. Inner margin of hand with a double row of tubercles, outer margin of moveable finger also with tubercles. Outer tip of gonopods straight, longer than the inner; shoulder well developed in the male of the I form.

CHARACTERS OF THE CUMBERLAND FORM.

This is closely allied to the typical phase, and agrees with it in the general shape of the rostrum, in areola, and hand, but differs in the occasional presence of a weak keel on the rostrum, and in the outer tip of the gonopods, which is always slightly recurved. It thus somewhat approaches the *placidus*-type, yet it is easily distinguished from the latter by rostrum and hand, and the presence of a shoulder on the gonopods. I do not think that this warrants the creation of a new variety, but it serves to demonstrate, that *placidus* should be regarded merely as a variety of *rusticus*.

Cambarus (Faxonius) juvenilis Hagen (1870).

C. juvenilis HAGEN, '70, p. 66, Pl. 1, figs. 29-33, Pl. 3, fig. 157;—SMITH, '74, p. 639.

C. putnami FAXON, '84, p. 131;—FAXON, '85a, p. 118, Pl. 5, fig. 5, Pl. 9, fig. 6;—FAXON, '85b, p. 361;—UNDERWOOD, '86, p. 372;—HAY, '96, p. 504, fig. 15 (description of gonopods not quite correct: figure fair, but does not show shoulder);—HAY, '99, pp. 960, 964;—HAY, '02a, p. 236;—HARRIS, '03, p. 121;—ORTMANN in WILLIAMSON, '05, p. 311;—FAXON, '14, pp. 377, 419.

C. rusticus (*pro parte*) FAXON, '85a, p. 112 (discussion of *juvenilis*);—FAXON, '85b, p. 361 (specimens from Little Hickman, Kentucky);—UNDERWOOD, '86, p. 372;—HARRIS, '03, p. 121.

C. spinosus (*pro parte*) FAXON, '85a, p. 115, Pl. 9, fig. 7 (specimens from Cypress Creek, Alabama);—FAXON, '85b, p. 361;—UNDERWOOD, '86, p. 373;—HAY, '99, pp. 960, 964;—HARRIS, '03, p. 130.

C. spinosus FAXON, '98, p. 658;—ORTMANN, '13, p. 334.

C. (*Faxonius*) *putnami* ORTMANN, '05, pp. 112, 133.

C. rusticus ORTMANN, '13, p. 334.

Type-locality: Kentucky River, Little Hickman, Jessamine Co. Kentucky. (Hagen).

KNOWN LOCALITIES.

North of Ohio River.

Brookville, Franklin Co., Indiana. (Hay, *putnami*) (Whitewater drainage).

Big Sandy drainage.

Barrenshe Creek, Horsepen Creek, War Creek, Peeryville, McDowell Co., West Virginia. (Faxon, *putnami*).[12]

Licking drainage.

Licking River, Farmer, Rowan Co., Kentucky. (Ortmann, *rusticus*) (C. M. 5 ♂♂ I, 1♀, Sept. 27, and 28, '11).
Triplet Creek, Morehead, Rowan Co., Kentucky. (Ortmann, *rusticus*) (C. M. 1 ♂ I, 1 ♂ II, 1♀, Sept. 26, '11).
Fleming Creek, Pleasant Valley, Nicholas Co., Kentucky. (Ortmann, *rusticus*) (C. M. 1 ♂ II, Sept. 26, '10).

Kentucky drainage.

Kentucky River, Little Hickman, Jessamine Co., Kentucky. (Type-locality, Hagen, *juvenilis*).
Dix River, Hedgeville, Boyle Co., Kentucky. (3 ♂♂ I, Sept. 3, '24).
Hanging Fork Creek, Lytle, Lincoln Co., Kentucky. (1 ♂ II, 2♀♀, Sept. 2, '24) (to Dix River).

Green drainage.

Green River, Mammoth Cave, Edmonson Co., Kentucky. (Faxon, Hay, *putnami*) (C. M., 2 ♂♂ II, 1♀, Sept. 6, '21).
Barren River, Bowling Green, Warren Co., Kentucky. (1 ♂ II, 3♀♀, Aug. 11, '24).
Bear Creek, Grayson Springs, Grayson Co., Kentucky. (Faxon, type-locality of *putnami*).
Rocky Creek, Grayson Springs, Grayson Co., Kentucky. (Faxon, *putnami*).

Cumberland drainage.

Cumberland River, Orby, Bell Co., Kentucky. (1 ♂ I, 2♀♀, Sept. 10, '13) (near Cumberland Gap).
Pitman Creek, Burnside, Pulaski Co., Kentucky. (1 ♂ II, Sept. 1, '24) (to Cumberland River).

[12]Not "Perryville," as given. Barrenshe and War Creeks are about two miles above Yukon P. O.; Horsepen Creek is farther up, three miles south of Squirejim, forming the boundary toward Tazewell Co., Virginia. All these creeks go to Dry Fork and Tug Fork of Big Sandy River. Peeryville is about three to four miles farther down on the Dry Fork, and is now called English. See Topographic Atlas (Sheets: Tazewell, Welch, and Pounding Mill) West Virginia and Virginia.

Run tributary to South Fork Cumberland River, Burnside, Pulaski Co., Kentucky. (2 ♂♂ II, 1♀, Aug. 14, '23).

Rockcastle River, Livingston, Rockcastle Co., Kentucky. (Ortmann, in Williamson, *putnami*) (C. M., 2 ♂♂ II, 1♀, June 21, '04).

Tennessee drainage below Walden Gorge.

Cypress Creek, Lauderdale Co., Alabama. (Faxon, *spinosus*).

Cypress Creek, Florence, Lauderdale Co., Alabama. (1 ♂ I, 2♀♀, Aug. 24, '24).

Shoals Creek, Bailey Springs, Lauderdale Co., Alabama. (2 ♂♂ II, 1♀, Aug. 25, '24).

Shoals Creek, Lawrenceburg, Lawrence Co., Tennessee. (1 ♂ I, 1♀, Sept. 1, '23).

Courtland, Lawrence Co., Alabama. (Faxon, *spinosus*) (On Big Nance Creek, tributary to Tennessee River).

Run tributary to Richland Creek, Pulaski, Giles Co., Tennessee. (2 ♂♂ I, 2 ♂♂ II, 4♀♀, Aug. 29 and 30, '23) (to Elk River).

Tennessee drainage above Walden Gorge.

Clinch River, Walker's Ford, Claiborne Co., Tennessee. (Faxon, *spinosus*).

Clinch River, Fink, Russell Co., Virginia. (2 ♂♂ II, May 12, '13).

Clinch River, Raven, Tazewell Co., Virginia. (Ortmann, *spinosus*) (C. M., 2 ♂♂ I, 1♀, Sept. 21, '12).

Clinch River, Richland, Tazewell Co., Virginia. (Ortmann, *spinosus*) (C. M., 1 ♂ I, 2♀♀, Sept. 20, '12).

Clinch River, Cedar Bluff, Tazewell Co., Virginia. (1♀, with young, May 11, '13).

Indian Creek, six miles southeast of Cumberland Gap, Claiborne Co., Tennessee. (Faxon, *spinosus*) (to Powell River).

Doubtful, spurious, or indefinite localities.

A specimen from Osage River, Missouri, mentioned by Hagen (*juvenilis*), is not this, but stands closer to *rusticus* (*See* Faxon, '85a, p. 113). Compare also what has been said above about *rusticus* from Missouri.

Cumberland Gap Kentucky. (Faxon *putnami* and *rusticus*). Possibly in the Cumberland drainage. We may disregard this locality, since I am able to give a more exact place in this region (Orby). There is also a locality on the south side of Cumberland Gap, in the Powell drainage.

Knoxville, Tennessee and Bradford, Indiana, given by Faxon for *putnami*, and other localities in southern Indiana, given by Hay, are doubtful since the identification is not positive.

Specimens from Salt River, Kentucky, and from Perryville, Boyle Co., Kentucky. (Chaplin River drainage, to Salt River), mentioned by Faxon ('85a, p. 112) under *rusticus*, may belong here, but the remarks about them are too incomplete.

SUMMARY OF DISTRIBUTION.

The metropolis of this species is in the rivers of Kentucky, Licking, Kentucky, Green, and upper Cumberland. It is also found in the headwaters of Big Sandy, in West Virginia, and in Clinch River in Virginia and Tennessee. These localities are grouped around the highest parts of the Cumberland Mountains, and the adjoining portion of the Cumberland Plateau. The headwaters of these drainage systems closely interlock. This area is rather continuous, but belongs to different drainage systems.

This species also seems to be present north of the Ohio, in southern Indiana, and further, it is in the Tennessee drainage below Walden Gorge (Cypress, Shoals, Big Nance, and Richland Creeks). For the present, this latter area appears entirely disconnected from the range in the upper Tennessee (Clinch), unless a record, given by Faxon for "*spinosus*," belongs here, "Tennessee River, near borders of Georgia"; but this is entirely too indefinite. The record of *C. spinosus gulielmi* from Rossville, Georgia, does not refer to our species, but belongs to *erichsonianus* (see above).

C. spinosus Bundy (type-locality Rome, Floyd Co., Georgia, and also from Saluda River, South Carolina and Tar River, Rocky Mount, Edgecombe Co., North Carolina, according to Faxon) is still, as will be pointed out below, a doubtful form, and requires further study on the basis of better material. It may be different from *juvenilis*.

C. juvenilis is a river-form, living in larger and smaller streams, and sometimes in small runs (at Burnside, Kentucky). Males of the I form have been found at the end of August and in September; a female with young on May 11.

TAXONOMIC REMARKS.

The original description of *C. juvenilis*, given by Hagen, is sufficient to recognize this species, since the most important character, the long gonopods, has been mentioned and also correctly figured. Faxon has furnished further information, and he again emphasizes the difference of the gonopods from those of *rusticus*. Nevertheless he placed

juvenilis with *rusticus*, and described other material, with exactly the same gonopods, as a new species (*putnami*).[13] He also described and figured gonopods of specimens from Cypress Creek, in Alabama as *spinosus*, which are again identical. I possess topotypes of this "*spinosus*" from Cypress Creek. In all of these forms the other characters of rostrum, chelæ, areola, etc., are the same, subject only to very slight variations.

Whether the original *spinosus* of Bundy (from Georgia, North and South Carolina) belongs here, is doubtful. There are discrepancies in Bundy's and Faxon's descriptions, chiefly in the gonopods of those of the I form as described by Bundy which do not correspond to those of the II form (tips nearly equal in the I form, unequal in the II form), and do not correspond to Faxon's account of the Alabaman specimens. Thus the original *spinosus* remains doubtful, and more material from Georgia and the Carolinas should be investigated to settle this question. *C. spinosus* is said to have a shorter areola than *putnami*.

The rostrum of *juvenilis* is not of the *rusticus*-type, but rather of the *propinquus*-section including *erichsonianus*, with the margins parallel or slightly convergent anteriorly, and straight (not concave). The margins are elevated, but not distinctly thickened. Yet the condition of *rusticus* (slightly concave and thickened margins) may be seen occasionally in specimens from Kentucky (I have such from Licking River and upper Cumberland). The upper surface is more or less concave, and generally has no median keel. Yet Faxon ('14) mentions that a keel is present in specimens from upper Big Sandy, and I have found this keel, more or less distinctly, in many (but *not all*) specimens from the upper Clinch. Some specimens from Dix River, from Pulaski, and from Bailey Springs also have traces of this keel, while others have not.

The lateral spines of the carapace are present, larger or smaller. Branchiostegal spines small, tuberculiform, or missing. The external orbital angle is never spiniform, but consists of a blunt, inconspicuous projection, or may be nearly obliterated.

The areola is moderately narrow. In its narrowest part are three to four (rarely five) rows of dots. The length of the areola is about one-third of the length of the carapace, from 32 to 35 per cent of it, mostly 32 or 33 per cent, thus corresponding closely to the description given by

[13]The figures of the gonopods of *putnami* do not show the shoulder, although this is mentioned in the text.

Faxon for *putnami*. This also holds good for my specimens from Cypress Creek, Shoals Creek, and the Elk River drainage in southern Tennessee and Alabama. These specimens come from the same general region as Faxon's Alabaman specimens of "*spinosus*."[14]

The chelipeds and chelæ have no especially prominent characters. The hand is rather broad, the fingers are somewhat elongated. In large males they may be slightly gaping at the base, but in younger individuals, they are not gaping. The immoveable finger generally is bearded at the inner base, but this beard may be poorly developed or missing, chiefly in old males. The inner margin of the palm and the outer margin of the dactylopodite have the usual tubercles.

The carpopodite of the first peræopods has the three spines usually found, an interior one; another in the middle of the lower anterior margin; and an exterior one. Rarely there are accessory spines. The spines may be strong, sharp, or blunt, and the one at the lower anterior margin may be missing.[15] The two rows of spines on the lower side of the meropodite are, in most cases, indicated only by the presence of the anterior one of each row, but the inner row often shows small additional spines or serrations; rarely there are two to three spines in the outer row.

Gonopods long, slightly variable in length, but always reaching to the posterior end of the coxopodites of the first peræopods (barely reaching as far as that in specimens from the upper Clinch), and often a little farther (to the middle of the coxopodite). Tips long and slender, deeply split, the outer one, in the male of the I form, nearly straight, or very gently and uniformly curved all along its length, distinctly, often considerably, longer than the straight inner part. A distinct shoulder is present. In the male of the II form, the outer tip is nearly straight, but slightly recurved at the end, and it also is distinctly longer than the inner.

Annulus of the female strongly tuberculate, and in old females quite characteristic. The two tubercles of the anterior border are very well developed, and are separated by a deep and narrow cleft. They

[14]In the real *spinosus*, the areola is shorter, being only 29 per cent of the length of the carapace. Whether this is an important character, remains to be seen; but at any rate, specimens from the lower Tennessee are, in this respect, *putnami* (=*juvenilis*), and *not spinosus*. Faxon does not give exact measurements of areola and carapace of his specimens from Alabama.

[15]Absent in specimens from Pleasant Valley and from Burnside; in one from Dix River, and in three (out of four) from Bowling Green.

slightly incline backward, and overhang, in part, the narrow and deep transverse fossa. The posterior tubercle also is well developed. Of course in young females these features are not so strongly pronounced, but they generally serve to distinguish the female of *juvenilis* from the otherwise very similar female of *erichsonianus*; where the anterior tubercles of the annulus are less developed, are wider apart, and do not overhang the wider and shallower transverse fossa, where the posterior tubercle is about as high as, or even higher, than the anterior tubercles.

My largest male (I) (Florence) is 91 mm. long; another one (Orby) is 75 mm.; my largest female (Florence) is 87 mm.; another one (Pulaski) is 83 mm.

SECTION OF CAMBARUS VIRILIS.

Gonopods generally rather long (rarely somewhat shorter), reaching about to the second peræopods, deeply split, tips slender (rarely somewhat stout), and more or less gently *recurved, both in the same direction.* Always the third peræopods only with hooks in the male.

I have divided ('05, p. 110) this section into three groups according to the areola. The first group (*alabamensis*) contains two species (*alabamensis* and *compressus*), said to differ from the others by wide and short areola. I had then never seen any specimens belonging here, and the characters assigned to this group were taken from Faxon ('85a). I have now seen a specimen of *C. alabamensis*, and a close comparison of this with its original description and with that of *C. compressus* has convinced me that these two species are not so very closely allied. *C. compressus* possesses characters which are unique, and give it a rather isolated position, while *C. alabamensis* is more closely related to those species, which I have placed in the second group (*virilis*, see: '05, pp. 112, 113).

I now would arrange these groups as follows:

1. Group: (*virilis*).—Carapace not compressed; lateral spines present; rostrum mostly without keel; areola not obliterated (A number of species, some of them in our region, see below).
2. Group: (*palmeri*).—Carapace not compressed; lateral spines present; rostrum without keel; areola obliterated in the middle (Species: *palmeri, difficilis, mississippiensis.* Not represented in our region).
3. Group: (*compressus*).—Carapace compressed; lateral spines absent; rostrum with keel; areola not obliterated in the middle (Species: *compressus*).

1. GROUP OF C. VIRILIS.

This group contains the following species: *alabamensis*, *meeki*, *longidigitus*, *virilis*, *nais*, *pilosus*, *immunis*, *validus*; the first and the last being found in our region. Of these, the last two, *immunis* and *validus*, are distinguished from the rest by the peculiar conformation of the rostrum which has strongly convergent margins and a very short acumen with the marginal spines mostly absent. The fingers of the chelæ also have peculiar features. The areola is of moderate length, a little over one-third of the carapace.

The other species are all closely allied to each other, possess a rostrum of rather normal shape with the acumen somewhat longer, and with more or less distinct marginal spines. The chelæ also are of normal shape; at any rate, they do not show the peculiar characters seen in *immunis* and *validus*. Among these species, *alabamensis* is peculiar by its short areola (28-30 per cent), and differs from the others chiefly in this character.[16]

Thus we get the following key for the species of the *virilis*-group.

a. Areola short (28-30 per cent of carapace) and comparatively wide. *C. alabamensis.*

a′. Areola longer (at least 32 or 33 per cent of carapace) and narrower.

b. Rostrum with acumen rather normal, as long as, or longer than, the width of the rostrum at base; margins parallel, concave, or slightly convergent, with marginal spines (sometimes small). Fingers of chelæ not excavated or curved at base (Species: *meeki*, *longidigitus*, *virilis*, *nais*, *pilosus*. All extralimital).

b′. Rostrum with acumen considerably shorter than width of rostrum at base; margins distinctly convergent, without (rarely with small) marginal spines. Fingers of chelæ with peculiar features.

c. Moveable finger with a deep emargination at base of inner margin. Immoveable finger regularly curved..... *C. immunis* (*extralimital*).

c′. Moveable finger without emargination. Immoveable finger curved strongly outward at base..... *C. validus.*

Cambarus (Faxonius) alabamensis Faxon (1884).

C. alabamensis FAXON, '84, p. 125;—FAXON, '85a, p. 104, Pl. 4, fig. 4, Pl. 10, fig. 3;—FAXON, '85b, p. 359;—UNDERWOOD, '86, p. 366;—HAY, '99, pp. 960, 962; HARRIS, '03, p. 70;—FAXON, '14, p. 420.

C. (*Faxonius*) *alabamensis* ORTMANN, '05b, p. 112.

[16]Of the others, the areola is shortest in *longidigitus* (32 per cent), which, however, has a very narrow areola; then follow *nais* and *pilosus* with the areola respectively of 33 and 34 per cent; and *meeki* and *virilis* with the longest areola, (36 to 38 per cent).

Type-locality: Second Creek, Waterloo, Lauderdale Co., Alabama. (Faxon).

Additional locality: Tennessee River, Florence, Lauderdale Co., Alabama. (1 ♂ II, Aug. 26, '24).

The two localities are in the lower Tennessee drainage in the vicinity of the Mussel Shoals. It apparently is a river-form.

TAXONOMIC REMARKS.

This species was known hitherto only from Faxon's description and only from the type-locality. I have found an additional specimen not very far from the latter. There is no question but that it belongs here, for the main character, the short and comparatively broad areola, is distinctly seen, as is shown by the measurements. Length of body 52 mm; carapace 23 mm; areola 7 mm; width of areola 1 mm. Thus the areola is only 30 per cent of the carapace. This fairly well agrees with *alabamensis*, for which the measurements of two specimens published by Faxon, give even less (28 per cent of the carapace). The width of the areola does not fully agree with Faxon's types, for it is a good deal less. In the latter it is 36 and 43 per cent of the length of the areola, in my specimen only 25 per cent.[17]

My specimen corresponds well with Faxon's account. The rostrum is like that in the figure (Pl. 4, fig. 4), but it has no trace of the "broad, rounded, slightly elevated median carina near the tip," mentioned in the text (p. 104), but *not* indicated in the figure. The various spines of the carapace, which are small according to Faxon, are well developed in my specimen. The chelipeds agree with Faxon's account, but the hands are smaller. The immoveable finger is bearded at the inner base, as described.

The gonopods of my male (II) fully agree with the figures given by Faxon (Pl. 10, figs. 3a, 3a^1); they reach to the middle of the coxopodites of the second peræopods.

[17]Yet it is considerably wider than in other species of the *virilis*-group, where the width of the areola (according to the few measurements published) is from 4 per cent of the length (*longidigitus*) to about 8 per cent (in *pilosus* and *virilis*). Concerning the differences of my measurements from those of Faxon, it should be kept in mind, that errors of a fraction of a millimeter easily are made, and would considerably alter the percentage. Faxon's *illustrations* often are not very reliable in this respect.

Affinities.

Aside from the areola, this species has no very prominent characters. It has the general "habitus" of *virilis*, but differs, among other minor items, in the shape of the gonopods, which are more strongly recurved. In this character *alabamensis* rather resembles *meeki*, *nais*, and *pilosus*. Possibly the bearded immoveable finger may be a peculiar character of this species, but we should not forget, that in other groups this is a rather variable feature.

According to the areola *alabamensis* appears as a primitive type of the *virilis*-group; and, if this is correct, its distribution is significant. It is found near the southwestern extremity of the Cumberland Plateau (Mussel-Shoals region of the Tennessee), and possibly indicates the original center of the *virilis*-group, which subsequently reached its greatest development and diversity in the Interior Basin. But this is only a theory, which should be confirmed by additional evidence, chiefly with regard to the limits of the present distribution of this species, which thus far is very unsatisfactorily known.

Cambarus (Faxonius) virilis Hagen (1870).

Faxon ('85a, p. 97) mentions this species from a pond at Bridgeport, Jackson Co., Alabama. The record is founded upon a *female* with mutilated rostrum, and Faxon himself admits, that his identification may be incorrect. *C. virilis* has not been found at any other place east of the Mississippi and south of the Ohio, the nearest place being in southern Illinois. I think this species should not be admitted to our list.

Cambarus (Faxonius) immunis Hagen (1870).

This species has been reported from our region, but the specimens taken for it are the next species, *validus* (which see).

But I wish to say a few words about this species since it is present immediately to the west of the Cumberland Plateau, in the region of the Mississippi Embayment in western Tennessee. Faxon gives it from Obion Co., Tennessee, and distinguishes this form as var. *spinirostris*. I have collected it (3 ♂♂ I, 4 ♂♂ II, 10♀♀) in a small run, tributary to Reelfoot Lake, at Spoutsprings, Obion Co., Tennessee, (Aug. 14, '24), and these specimens thus are *topotypes* of *spinirostris*. In most of them the marginal spines of the rostrum are present, although sometimes very small; yet in several, chiefly larger ones, they

are practically absent, the margin of the rostrum being simply angled at their place. Since the form with spines has also been found elsewhere, associated with normal *immunis*, and since chiefly younger specimens show these spines,[18] *spinirostris* should not be regarded as a variety, but merely as a variation of *immunis*, belonging largely to the juvenile stage.

On August 22, '24, I collected specimens (1 ♂ II, 6♀♀, all rather young) at another locality in this region, in a small stream tributary to Forked Deer River, Jackson, Madison Co., Tennessee. These all had marginal spines on the rostrum.

Cambarus (Faxonius) validus Faxon (1914).

C. immunis (*pro parte*) HAGEN, '70, p. 71, Pl. 8, fig. b;—FAXON, '85a, p. 100.
C. validus FAXON, '14, pp. 382, 421, Pl. 7, figs. 3, 4, 8, Pl. 13, fig. 1.

Known localities.

Huntsville, Madison Co., Alabama. (Faxon, type-locality) (in drainage of Tennessee below the Gorge).
Nashville, Davidson Co., Tennessee. (Faxon) (in Cumberland drainage).

This species is known only from Faxon's account of it. The two localities, rather far apart, and in different drainage areas, do not give any information as to the character of its range.

3. GROUP OF C. COMPRESSUS.[19]

Cambarus (Faxonius) compressus Faxon (1884).

C. compressus FAXON, '84, p. 127;—FAXON, '85a, p. 105, Pl. 5, fig. 6, Pl. 10, fig. 2;—FAXON, '85b, p. 359;—UNDERWOOD, '86, p. 368;—HAY, '99, pp. 960, 962;—HARRIS, '03, p. 83;—FAXON, '14, p. 419.
C. (*Faxonius*) *compressus* ORTMANN, '05b, p. 112.

Known localities.

Second Creek, Waterloo, Lauderdale Co., Alabama. (Faxon, type-locality).
Cypress Creek, Lauderdale Co., Alabama. (Faxon).

This species is known only from two localities in close vicinity in the

[18]Faxon's specimens from Obion Co., Tennessee were all immature!

[19]The second group (of *C. palmeri*) is not represented in our region, but *C. palmeri* is found in the Mississippi Embayment in west Tennessee, and *C. mississippiensis* on the Coastal Plain in Mississippi. I have found *C. palmeri* in August '24 in North Fork of Obion River, Union City, Obion Co., Tennessee.

lower Tennessee drainage, and has never been found subsequently. Thus we must rely entirely upon Faxon's account of it. Its taxonomic and geographical relations are rather obscure, but it is a member of the *virilis*-group, which is chiefly distributed in the Interior Basin.

Subgenus CAMBARUS Fowler (1912).

Bartonius (subgen.) ORTMANN, '05, pp. 97, 117 (Type: *Astacus bartoni* Fabricius).
Cambarus (subgen.) FOWLER, '12, p. 341 (Type: *Astacus bartoni* Fabricius).

Gonopods distinctly separated at the tips, tips rather short, the outer, in the male I, entirely transformed into a horny spine. No accessory spines. Both tips sharply recurved, forming nearly right angles with the basal part. Male with hooks on third peræopods only.

I have ('05, pp. 118, 119) distinguished in this subgenus four sections, all of which are represented in our region. Their essential characters are set forth in the following key.

a. Eyes rudimentary. Carapace subcylindrical. Chelæ long, subcylindrical (Cave forms) ..... Section of *C. hamulatus*.
a'. Eyes present. Carapace depressed or compressed. Chelæ comparatively short and broad, depressed.
  b. Rostrum with marginal spines. Areola generally comparatively wide, of medium length (but variable) ..... Section of *C. extraneus*.
  b'. Rostrum without marginal spines. Areola wide or narrow, short or long.
    c. Carapace depressed. Areola wide or narrow, but never linear (obliterated), shorter or longer ..... Section of *C. bartoni*.
    c'. Carapace compressed. Areola very narrow or obliterated in the middle, long ..... Section of *C. diogenes*.

1. SECTION OF C. HAMULATUS.

The chief character of this section is the rudimentary condition of the eyes. The three species belonging here are blind cave-forms. They differ from other sections also in the subcylindrical shape of the carapace, and the long, subcylindrical chelæ.

Only one species is found in our region (*hamulatus*), the other two (*setosus* Faxon ('89) and *ayersi* Steele ('02)) exist in the Ozark-region of Missouri. *C. hamulatus* differs from *setosus* in the presence of marginal spines on the rostrum, and in the wide areola. *C. ayersi* has also marginal spines on the rostrum, but the areola is linear in the middle.

Cambarus (Cambarus) hamulatus (Cope and Packard) (1881).

Orconectes hamulatus COPE and PACKARD, '81, p. 881, Pl. 7, fig. 1.
Cambarus hamulatus FAXON, '84, p. 145;—FAXON, '85a, p. 81; Pl. 4, fig. 6; Pl. 9, fig. 1;—UNDERWOOD, '86, p. 369;—PACKARD, '88, p. 40, fig. 10;—HAY, '99, pp. 959, 966;—HAY, '02b, p. 435, fig. 8;—HARRIS, '03, p. 101;—FAXON, '14, p. 422.
C. (*Bartonius*) *hamulatus* ORTMANN, '05b, p. 120.

Known localities.

Nickajack Cave, Shellmound, Marion Co., Tennessee. (Cope and Packard, type-locality) (Hay).
Wine House Cave, Shellmound, Marion Co., Tennessee. (Hay).

This species is well known by the descriptions furnished by Cope, Packard, and Hay.

2. SECTION OF C. EXTRANEUS.

Carapace more or less ovate, depressed, with or without lateral spines. Rostrum with marginal spines. Chelæ not very elongated, depressed, and rather broad, but a little more elongated than in the sections of *bartoni* and *diogenes*. Areola more or less wide, and of variable, moderate length. Eyes well developed.

The essential character is the *presence of marginal spines on the rostrum*. This is a primitive group, forming the transition to the section of *bartoni*.

Several species have been created, all belonging to our region, but I recognize only two of them, distinguished as follows:

a. Antennæ with very long, compressed flagellum, ciliated, or bearded on inner side. Rostrum with strong marginal spines, concave margins, and long acumen. Lateral spine of carapace strong..... *C. cornutus*.
a′. Antennæ with normal flagellum. Marginal spines of rostrum less strongly developed, margins not distinctly concave, acumen shorter. Lateral spine of carapace well developed, small, or absent..... *C. extraneus*.

Cambarus (Cambarus) cornutus Faxon (1884).

C. cornutus FAXON, '84, p. 120;—FAXON, '85a, p. 80, Pl. 5, fig. 1, Pl. 9, fig. 3;—UNDERWOOD, '86, p. 368;—HAY, '99, pp. 959, 962;—HARRIS, '03, p. 83;—FAXON, '14, p. 423.
C. (*Bartonius*) *cornutus* ORTMANN, '05b, p. 120.

Type-locality: Green River, Mammoth Cave, Edmonson Co., Kentucky. (Faxon).

This species thus belongs to the Cumberland Plateau, but up to the present time it is undoubtedly the rarest species of *Cambarus*, known only from the single individual (♂ I) described by Faxon. It is a

rather aberrant type on account of the peculiar conformation of the antennæ and the long areola, but in the characters of rostrum, etc., it appears as primitive. The finding of additional material of this species is highly desirable, and probably the ecological conditions, under which it lives, will be interesting.

Cambarus (Cambarus) extraneus Hagen (1870).

C. extraneus HAGEN, '70, p. 73, Pl. 1, figs. 88, 89, Pl. 3, fig. 156;—FAXON, '85a, p. 84;—FAXON, '98, p. 650;—HAY, '99, p. 966;—ORTMANN, in WILLIAMSON, '05, p. 310;—FAXON, '14, p. 422.

C. (*Bartonius*) *extraneus* ORTMANN, '05b, pp. 120, 134.

C. girardianus FAXON, '84, p. 117;—FAXON, '85a, p. 78, Pl. 4, fig. 1, Pl. 9, fig. 2; —HAY, '99, p. 966.

C. extraneus girardianus FAXON, '98, p. 650;—FAXON, '14, p. 422.

C. (*Bartonius*) *girardianus* ORTMANN, '05b, p. 120.

C. jordani FAXON, '84, p. 119;—FAXON, '85a, p. 83, Pl. 3, fig. 3;—HAY, '99, p. 963;— FAXON, '14, p. 423.

C. (*Bartonius*) *jordani* ORTMANN, '05b, p. 120.

Type-locality: "Tennessee River, Georgia." (Hagen). This record is erroneous, since the Tennessee River is not in Georgia. I think, it would be well to select as type-locality the next one given by Faxon ('85a, p. 84); Etowah River, Rome, Floyd Co., Georgia.

KNOWN LOCALITIES OF C. EXTRANEUS.

Cumberland drainage.

Cumberland River, Orby, Bell Co., Kentucky. (1 ♂ II, Sept. 10, '13).

Harpeth River, Kingston Springs, Cheatham Co., Tennessee. (1♀, Aug. 31, '21).

Town Creek, Sparta, White Co., Tennessee. (1 ♂ I, 5 ♂♂ II, 6♀♀, Aug. 27, '22) (to Calf-killer and Upper Caney Fork).

New River, New River, Scott Co., Tennessee. (2 ♂♂ II, 4♀♀, Aug. 30, '24) (headwaters of South Fork Cumberland).

Rockcastle River, Livingston, Rockcastle Co., Kentucky. (Ortmann in Williamson) (C. M., 2 ♂♂ II, 2♀♀, June 21, '04).

Tennessee drainage.

Duck River, Shelbyville, Bedford Co., Tennessee. (1♀, Sept. 1, '22).

Cypress Creek, Lauderdale Co., Alabama. (Faxon, type-locality for *girardianus*).

Cypress Creek, Florence, Lauderdale Co., Alabama. (1♀, Aug. 24, '24) (topotype of *girardianus*).

Shoals Creek, Bailey Springs, Lauderdale Co., Alabama. (1 ♂ II, Aug. 25, '24).

Keithly Branch, Bailey Springs, Lauderdale Co., Alabama. (1 ♂ II, Aug. 25, '24) (to Shoals Creek).

Spring Creek, above Estill Springs, Franklin Co., Tennessee. (1♀, Aug. 19, '23) (to Elk River).

Eastanaula Creek, Athens, McMinn Co., Tennessee. (Faxon, *girardianus*) (to Hiawassee River).[20]

Piney River, Spring City, Rhea Co., Tennessee. (5 ♂♂ II, 3♀♀, May 18, '15) (to Tennessee).

Alabama drainage (upper Coosa.)

Etowah River, Rome, Floyd Co., Georgia. (Faxon, supplementary type-locality for *extraneus*, type-locality for *jordani*).

Cartecay River, East Ellijay, Gilmer Co., Georgia. (2 ♂♂ II, Aug. 23, '22).

SUMMARY OF DISTRIBUTION

The range of this species includes the Tennessee drainage in southeastern Tennessee (but not in the headwaters, north of the Knoxville region) and northern Alabama. It is also found in upper Duck River, and extends into the southern tributaries of the Cumberland (Harpeth and Caney Fork), the headwaters of the Cumberland, and southward into the headwaters of the Coosa in Georgia. Possibly it goes farther south, as is indicated by a locality given by Faxon; "Big Cahaba River, Alabama." But this is too indefinite to be of any use.

This species belongs typically to creeks of moderate size; and is generally not found in very small streams, but occasionally in small rivers (the upper Cumberland, New, and Duck Rivers are the largest in which I found it. The smallest stream is Keithly Branch of Shoals Creek). Thus it is more of a river-form than a small-creek-form, and should follow, in its distribution, the laws governing the river-species. It lives under stones and other objects in the usual way.

The male of the I form, hitherto unknown, was found by myself (at Sparta) on Aug. 27. The gonopods are of the type of the subgenus *Cambarus*, and do not offer any special features. Females with eggs were collected at Spring City on May 18: they indicate that spring is the spawning season, as usual in the case of river-forms.

[20]This creek is given on Topographic Atlas (Sheet Cleveland) as "Oostanaula," but Eastanaula is correct.

Taxonomic Remarks.

Since I unite, under *C. extraneus*, three previously accepted species, and since variations of this form undoubtedly are connected with its decidedly discontinuous range, and since the study of these seems to have an important bearing upon the development of the drainage features in our region, I have to go more than usual into a detailed discussion of this species, so that no doubt may remain as to the justification of my views.

When Faxon separated his species *girardianus* and *jordani* from *extraneus*, he had of the latter nine specimens at his disposal (probably including the five (not six) reported by Hagen). Of *girardianus* he had five, and of *jordani* a single specimen. To these he added subsequently five specimens of *extraneus*, and two of *girardianus*. With the four specimens mentioned by Ortmann (in Williamson, '05), twenty-six individuals belonging to this group were known. My present material includes the four specimens mentioned previously, and thirty-five additional specimens, collected by myself in northern Georgia, northern Alabama, central and eastern Tennessee, and southeastern Kentucky.

In 1884 and 1885, Faxon pointed out the distinguishing characters of the three "species," but already in 1898 he recognized that forms intermediate between *extraneus* and *girardianus* occur, and the same observation was made by Ortmann in 1905. According to the present material, *nearly all specimens are intermediate, i. e.* they show a mixture of characters which have been assigned to these "species," and this, of course, means, that the characters are individually variable, and are not of specific value. This holds good, in the first line, for *extraneus* and *girardianus*, for which Faxon gives the following differences ('85a, pp. 79 and 84).

1. Areola broader and shorter in *extraneus* (length not over 33 per cent of carapace); longer and narrower in *girardianus* (length 35.4 per cent).
2. Palm of hand longer, fingers shorter in *extraneus*; the opposite in *girardianus*.
3. Upper margin of meropodite of chelipeds with two spines near distal end in *extraneus*; with only one spine in *girardianus*.
4. Thoracic sterna setiferous in *extraneus*; naked in *girardianus*.
5. Body smoother, punctations of carapace finer in *girardianus* than in *extraneus*.
6. Orbital angle with a more prominent spine in *girardianus* than in *extraneus*.

7. Lateral spine of carapace prominent in *extraneus*; rudimentary in *girardianus*.

I have to make the following remarks as to these characters:

1. There are differences in the length of the areola, and in a number of cases, the areola is even considerably longer than indicated by Faxon for *girardianus* (35.4 per cent), going up to 40.9 per cent. The width of the areola is correlated in a general way to the length; *i. e.* a longer areola is proportionally narrower.

2. The proportion of the length of the palm and fingers (1 : 1.9), given for *girardianus* (with longer fingers), is often found, or figures close to this, going up to 1 : 2.1. In other cases, the fingers are much shorter (1 : 1.3, to 1 : 1.5); but intergrades are found.

3. The upper distal end of the meropodite of the chelipeds may have one or two, but rarely three spines.

4. The setæ of the thoracic sterna are entirely unimportant: their presence apparently depends upon the condition of the individual. They are also present more frequently in males. They may have been worn off, when absent.

5. The punctations of the carapace, and its granulations, are variable, the latter largely depending on the age of the individual (young ones are smoother). The punctations may be coarse and comparatively distant from each other, or more closely set, with finer dots, more or less distinct, between the larger ones: these conditions pass insensibly into each other. The number of dots across the narrowest part of the areola varies, accordingly, between four and ten rows.

6. There is great variation in the spine of the external orbital angle; very often there is none.

7. Furthermore the lateral spine of the carapace is variable, and it may be entirely absent.

There are other differences, which may be taken from the descriptions of the two forms, but which have not been emphasized by Faxon. I pass over slight differences in the armature of the carpopodite of the chelipeds and the lower margin of the meropodite, since these rather variable features could never be used as specific characters, but I mention the inner margin of the palm, which has a double row of tubercles in *extraneus*, and a single, indistinct row in *girardianus* ("slightly serrated"). Just this character is a little more important, for there are certain sets of specimens well characterized by it. But it cannot be used to distinguish two species, as will be shown below.

In studying my material, I have discovered a few other characters, which should be considered.

The rostrum has been described in both *extraneus* and *girardianus*

as broad and excavated, with subparallel or slightly convergent margins, which end in marginal spines. These spines vary somewhat; they may be strong and distinctly upturned, or they may be (as described in *girardianus*) small, almost rudimentary, resembling small horny tubercles. The convergence of the lateral margins and the excavation of the upper surface is also variable: generally, more strongly convergent margins are connected with more deeply excavated surfaces. There are, however, numerous transitions. Finally the acumen of the rostrum may vary in its proportional length.

In both "species," the outer finger has been described as bearded at the base; this is actually the case in certain lots, but in others the base of this finger cannot be called "bearded," although there may be some hairs.

It should further be added, that in large specimens, chiefly males, the fingers become somewhat gaping at the base.

Among my material, there hardly is a set, which can be assigned to either *extraneus* or *girardianus*, and, moreover, there are hardly single individuals, which distinctly and unqualifiedly are the one or the other with the exception of one specimen from Cypress Creek, and two specimens from Shoals Creek and Keithly Branch. These are *girardianus*, agreeing with it in the characters given above under 1 (areola 35 per cent), 2 (length of palm to fingers = 1 : 1.9), 3, 5, and 6. But even here are slight differences. The thoracic sterna (character 4) in the two males are hairy, and the lateral spines of the carapace (character 7) are well developed in all three of them. These specimens also agree with *girardianus* in the shape and armature of the rostrum (marginal spines small), and armature of the hand (one row of serrations on inner margin of palm), carpopodite and meropodite.

Among my other sets, we cannot recognize these two forms; yet there are some regionally circumscribed groups, which possess peculiar features, but these features are not those given as the supposed specific differences of *extraneus* and *girardianus*.

The *first group* contains specimens from the Alabama and upper Tennessee drainages in Georgia and east Tennessee (East Ellijay and Spring City). Specimens from this region have been called by Faxon *extraneus* (Georgia) and *girardianus* (Athens, Tennessee).

My specimens resemble *girardianus* in the moderately long areola, the moderately developed lateral spines of the carapace, in the rather long fingers of the hand, and the single spine of the upper margin of the

meropodite of the chelipeds. But in the external orbital angle they are rather like *extraneus*, having no spine on it, or only a small one. Single individuals may have a shorter areola, and in one case (Spring City), the length of the areola is of the *extraneus*-type (33 per cent). These specimens stand nearer to *girardianus* than any others, except those from near the type-locality of the latter.

The *second group* includes specimens from the northern extremity of the range, the upper Cumberland drainage (Livingston, Orby, and New Rivers). These are all remarkable for their *double* row of tubercles on the inner margin of the palm (*extraneus*), and also the areola is here not very long, approaching that of *extraneus* even more distinctly than in the first group (length 30.2 to 34.5 per cent). The well developed lateral spines also point to *extraneus*. Yet other characters are those of *girardianus*. For instance, the external orbital angle has a spine. With regard to the upper distal spine of the meropodite of the chelipeds, all specimens from Livingston and New River agree with *extraneus* (two or three spines), while the one from Orby has only one spine, like *girardianus*. In the length of the fingers, this is in part reversed; specimens from Livingston have the long fingers (1 : 1.8) of *girardianus*, that from Orby the short fingers (1 : 1.4) of *extraneus*. But those from New River are peculiar in having *very long* fingers (1 : 2.1), and differing from all others in this respect.

On the average, these specimens of the second group stand closest to *extraneus*, but possess certain *girardianus*-features.

A *third group* is from central Tennessee, and contains specimens from the Caney Fork and Harpeth River drainages (middle Cumberland system), and from Duck River. This western set is noted for the unusually long areola (36 to 40.9 per cent), which, at the same time, is correspondingly narrow. This form outdoes in this respect the typical *girardianus*. Also other characters are of the *girardianus*-type, chiefly the presence of only one spine on the upper margin of the meropodite, and the inner margin of the palm which is simply serrated. On the other hand, in the extraorbital angle (without spine), and in the short fingers (1 : 1.3 to 1 : 1.6), these specimens are distinctly *extraneus*. The lateral spine in specimens from the Cumberland drainage is generally well developed (*extraneus*), but in the only one from Duck River it is missing (*girardianus*).

These specimens stand about midway between the two forms, but

in one particular feature (length of areola), they even go beyond the established limits of *girardianus*.

A young specimen from Estill Springs approaches geographically the type-locality of *girardianus*, but it agrees in the areola rather with the group from central Tennessee. It has, however, a double row of weak tubercles on the inner margin of the palm, and well developed spines on the carapace (*extraneus*).

The *fourth and last group* is formed by specimens from the region of the type-locality in Alabama: these represent the typical *girardianus*, with certain deviations, as explained above.

As to the rostrum, I should add, that strongly convergent margins and deep excavation are found in specimens from Ellijay and in some from Sparta. In the latter set we have the greatest variety, for we have here specimens with moderately convergent margins and moderate concavity, and also some in which the margins are practically parallel, and the excavation very shallow. The specimens from Livingston and New River have only a gently excavated upper surface, and have a peculiarity of their own; a comparatively long acumen not found elsewhere (also not in the specimen from Orby).

A "bearded" outer finger of the chela is found in all specimens from Ellijay and Spring City. In all others this character is missing, except in the typical *girardianus* from Cypress Creek and Shoals Creek, but again the one from Keithly Branch does not have this finger bearded.

From the above account of my material, it is clear that the characters used for distinguishing *extraneus* and *girardianus* are not reliable. There *are* variations in the crawfishes belonging to this aggregation, and some of these seem to be regionally restricted. However, they are not sufficient even to distinguish varieties. The four types described above might easily be subdivided, and we would finally arrive at the preposterous result of distinguishing specimens from almost each locality as a geographical variety. The only way is to regard *girardianus* simply as a synonym of *extraneus*. *C. extraneus* is a very variable species, but this is not astonishing when we consider its peculiar range, which is rather discontinuous, covering several, more or less independent, drainage-systems.

In the foregoing, we have not paid any attention to *C. jordani* Faxon, founded upon a single individual (♂ II) from Etowah River, Rome, Georgia, (where *extraneus* is also found). This specimen is

still the only one known, and its distinguishing characters are said to be as follows:

1. Rostrum broad, subplane, with the margins nearly parallel, and with long acumen.

2. Areola narrow. According to Faxon's measurements, it is about as long as that of *girardianus* (34.8 per cent as against 35.4 per cent in *girardianus*), but it is distinctly narrower (16 per cent of its own length, as against 31.8 per cent in *girardianus*).

In other characters it agrees partly with *extraneus* (sharp lateral spine, prominent extraorbital angle, without spine, two upper distal spines on meropodite), partly with *girardianus* (long fingers, and simply serrated inner margin of palm).

We have seen that specimens with a rostrum, as described for *jordani*, are occasionally found with *extraneus* (nearly flat rostrum at Sparta, and long acumen at Livingston and New River), and it should be mentioned that the acumen of the rostrum of *jordani*, as figured by Faxon ('85a, Pl. 3, fig. 3), greatly resembles these latter specimens, and hardly differs from that of *girardianus* (*ibid.*, Pl. 4, fig. 1). Furthermore, we know that in central Tennessee *extraneus* possesses an unusually narrow, although longer, areola. My measurements of specimens from Sparta give the width of from 14.5 to 23.5 per cent of its length; from Kingston Springs 15 per cent; from Shelbyville 16 per cent; from Estill Springs 22 per cent. In specimens from East Tennessee and Kentucky, these measurements vary from 25 to 42 per cent.[21]

Thus specimens of *extraneus* with flat rostrum and narrow areola like *jordani* do exist, associated with unquestioned *extraneus*-forms, and, in fact, relying only upon these characters, some specimens from central Tennessee actually should be called *jordani*. This, of course, tends to show that the single known individual of *jordani* is nothing but one of the many individual phases of *extraneus*.

My largest ♂ I (Sparta) measures 51 mm., but I have a ♂ II (New River) 80 mm. long. My largest ♀ (Florence) is 76 mm.

COLOR

Specimens from Sparta (found associated in the same creek with *C. bartoni cavatus*) attracted my attention on account of their peculiar

[21]Faxon's figure of *jordani* is very inaccurate in this respect, and it should be pointed out, that the exact measurement of the width of the areola is rather difficult.

color in life. At other localities I did not notice this; except at New River where I found a similar coloration but not so strikingly developed.

Carapace and abdomen light brownish red, cervical groove, rostrum, posterior margin of carapace, dark greenish, also anterior and posterior margins of abdominal segments. Telson light green, as also are the second to fifth peræopods. Under side pale, except that of telson, which is also light green. Chelipeds light brown-red, greenish near the joints. Tubercles of palm, at base of dactylopodite, and at articulation with carpopodite, red-brown. Margin of rostrum red-brown.

All specimens of this locality had these colors, and the contrast between the brown-red and greenish tints was rather marked and attractive. The specimens of *C. bartoni cavatus* found at the same place were of a rather dull greenish-olive color.

3. Section of C. bartoni.

Carapace ovate, more or less depressed, with, or mostly without, lateral spines. Rostrum without marginal spines. Chelæ comparatively short and broad, ovate. Areola wide or narrow, but never linear (obliterated), generally distinctly longer than half of the anterior section of the carapace, rarely shorter. Eyes well developed.

The missing marginal spines of the rostrum distinguishes this section from the preceding (*extraneus*), and the ovate and depressed carapace distinguishes it from the next (*diogenes*). In the latter, the areola is always very narrow and often obliterated (*linear*) in the middle, but the areola of certain forms of the *bartoni*-section leads to this condition gradually. Yet, in the latter section, the areola never is linear.

This section contains a number of species with a great number of varieties which in part are regionally restricted, in part appear as mere variations. Their distinction often is very difficult, and the literature about them consequently is rather confused. Our region is apparently the center of origin of the section, and also contains at the present time the majority of the known forms. The following key may serve to distinguish them, and for the sake of completeness, I also include in it a few forms which do not strictly belong here geographically.

a. Areola shorter or longer, rather wide, with numerous, rather crowded dots, generally five or more in its narrowest part. Rostrum rather long, tapering; gently, or hardly at all, contracted into a long acumen.

b. Areola rather short and wide. Margins of rostrum not swollen. Chelæ somewhat rough by dots, tubercles, and longitudinal ridges on the subconical fingers. Fingers not gaping, or only slightly so..... *C. montanus.*

c. Lateral spines of carapace present.

d. Inner margin of palm with two rows of tubercles. *C. montanus acuminatus.*

d′. Inner margin of palm with one row of tubercles. *C. montanus veteranus.*

c′. Lateral spines of carapace absent..... *C. montanus montanus.*

b′. Areola somewhat longer, but also wide. Margins of rostrum swollen. Chelæ rather smooth, with few dots, without distinct granulations or tubercles, and without ridges on the subcylindrical fingers. Fingers (in old specimens) widely gaping..... *C. longulus.*

c. Extraorbital angle little prominent, mostly rounded. *C. longulus longulus.*

c′. Extraorbital angle prominent, mostly spiniform. *C. longulus longirostris.*

a′. Areola generally long, rarely short, moderately wide or narrow, the dots irregular, and not much crowded, in its narrowest part generally not more than 5. (Rostrum longer or shorter).

b. Areola rather short, but rather narrow, with only about three dots in its narrowest part. Lateral spines present, but small. Carapace rough, strongly granulated. Chelæ rough, with tubercles in several rows toward the inner margin of the palm. Rostrum short and broad, suddenly contracted into a short acumen..... *C. latimanus.*

b′. Areola somewhat longer, wider or narrower, with two to five dots in its narrowest part. Lateral spines present or absent. Carapace not rough, but often somewhat granulated on the sides. Chelæ not very rough, tubercles only on inner margin of palm in one or two rows. Rostrum longer or shorter..... *C. bartoni.*

c. Rostrum longer, tapering, gently contracted into the long acumen. Palm at base of outer finger (in large specimens) with a distinct depression above and below..... *C. bartoni robustus* (extralimital).

c′. Rostrum shorter, suddenly contracted into a short acumen (rarely somewhat longer). Palm at base of outer finger without distinct depressions.

d. Eyes normal. Lateral spine of carapace rarely present. Areola more or less elongated.

e. Areola moderately long (34-38 per cent), with three to five rows of dots in its narrowest part. Rostrum broad and short, with short acumen.

f. Margins of rostrum nearly parallel, sharply elevated, their anterior ends sharply angular, sometimes subspiniform. Surface of rostrum excavated. Lateral spines of carapace present or absent. Inner margin of palm with one or two rows of tubercles..... *C. bartoni cavatus.*

f′. Margins of rostrum more or less convergent, not sharply elevated, angles at base of acumen rounded. Surface of rostrum rather flat. Lateral spines mostly absent. Inner margin of palm rarely with two rows of tubercles, mostly only with one, or simply serrated.

g. Upper surface of rostrum without median keel.

h. Inner margin of hand serrated, or with one, rarely with two rows of small tubercles..... *C. bartoni bartoni.*

h′. Inner margin of hand with a cristiform row of large tubercles..... *C. bartoni asperimanus.*

g′. Upper surface of rostrum with a median keel. *C. bartoni carinirostris* (extralimital).

e′. Areola longer (about 40 per cent or more) and narrower, with only one or two rows of dots.

f. Carapace granulated on the sides. Hand with sharp and distinct tubercles..... *C. bartoni striatus* (=*graysoni* ?).

f′. Carapace rather smooth, weakly granulated. Hand with less distinct tubercles..... *C. bartoni laevis.*

d′. Eyes reduced, but not absent. Lateral spines of carapace present, small. Areola long..... *C. bartoni tenebrosus.*

Cambarus (Cambarus) montanus Girard (1852).

GENERAL REMARKS.

Faxon ('14) was the first to correctly recognize this species. The essential characters of *C. montanus* (in the wider sense) are found in the *areola*, in the shape of the *rostrum*, and in the shape and sculpture of the *hand*.

The areola is rather short, sometimes shorter than one-third of the total length of the carapace, rarely slightly longer. My measurements vary between 29.8 and 36.8 per cent, but an areola of over 33 per cent is very rare. It is always broad, and is covered by a number of dots, which are more or less closely set, and uniform. In the narrowest part stand six to eight dots, rarely less (five), sometimes more (up to ten). (In *C. longulus*, the number of dots is about the same, but the areola is longer; in *C. latimanus*, the areola is also short, but narrower, with about three dots; in *C. bartoni*, the areola is longer and narrower, with five dots or less).

The rostrum of *C. montanus* is rather elongated with the lateral margins convergent and gently contracted toward the tip, forming a rather long acumen. There is a good deal of variation, however, as sometimes the contraction is very indistinct hardly marking off the

acumen. The margins of the rostrum are somewhat elevated, but not swollen. A similar shape of the rostrum is found in *longulus*, and in certain forms of *bartoni*. But in most *bartoni*-forms, and in *latimanus*, the rostrum is distinctly shorter, and the margins are suddenly contracted to form a short acumen.

The chelæ of *montanus* are rather indifferent. They are long-ovate, not very broad, with the fingers rather long, generally not gaping (or only slightly so in old specimens). Their sculpture is well developed, with distinct tubercles near the inner margin of the palm and along the margin of the dactylopodite. The chelæ are covered all over with dots which fall, upon the fingers, into longitudinal lines, forming furrows, including ridges. (In *C. longulus*, the chelæ are much smoother, with widely gaping fingers; in *bartoni*, the sculpture is similar, but the chelæ are shorter and broader; and in *latimanus*, they are also shorter and broader, but the sculpture is more strongly developed).

C. montanus, in all these characters, is a rather primitive type of the *bartoni*-section, and it varies considerably in other characters. Some of the latter, such as the extraorbital angle, granulation of the carapace, and hairiness of fingers, are individually variable, so that they cannot be used for the distinction of varieties. I have found, however, that the presence or absence of lateral spines on the carapace, and the number of rows of tubercles on the inner margin of the palm, are a little more constant, so that, generally, specimens from one and the same locality are alike in these characters. Thus it has been possible to distinguish three races under *montanus* (see key). Yet these races are *not species*, for the characters merge into each other.

I have found no evidence that *montanus* passes into *longulus*, nor into *latimanus*, but there is some slight indication of its connection with *bartoni* in specimens of *C. montanus acuminatus* from the Piedmont Plateau (Raleigh, North Carolina, see below).

Cambarus (Cambarus) montanus acuminatus (Faxon) (1884).

C. acuminatus FAXON, '84, p. 113;—FAXON, '85a, p. 67, Pl. 3, fig. 5, Pl. 8, fig. 6; —UNDERWOOD, '86, p. 365;—FAXON, '90, p. 624;—HAY, '99, pp. 959, 964;—HARRIS, '03, p. 68;—ORTMANN, '13, p. 336.

C. (*Bartonius*) *acuminatus* ORTMANN, '05b, p. 120.

C. bartoni acuminatus FAXON, '14, pp. 391, 424.

Type-locality: Saluda River, at Farr's Mills, west of Greenville, Greenville Co., South Carolina. (Faxon, '14, p. 424).

KNOWN LOCALITIES.

Atlantic drainage.

Indian Creek, Beltsville, Prince George Co., Maryland. (Faxon) (most northern locality, in Potomac drainage).

Northwest Branch, Hyattsville, Prince George Co., Maryland. (Faxon) (to Anacostia and Potomac Rivers, near Washington, D. C.).

Fredericksburg, Spotsylvania Co., Virginia. (Faxon)[22] (Rappahannock drainage).

Deep Run, Fredericksburg, Spotsylvania Co., Virginia. (4 ♂♂ II, 1♀, Aug. 17, '25) (Rappahannock drainage).

Mountain Run, Culpeper, Culpeper Co., Virginia. (Ortmann, '13) (C. M., 2♀♀, June 3, '12) (Rappahannock drainage).

Mattapony River, Woodford, Caroline Co., Virginia. (3♀♀, one with eggs, Aug. 17, '25) (York River drainage).

James River, Six Mile Bridge, Campbell Co., Virginia. (1♀, Aug. 31, '25) (below Lynchburg, at mouth of Beaver Creek).

Ivy Creek, Lynchburg, Campbell Co., Virginia. (1 ♂ I, 1 ♂ II, Aug. 29, '25) (to James River).

Tinker Creek, Roanoke, Roanoke Co., Virginia. (Ortmann, '13) (C. M., 2 ♂♂ II, 3♀♀, June 10, '12) (Roanoke drainage).

Mason Creek, Salem, Roanoke Co., Virginia. (Ortmann, '13) (C. M., 1 ♂ II, Aug. 13, '11) (Roanoke drainage).

Neuse River, Raleigh, Wake Co., North Carolina. (Faxon, as *robustus*).

Rocky Branch, Raleigh, Wake Co., North Carolina. (Brimley Bros. 4 ♂♂ I, 3 ♂♂ II, 8♀♀, May 7, '07) (to Walnut Creek and Neuse).

Reedy Fork Cape Fear River, Greensboro, Guilford Co., North Carolina. (Faxon).

Jones River,[23] Morganton, Burke Co., North Carolina. (Faxon) (to Catawba River).

Small Run tributary to Catawba River, Marion, McDowell Co., North Carolina. (1 ♂ II, May 16, '14).

Oldfort, McDowell Co., North Carolina. (Faxon) (Catawba drainage).

Saluda River, Farr's Mills, west of Greenville, Greenville Co., South Carolina. (Faxon, type-locality).

[22]Specimens recorded by Faxon ('14, p. 388) under *robustus*, but with the express statement that certain characters *differ* from *robustus*. They are just those which belong to *acuminatus*. That the latter actually is found in the Rappahannock drainage, is shown by the specimens collected by myself at Fredericksburg and Culpeper.

[23]Not "James River."

Interior drainage.

Blowing Rock, Watauga Co., North Carolina. (J. P. Moore, 1 ♀, June '93) (headwaters of New River).

Swananoa River, Ashville, Buncombe Co., North Carolina. (1♀, May 13, '14) (to French Broad and Tennessee).

Swananoa River, Black Mountain, Buncombe Co., North Carolina. (Faxon).[24]

Cove Creek, Caryville, Campbell Co., Tennessee. (2 ♂♂ II, 1♀, Sept. 12, '15) (to Clinch River and Tennessee).

Gulf drainage.

Chattooga River, Trion, Chattooga Co., Georgia. (4 ♂♂ I, 2 ♂♂ II, 3♀♀, May 19, '15) (to Coosa and Alabama Rivers).

SUMMARY OF DISTRIBUTION.

Thus far, the main distribution of *C. montanus acuminatus* seems to be on the Piedmont Plateau of the Atlantic slope, from Maryland (close to Washington, D. C.) to South Carolina. The new locality in the upper Coosa drainage (Trion) is probably connected with this range around the southern margin of the Appalachian system. This form also ascends into the mountains in Roanoke River (west of Blue Ridge), and in the Catawba drainage it goes up close to the foot of the high Mountains in North Carolina. Here the range crosses over the divide, and extends into the headwaters of New River (Kanawha system) and French Broad (Tennessee system).

An isolated locality is in Cove Creek at Caryville. However, disregarding the somewhat longer areola of one of the males, these specimens are absolutely typical, and distinctly belong to this form. This locality is on the other (western) side of the Great Allegheny Valley, at the foot of the Cumberland Escarpment. As we shall see below, the var. *veteranus* and the typical *montanus* are found in the Great Valley and on its eastern side (near the High Mountains). It is not impossible that additional investigations will modify the present impression concerning the range of *acuminatus* in the Great Valley.

Ecology. According to my experience, *C. montanus acuminatus* lives in smaller or medium-sized streams. The smallest run in which I found it is at Marion, North Carolina. I found it only once in a large river, the James at Six Mile Bridge, but here it was at the mouth of a

[24]Faxon also gives, French Broad River, North Carolina. This is rather indefinite, and might very well be dismissed, since other more exact localities in this drainage are known.

creek (Beaver Creek). All of the places had rapidly flowing water, and the crawfishes live under stones in the usual way. The female with eggs, collected at Woodford, was dug out of a hole on the bank, close to running water. In Chattooga River, at Trion, possibly the largest body of water (except James River), this form was abundant under stones, and *chiefly* among water weeds, but again in lively flowing water. At the latter locality, I found males of the I form (May 19), and, associated with them, two females with eggs. Another male of the I form was found in Ivy Creek, Lynchburg (Aug. 29) and another female with eggs at Woodford (Aug. 17). These dates probably indicate, that there is no restricted breeding season.

TAXONOMIC REMARKS.

C. montanus acuminatus is distinguished from the other forms of *montanus* by the presence of lateral spines on the carapace (mostly well developed), and the double row of tubercles on the inner margin of the palm. In the sets enumerated above these characters are uniformly present, yet, in the original description of *acuminatus*, the double row of tubercles is not mentioned ("serrato-tuberculate on internal border"). The figure is not clear enough to make out this character. But since several of my sets showing this feature have been collected in close vicinity to localities given by Faxon, we must consider it as important. In very young individuals the tubercles are weak, but stand in two rows.

In the general shape of the chelæ, my specimens are also rather uniform. The outline is elongated, with rather long fingers, and the surface has the sculpture described for the species. The fingers are not gaping, and are somewhat hairy, but not bearded. Only in a large male I from Lynchburg, the fingers are slightly gaping.

The areola varies in length, from 29.8 to 33.8 per cent of the carapace, but in one male from Caryville it is 35.4 per cent (the other male and the female have 32.1 per cent). This, apparently, is an isolated, exceptional individual, in which possibly, hybridisation with some other form is suggested. Of the dots of the areola, six to nine stand in the narrowest part. Generally, they are not exceptionally crowded, yet they are more so than in the *bartoni*-forms.

The rostrum varies in the length of the acumen and in the distinctness of the latter, that is to say, in the constriction at its base. Faxon's figure gives the extreme case of elongation, but, there are

specimens in which the constriction and the acumen are more distinct, the latter being longer or shorter. Specimens from the same locality vary in this respect.

Faxon makes special mention of the extraorbital angle, which may or may not have a spine; in his type, this angle was rounded. But, according to my material, it is mostly spiniform; only in the specimen from Ashville, and that from Six Mile Bridge, is it absent. It is small in the specimen from Marion, and in the specimens from Lynchburg. In one specimen from Culpeper it is small on the right side, and absent on the left.

My set from Raleigh deserves special mention, and probably corresponds to specimens mentioned by Faxon, from Raleigh as *robustus*. These agree with *acuminatus* in the double row of tubercles on the palm, and in the shape of the rostrum. The fingers of the hand are also similar, yet somewhat shorter in the average. They do *not* possess a trace of the depressions on the hand, characteristic for *robustus*. But then again, the areola is somewhat longer (32.8 to 36.1 per cent), and the dots are a little more irregular, yet rather numerous (five to six rows). The lateral spine is variable here, rarely well developed, usually small or represented by a tubercle.

These specimens, of course, are not typical *acuminatus*, but transitional toward *bartoni*, inclining to the *robustus*-phase. They probably indicate how *robustus* and typical *bartoni* originated from the *montanus*-stock.

Cambarus (Cambarus) montanus veteranus (Faxon) (1914).

C. bartoni veteranus FAXON, '14, pp. 389, 424, Pl. 13, fig. 2.

Type-locality: Indian Creek, Baileysville, Wyoming Co., West Virginia. (Faxon) (headwaters of Guyandot River, to Ohio).

KNOWN LOCALITIES.

Kanawha drainage.

Elk River, Cogar, Webster Co., West Virginia. (Faxon).[25]
West Fork Greenbrier River, Durbin, Pocahontas Co., West Virginia. (Faxon).[26]

[25]Given as: Elk River, Cogar's Mill, West Virginia. A place named Cogar is in Webster County.

[26]Reported as *robustus*, (*l. c.*, p. 388), but, according to remarks made by Faxon, apparently belonging here. The specimens differ from *robustus* by wide areola and less prominent depressions on hand.

Crane Creek, near Montcalm, Mercer Co., West Virginia. (Faxon).[27] (tributary to Bluestone River).

Guyandot drainage.

Indian Creek, Baileysville, Wyoming Co., West Virginia. (Faxon, type-locality).

Tennessee drainage.

Brush Fork, Marlow, Anderson Co., Tennessee. (2 ♂♂ II, Sept. 2, '14) (to Clinch River).
Pistol Creek, Rockford, Blount Co., Tennessee. (3 ♂♂ II, 1♀, Sept. 4, '14) (to Little River).
Fourmile Creek, Vonore, Monroe Co., Tennessee. (2 ♂♂ II, 1♀, Aug. 29, '14) (to Tellico River, and Little Tennessee).
Hiawassee River, Austral, Polk Co., Tennessee. (1 ♂ I, 1♀, Sept. 19, '15).

DISTRIBUTION.

At least in part, the distribution of this form seems to overlap with that of *acuminatus*, namely, in the Great Valley in east Tennessee. It does not extend into the High Mountains eastward, nor to the Piedmont Plateau, as *acuminatus* does. On the other hand, this form advances into West Virginia, westward of the Allegheny Mountains, into a region which belongs to the Allegheny-Cumberland Plateau, (here its type-locality is found). But altogether, our information as to the range of this form is rather meager.

Where I found it, it was in rather small creeks (also at Austral, in a small slough of the main river), as usual under stones in running water. A male of the I form was captured on September 19.

TAXONOMIC REMARKS.

Only eleven specimens, collected at four localities in the Great Valley, are at hand, one of them a male I. They agree very well with each other, and also with Faxon's description of *veteranus*. The essential characters are the same as in *acuminatus*, with the exception, that the inner margin of the palm has only *one* row of tubercles. In addition, all of my specimens have the outer finger of the chelæ bearded on the inner base, and in the larger and more fully developed specimens (from Austral), the fingers are distinctly gaping at the base.

The rostrum is always distinctly contracted, with a rather long

[27]Also given as *robustus*, but the same remark applies as in the case of Durbin.

acumen. The areola measures from 31.7 to 36.8 per cent of the length of the carapace, and the extraorbital angle has a small spine.

The original description of *veteranus* mentions most of these characters. The areola, according to the measurements given, would be 34.7 per cent, and has many dots. The rostrum is long; the lateral spines of the carapace are present. The fingers of the hand are gaping, and the general shape of the hand is about the same as in my specimens from Austral. There are, however, a few minor differences. The inner margin of the palm is said to have only one row of tubercles, but there is another one, "obsolescent," running alongside of it. There is no "beard" on the base of the outer finger, and the extraorbital angle is not distinctly angular. The type of *veteranus* is much larger (total length 93 mm., carapace 49 mm.) than any of my specimens (♂ I from Austral about 59 mm., carapace 30 mm. ♀ from Austral, carapace 33 mm., largest ♂ from Marlow, 75 mm., carapace 38 mm.). It is possible that the above differences may be due to age. This much is sure, our specimens stand *very close* to *veteranus*, and the latter is not a form of *bartoni*, but of *montanus*. It is not idential with *acuminatus*, and is not the same as typical *montanus*, but stands between these two to a certain degree. It is quite possible that the true *veteranus* and our specimens, coming from somewhat different regions, represent two geographical races, but, I do not consider it advisable to separate them before more material has been studied.

Cambarus (Cambarus) montanus montanus Girard (1852).

C. montanus GIRARD, '52, p. 88.
C. bartoni montanus FAXON, '14, pp. 386, 423.

Type-locality: Tributary of James River, Rockbridge Co., Virginia. (Girard).

KNOWN LOCALITIES.

Potomac drainage. (It is desirable to have these confirmed!)

Cumberland, Allegany Co., Maryland. (Girard).
Shenandoah River, Clarke Co., Virginia. (Girard).

James drainage.

Tributary of James River, Rockbridge Co., Virginia. (Girard, type-locality).

Kanawha drainage.

Gauley River, Gauley Bridge, Fayette Co., West Virginia. (1 ♂ II, May 8, '13).
"Barger's Springs,"[28] on Greenbrier River, Summers Co., West Virginia. (Faxon).
Greenbrier River, White Sulphur Springs, Greenbrier Co., West Virginia. (Girard).
Greenbrier River, Ronceverte, Greenbrier Co., West Virginia. (1 ♂ I, Aug. 11, '11).
Madam Creek, Hinton, Summers Co., West Virginia. (Faxon) (to New River).
New River, Hinton, Summers Co., West Virginia. (1♀, Sept. 12, '12).
New River, Pearlsburg, Giles Co., Virginia. (2 ♂♂ II, 1♀, Sept. 14, '12).
Bluestone River, Abb's Valley, Mercer Co., West Virginia. (Faxon).
Rich Creek, Spanishburg, Mercer Co., West Virginia. (Faxon) (to Bluestone).
Delashmeet Creek, Kegley, Mercer Co., West Virginia. (Faxon) (to Bluestone).
East River, Mercer Co., West Virginia. (Faxon) (to New River).
Wolf Creek, Rocky Gap, Bland Co., Virginia. (Faxon) (to New River).
Reed Creek, Wytheville, Wythe Co., Virginia. (Faxon) (to New River).

Guyandot drainage.

Guyandot River, Baileysville, Wyoming Co., West Virginia. (Faxon).

Big Sandy drainage.

Barrenshe Creek and War Creek, Yukon, P. O. (Peerysville), McDowell Co., West Virginia. (Faxon).
Horsepen Creek, (Squirejim), McDowell Co., West Virginia. (Faxon).

Tennessee drainage.

Middle Fork Holston River, Marion, Smyth Co., Virginia. (1♀, Sept. 16, '12).
Cane Creek, Offutt, Anderson Co., Tennessee. (9 ♂♂ II, 6♀♀, Sept. 1, '14) (to Clinch River).
Emory River, Harriman Junction, Roane Co., Tennessee. (2♀♀, May 15, '15) (to Clinch River).
Toccoa River, Blue Ridge, Fannin Co., Georgia. (1 ♂ II, 1♀, Aug. 21, '22) (Hiawassee system).

[28]Probably this is meant to be "Bergen Springs."

SUMMARY OF DISTRIBUTION.

The metropolis of this form seems to be in the upper Kanawha (New River) drainage in West Virginia and Virginia. Thence it has extended northeastward, having been reported from the James drainage (type-locality), and even from the Potomac. In West Virginia it has reached the headwaters of the Guyandot and Big Sandy, and in southwestern Virginia, the headwaters of the upper Tennessee, passing into Tennessee and even to the Hiawassee drainage in northern Georgia. Thus it is found in the Allegheny Mountains and the Great Valley from Maryland to Tennessee. In the Hiawassee it has entered the High Mountains of northern Georgia, and in West Virginia, it occupies parts of the Allegheny-Cumberland Plateau to the west of the mountains.

Ecology. Wherever found by myself, this form was in streams of moderate to large size. Cane Creek (Offutt) is the smallest creek. Middle Fork Holston is rather small at Marion. Emory and Toccoa are larger, and New, Greenbrier and Gauley Rivers are of considerable size. In all cases it lived in the usual way, under stones, in rather strongly flowing water. A male of the I form was obtained on Aug. 11.

TAXONOMIC REMARKS.

The typical *montanus* is distinguished from the other *montanus*-forms chiefly by the absence of lateral spines on the carapace. With regard to the tubercles on the inner margin of the palm it varies, having sometimes only one row, sometimes two, with the second row generally indistinct.

The rostrum is elongated, gently contracted at the base of the longer or shorter acumen. The acumen, generally, is shorter and more distinctly marked off than in the other forms. The areola is rather short, 31.3 to 34.8 per cent of the carapace, with many, usually much crowded, uniform dots, in five to ten rows at its narrowest part. Extraorbital angle mostly with a distinct spine, but sometimes this is small or even missing.

The hand is of the typical shape and sculpture, with the fingers somewhat elongated, but generally less so than in *acuminatus* and *veteranus*. The fingers are not gaping and not bearded, with the exception of the set from Offutt, where they are distinctly bearded in all

fifteen specimens. An indistinct second row of tubercles on the inner margin of the palm is found in all specimens from the New River drainage. In the (large) female from Marion, the second row is distinct and well developed. In all others from the Tennessee drainage, only one row is present. The two specimens from Toccoa River are remarkable for the long acumen of the rostrum, with only a very gentle contraction at the base, much resembling, in this respect, the rostrum of *acuminatus*.

Summary of the Distribution of the Montanus-forms.

The various forms of *C. montanus* are found in an area comprising the southern Allegheny Mountains from the Potomac River to northern Georgia (upper Coosa drainage). They extend into the Blue Ridge and its southern expansion, the High Mountains of North Carolina and northern Georgia, eastward to the Piedmont Plateau (from South Carolina to the vicinity of Washington, D. C.), and westward upon a section of the Allegheny-Cumberland Plateau in southern West Virginia.

In the upper Tennessee drainage all three forms are found, but attention should be called to the fact that at no locality were two of the forms found associated, although different forms often occur rather close to each other. In these parts there is no regional separation of them, and their variability seems to be greatest. They appear as if the characters distinguishing them have developed (or else been preserved) independently, and that here and there special features have been introduced. The distinction of three varieties in this region thus appears as artificial and arbitrary, and probably is so.

This becomes somewhat different, when we consider the further distribution of each form. The typical *montanus* extends, within the Alleghenies proper, as far north as the Potomac drainage. From the James River northward it is the only one present. This form also occurs on the Allegheny Plateau in West Virginia, apparently following the New River system, and crossing into the headwaters of the Guyandot and Big Sandy. It has, at no point, gone eastward beyond the Blue Ridge mountains.

The form *veteranus* is found in West Virginia in the same general region as typical *montanus* (Guyandot and Kanawha), but here again it should be remarked, that at no locality both have been found associated, thus similar conditions prevail as in the Tennessee drain-

age.[29] The form *veteranus*, however, has not extended its range northward, being absent within the mountains in the New River system and to the north of it. It also has no extension of its range to the east.

C. montanus acuminatus is, in its distribution, more eastern and northern, and seems to have its center in the High Mountains in North Carolina (Tennessee and New drainages). It extends along the Blue Ridges to the upper Roanoke, and on the Piedmont Plateau from South Carolina to the Potomac Valley in Maryland. In this latter region we again see that *acuminatus* is nowhere accompanied by any of the other forms.

C. montanus acuminatus has the best claim to be regarded as a good species. In the eastern and northern part of its range it is rather pure. *C. montanus montanus* and *C. montanus veteranus* stand closer together, are more variable, and their distribution is more confused. Local forms are found among them. This is most evident in a large series.

Cambarus (Cambarus) longulus longulus Girard (1852).

C. longulus GIRARD, '52, p. 90;—FAXON, '90, p. 623;—FAXON, '98, p. 650;—HAY, '99, pp. 959, 966;—HARRIS, '03, p. 107;—ORTMANN, '13, p. 335 (*pro parte*), p. 337.

C. (*Bartonius*) *longulus* ORTMANN, '05b, p. 120.

C. bartoni longulus FAXON, '14, pp. 389, 424.

Type-locality: "Middle States" (Girard). The first exact locality, which might be selected as a supplementary type-locality is: South River, Waynesboro, Augusta Co., Virginia. (Faxon) (to Shenandoah and Potomac).

KNOWN LOCALITIES.

Potomac drainage.

Waynesboro, Augusta Co., Virginia. (Faxon, supplemetary type-locality).

James drainage.

"Bath Co., Virginia." (Faxon) (indefinite, but in the James drainage).

North River, Buena Vista, Rockbridge Co., Virginia. (5 ♂♂ II, 3 ♀♀, June 8, '12).

[29]At Baileysville, West Virginia, typical *montanus* is in Guyandot River, *veteranus* in Indian Creek.

North River, Lexington, Rockbridge Co., Virginia. (Faxon).
Jackson River,[30] Lick Run, Botetourt Co., Virginia. (Faxon).
Jackson River, Covington, Alleghany Co., Virginia. (1 ♂ II, Aug. 11, '11).

Kanawha drainage.

Greenbrier River, Ronceverte, Greenbrier Co., West Virginia. (1♀, Aug. 11, '11).
Greenbrier River, White Sulphur Springs, Greenbrier Co., West Virginia. (Faxon).
Greenbrier River, Durbin, Pocahontas Co., West Virginia. (4 ♂♂ II, 1♀, Aug. 10, '11).
West Fork Greenbrier River, Durbin, Pocahontas Co., West Virginia. (Faxon).
Bluestone River, Abb's Valley, Mercer Co., West Virginia. (Faxon).
Reed Creek, Wytheville, Wythe Co., Virginia. (Faxon) (C. M., 1 ♂ I, 2 ♂♂ II, 1♀, Sept. 16, '12).

SUMMARY OF DISTRIBUTION.

This species is known from the drainages of the upper Kanawha (New) River, from the upper James (west of the Blue Ridge) and from the headwaters of the Shenandoah (Potomac drainage). In all three systems it is found within the Allegheny Mountains, but in New River it descends westward to the Allegheny plateau, and seems to be abundant in Greenbrier River.[31]

Ecology. *C. longulus longulus*, in distinction to other forms belonging to the *bartoni*-section, seems to be more of a river-species. Greenbrier, Jackson, and North Rivers are of good size, and the species is found, not in isolated specimens, but abundantly, living in the usual way under stones in strongly flowing water. However, it also ascends into the headwaters, but has never been found in very small streams or springs. A male of the I form was collected on Sept. 16.

TAXONOMIC REMARKS.

C. longulus has in common with *C. montanus* the elongated, tapering, rostrum with gently constricted margins, forming a rather long acumen. Also the areola is similar in so far as it has rather crowded,

[30]Given as "James River," but this is Jackson River.

[31]This part of the Allegheny Plateau resembles very much the mountains in its physical characters, the rivers being deeply cut into the highlands, and being very rough.

numerous, dots standing in six to nine rows on the narrowest part. Thus the areola is rather wide, but, in distinction to *montanus*, it is somewhat longer, its length being from 34.1 to 38.5 per cent of the length of the carapace (specimens with less than 36 per cent are rare).

A character peculiar to *longulus* is found in the margins of the rostrum. They are somewhat swollen (more or less so) so that the upper surface appears more concave than in the *montanus*-forms. Further, the shape and sculpture of the chelæ are characteristic, but only larger individuals show these peculiarities distinctly, the younger ones have them only slightly indicated. The most prominent feature is found in the gaping fingers. These are widely separated at the bases (thus making the palm rather broad), and meet only near the tips. Very often this produces a blunt angle on the outer margin of the immoveable finger so that the outline of the whole hand is somewhat elongate-rhombic. The hand and fingers are very little sculptured. The usual dots are present, but distant, shallow, and poorly developed, On the fingers they stand in irregular and indistinct rows, and do not form longitudinal furrows and ridges. Therefore, the fingers, being very little thicker at the bases, appear subcylindrical. The tubercles are very poorly developed, and form, on the inner margin of the palm, an indistinct row of weak serrations. In addition, the immoveable finger is very often densely bearded at the base of its inner margin. This character, however, is variable (it may change with age).

A lateral spine on the carapace is missing. I have never seen it in typical *longulus*. The extraorbital angle is always poorly developed, rounded or blunt. This is the only character in which it differs from the var. *longirostris*. Although this might seem to be insignificant, it justifies the distinction of the two varieties since they are also geographically separate.[32]

The fingers of the chelæ are of very variable length. In my specimens from the James drainage (nine specimens), they are comparatively short, hardly longer than the palm, even in the old males. In specimens from the New River drainage they are somewhat longer, chiefly in large males where the moveable finger may be over twice as long as the inner margin of the palm.

C. longulus appears to be a rather good species. That is to say, it is not connected by intergrades with related forms. The peculiar

[32]But there is some sort of transition: a blunt, rectangular angle is found in some specimens of the var. *longirostris* from Clinch River; see below.

shape and smoothness of the chelæ, the elongated rostrum with swollen margins, and the long, but broad, areola, are quite constant. Young individuals are not always easily recognized on account of the indifferent shape of the hand. It is a general rule in this genus, however, that young specimens do not have the specific characters well developed.

Cambarus (Cambarus) longulus longirostris (Faxon) (1885).

C. bartoni longirostris FAXON, '85a, p. 64;—FAXON, '85b, p. 358;—FAXON, '90, p. 623;[33]—FAXON, '98, p. 649;—HARRIS, '03, p. 75;—ORTMANN, '05b, p. 135; —FAXON, '14, pp. 389, 424.

C. longulus longirostris HAY, '99, pp. 959, 966.

Type-locality: "Eastern Tennessee and West Virginia" (Faxon, '85a). "Near the boundary between North Carolina and eastern Tennessee" (Faxon, '14). The first *exact* locality given by Faxon ('85b) is: Doe River, Carter Co., Tennessee, and, less exact ('85a): Cumberland Gap, Claiborne Co., Tennessee. But the latter specimens are not normal (they possess a lateral spine). Since I found the typical *longirostris* in Doe River, Elizabethton, Carter Co., Tennessee, practically the same place as that given by Faxon ('85b) we are justified in considering this the type-locality.

KNOWN LOCALITIES.

Powell drainage.

Cumberland Gap, Claiborne Co., Tennessee. (Faxon) (probably in Indian Creek).

Clinch drainage.

"Clinch River, West Virginia." (Faxon, '98) (this is nonsense, for the Clinch is not in West Virginia).

Clinch River, Cedar Bluff, Tazewell Co., Virginia. (2 ♂♂ I, Sept. 20, '12 and May 11, '13).

Clinch River, Richland, Tazewell Co., Virginia. (2 ♂♂ I, 3 ♀♀, Sept. 20, '12).

Clinch River, Raven, Tazewell Co., Virginia. (1 ♂ I, Sept. 21, '12). Tazewell, Claiborne Co., Tennessee. (Faxon, '98).[34]

Williams Creek, Liberty Hill, Grainger Co., Tennessee. (1 ♂ I, 1♀, Sept. 15, '15).

Cove Creek, Caryville, Campbell Co., Tennessee. (1 ♂ II, Sept. 12, '15).

Clinch River, Solway, Knox Co., Tennessee. (1♀, Sept. 12, '14).

[33]Listed twice in this article by mistake, "spinirostris."

[34]Given as *longulus*, but surely belongs here. Probably from a tributary (Balls Creek ?) of the Clinch.

Holston drainage.

Little Mocassin Creek, Gate City, Scott Co., Virginia. (1 ♂ II, May 16, '13).

Big Mocassin Creek, Mocassin Gap, Scott Co., Virginia. (2 ♂♂ II, 1♀, Sept. 9, '15).

Middle Fork Holston River, Marion, Smyth Co., Virginia. (2 ♂♂ I, 2 ♂♂ II, 1♀, Sept. 16, '12).

South Fork Holston River, Marion, Smyth Co., Virginia. (Faxon, '90).[35]

Beaver Creek, Bristol, Washington Co., Virginia. (1 ♂ II, 1♀, July 6, '13).

Muddy Creek, Blountville, Sullivan Co., Tennessee. (Faxon, '98).

Watauga River, Watauga, Carter Co., Tennessee. (1♀, July 14, '13).

Watauga River, Elizabethton, Carter Co., Tennessee. (Faxon, '90)[36] (C. M., 1♀, July 11, '13).

Doe River, Elizabethton, Carter Co., Tennessee. (Faxon, '85b. Type-locality) (C. M., 1 ♂ II, July 11, '13. Topotype) (to Watauga River).

Holston River, Noeton, Grainger Co., Tennessee. (1 ♂ II, 1♀, May 22, '14).

Holston River, Hodges, Jefferson Co., Tennessee. (1♀, May 25, '14).

Holston River, Mascot, Knox Co., Tennessee. (1 ♂ II, 1♀, Sept. 6, '13).

Holston River, McMillan, Knox Co., Tennessee. (1 ♂ II, Sept. 16, '14).

Big Flat Creek, Corryton, Knox Co., Tennessee. (2 ♂♂ II, May 12, '14).

Knoxville, Knox Co., Tennessee. (Faxon, '98).[37]

French Broad drainage.

Greeneville, Greene Co., Tennessee. (Faxon, '98).[38]

French Broad River, Bridgeport, Cocke Co., Tennessee. (1 ♂ II, Sept. 3, '14).

Spring Creek, Hot Springs, Madison Co., North Carolina. (Faxon, '90).[39]

[35]Originally given as *longulus*, but in '14 Faxon suggests that these specimens belong here.

[36]Originally given as *longulus*; but placed later by Faxon ('14) with *longirostris*.

[37]Given as *longulus*, but surely belonging here. Locality somewhat indefinite.

[38]This also given as *longulus*. Locality not very exact, but possibly from Roaring Fork, tributary to Lick Creek and Nolichucky River.

[39]Originally given as *longulus*, but placed later ('14) with *longirostris*.

Most southern locality.[40]

South Chickamauga Creek, Ringgold, Catoosa Co., Georgia. (1 ♂ I, 1 ♂ II, 1♀, May 20, '15) (to Tennessee River).

SUMMARY OF DISTRIBUTION.

C. longulus longirostris represents the typical *longulus* in the upper Tennessee drainage of Virginia, eastern Tennessee, North Carolina and northern Georgia. Specimens from the upper Clinch approach more closely the real *longulus* than specimens from other parts of the range (see below). This, possibly, is significant. The typical *longulus* has been reported repeatedly from this region. In part of the instances these specimens actually belong to *longirostris*. In the remaining localities (Tazewell, Greeneville, Knoxville), this is very likely true also, since in the whole region I never found a true *longulus*, but always the form *longirostris*.

In the Clinch, Holston, and French Broad drainages, the three main tributaries of the Tennessee, and in many of their affluents, this form seems to be common. It has not been found in the Tennessee River below Knoxville and the mouth of the Clinch, nor in its eastern tributaries (Little River, Little Tennessee, and Hiawassee Rivers). It may have been overlooked here, for it occurs again in Georgia, in a tributary (S. Chickamauga), that falls into the Tennessee at Chattanooga. This is the most southern locality known, and the one that is farthest downstream in the Tennessee drainage. The locality in Escambia Co., southern Alabama, is in the Escambia River drainage, not far from the Gulf, and is so widely remote from the rest of the range, and in so different a physiographical region, that I emphatically doubt its correctness.

Ecology. This form of the upper Tennessee River also prefers somewhat larger rivers. Its distribution is quite characteristic for a true river-form, being restricted to *one* drainage system, which forms a unit at the present time. Yet *C. longulus longirostris* also ascends into smaller streams, but again, it never is a form of small runs or springs. It is found, as usual, under stones, in flowing water.

I frequently found males of the I form. The dates are: May 11, May 20, and Sept. 15, 16, 20, and 21. (See above lists).

[40]The locality, Wills Creek, Pollard, Escambia Co., Alabama (Faxon, '98), is extremely doubtful (*see*: Ortmann, '05b, p. 135).

TAXONOMIC REMARKS.

The characters and affinities of this form hitherto have been rather obscure. Faxon has correctly recognized its relation to *longulus*. The close similarity to it, chiefly with regard to the chelæ, has not been properly brought out, since fully developed males had not been observed. According to my material, which contains nine males of the I form, *longirostris* is almost identical with *longulus*, with the exception, that the external orbital angle is more prominent, sharply angular, or even spiniform. Only in specimens from the uppermost Clinch (Cedar Bluff, Richland, Raven) this is not so evident. In the eight specimens, which I have from these parts, this angle is distinct, but not very sharp; it is rectangular or even blunt. Therefore, there is apparently some transition between *longulus* and *longirostris*, and for this reason the two should be regarded as varieties of the same species.

For the rest, little need to be said. The rostrum in both forms has the same shape, but as a rule, the margins are less swollen in *longirostris*. The hand has the same general shape, the fingers are gaping, and of moderate length. The base of the outer finger may be bearded in *longirostris*, or it may be naked. There is great variability in his character, and the absence of a beard may be due to abrasion of the hairs.

Faxon ('85a) mentions the presence of lateral spines on the carapace of three specimens from Cumberland Gap. I have a single large female from Hodges (Holston River), which has a small, sharp, lateral spine on each side. In all others, this spine is absent.

Cambarus (Cambarus) latimanus (LeConte) (1855).

Astacus latimanus LECONTE, '55, p. 402.

Cambarus latimanus HAGEN, '70, p. 83, Pl. 1, figs. 43-46, Pl. 3, fig. 162;—FAXON, '85a, p. 69, Pl. 2, fig. 3;—FAXON, '85b, p. 359;—UNDERWOOD, '86, p. 370; FAXON, '98, p. 650;—HAY, '00, pp. 959, 965;—HARRIS, '03, p. 106;—FAXON, '14, pp. 395, 425.

C. (*Bartonius*) *latimanus* ORTMANN, '05b, pp. 120, 135.

Type-locality: Athens, Clarke Co., Georgia. (see: Faxon, '14).

KNOWN LOCALITIES.[41]

"Brook with muddy bottom," Raleigh, Wake Co., North Carolina. (Brimley Brothers, 4♀♀, Nov. 13, '03).

[41]Ocean Springs, Jackson Co., Mississippi (Faxon) is doubtful, the identification being unreliable; moreover, the locality does not fit into the known range.

Columbia, Richland Co., South Carolina. (Faxon).
Greenville, Greenville Co., South Carolina. (Faxon).
Athens, Clarke Co., Georgia. (LeConte, Faxon, type-locality).
Milledgeville, Baldwin Co., Georgia. (Hagen).
Roswell, Cobb Co., Georgia. (Faxon).
Auburn, Lee Co., Alabama. (Faxon).
Attala, Etowah Co., Alabama. (Faxon).

Summary of Distribution.

The main range of this species does not strictly belong to our region. It is on the Piedmont Plateau, east of the Allegheny Mountains, from North Carolina to Georgia and northeastern Alabama. In the latter state, only, does it approach and enter the southern extremity of the Appalachians. It has been introduced here for comparison with the form which has been called *C. latimanus striatus* Hay. This, however, actually belongs to *C. bartoni* (*See* below), and is found on the Cumberland Plateau.

Taxonomic Remarks.

I possess only four females from the northernmost locality (North Carolina). These, however, are typical in every respect, and agree very well with the description of the species. The chief characters are: the short, but rather narrow, areola, with only two to three rows of dots; the presence of small lateral spines on the carapace; the rather rough carapace and chelæ. The carapace is covered everywhere, except in the middle of the upper side, with numerous sharp granules. The chelæ have several rows of tubercles on and near the inner margin of the palm. The margin of the dactylopodite is also strongly tuberculated, and the hand and both fingers are strongly pitted. The pits (or dots) on the fingers forming deep, longitudinal furrows, with sharp ridges between them.

In my largest specimen (60 mm.), the length of the areola is 32 per cent of the length of the carapace, *i. e.*, shorter than in *bartoni*. The width, however, is about the same, with not more than three dots in the narrowest part. The rostrum is of the *bartoni*-type, rather broad and short, with short acumen. The roughness of the carapace and chelæ is remarkable, even in my specimens, which are females. This character will probably be still more pronounced in old males. It is, aside from the areola, the chief distinguishing character from *bartoni* and its subspecies and forms. In the geographical distribution also, *latimanus* is distinct from the *bartoni*-forms.

Cambarus (Cambarus) bartoni (Fabricius) (1798).

GENERAL REMARKS.

This species is widely distributed over the Appalachian region, the Piedmont Plateau, the Allegheny-Cumberland Plateau, and extends its range far northward and northeastward. It is extremely variable, individually and regionally, and a number of varieties have been distinguished. These are preëminently found in the southern portion of its range. We are to regard the one found in eastern Pennsylvania as the typical form, however, this also has a range nearly co-extensive with that of the species in the wider sense.

The latter is characterized by a moderately long and moderately narrow areola, with irregular, not crowded, dots, standing in about three to five rows in its narrowest part; yet there are varieties with a somewhat narrower areola and with a smaller number of dots. The rostrum may be (in var. *robustus*) rather long and gently contracted into a rather long acumen, but in most cases it is short and broad, suddenly contracted, with short acumen. The chelæ are not very rough, and have tubercles only on the inner margin of the palm, rarely in two rows, mostly only in one. Often these tubercles are represented by a row of mere serrations. The carapace is rather smooth, but often somewhat granulated on the sides. The lateral spines are mostly absent, although they may be present in some cases.

All forms of *C. bartoni* prefer small creeks and runs, and they are often found in cool springs, burrowing under stones, or making holes very much like those made by the species of the *diogenes*-section. This holds good chiefly for the typical form, which is distinctly a spring-form, or a form of very small, often intermittent, runs. Other forms are in streams of somewhat larger size, but they all avoid rivers of a larger size.

Cambarus (Cambarus) bartoni robustus (Girard) (1852).

(Partial bibliography).

C. robustus GIRARD, '52, p. 90;—HAGEN, '70, p. 80, Pl. 3, fig. 167.
C. bartoni robustus FAXON, '85a, p. 61;—FAXON, '14, pp. 387, 423, Pl. 3.
C. (*Bartonius*) *bartoni robustus* ORTMANN, '06, p. 388, Pl. B, fig. 2, Pl. 39, fig. 2, Pl. 40, fig. 3.

Type-locality: Humber River, Toronto, Canada (Girard).

An *extralimital* form, introduced here only for comparison with the others, and because it has been erroneously reported from our region.

It is distinguished from all other *bartoni*-forms by the more elongated rostrum, with longer acumen; by the two rows of tubercles on the inner margin of the palm; the distinct depressions of the upper and lower side of the hand at the base of the immoveable finger; and the frequent presence of lateral spines on the carapace. The areola is of the *bartoni*-type, moderately long, with remote dots, numbering four to six in its narrowest part.

This is distinctly a *northern* form, being most abundant in the basin of the Great Lakes. It has been repeatedly reported from the middle, and even the southern Appalachian region. It is now evident, however, that it is not the true *robustus* that is found here, but forms belonging to the *montanus*-group. Faxon ('14) gives the following localities: West Fork Greenbrier River, Durbin, Pocahontas Co., West Virginia; Crane Creek, Mercer Co., West Virginia; Fredericksburg, Spotsylvania Co., Virginia; and Raleigh, Wake Co., North Carolina.

As has been shown above, the latter two localities should be referred to *C. montanus acuminatus*, and the two former to *C. montanus veteranus*, hence no positive records for *robustus* are left from our area.

Cambarus (Cambarus) bartoni cavatus Hay (1902).

C. bartoni cavatus HAY, '02b, p. 435;—FAXON, '14, p. 425.

Type-locality: Powell River, Tazewell, Claiborne Co., Tennessee. (Hay).[42]

Other known localities in the Tennessee drainage.

Indian Creek, Cumberland Gap, Claiborne Co., Tennessee. (Hay) (to Powell River).
Ball Creek, Tazewell, Claiborne Co., Tennessee. (Hay) (to Clinch River).
Tennessee River, Knoxville, Knox Co., Tennessee. (Hay).
Tennessee River, Chattanooga, Hamilton Co., Tennessee. (Hay).
John Ross Spring, Rossville, Walker Co., Georgia. (Hay) (to Chattanooga Creek and Tennessee).

Upper Caney Fork drainage (Cumberland System).

Calfkiller River, Amanda, White Co., Tennessee. (2 ♂♂ II, 1♀, Aug. 29, '22).

[42]Tazewell is some distance from Powell River, the locality very likely is in the vicinity of Combs.

Town Creek, Sparta, White Co., Tennessee. (8 ♂♂ II, 4♀♀, Aug. 27, '22) (to Calfkiller).

Barren Fork, McMinnville, Warren Co., Tennessee. (3 ♂♂ II, 4♀♀, Aug. 31, '22).

Duck drainage.

Little Duck River, Manchester, Coffee Co., Tennessee. (1 ♂ II, 2♀♀, Aug. 21, '23).

Thompson Creek, Raus, Bedford Co., Tennessee. (1 ♂ II, Aug. 20, '23).

SUMMARY OF DISTRIBUTION.

Hay described this form from localities all situated in the upper Tennessee drainage; in the Tennessee River proper, small tributaries of it near Chattanooga, and from the Clinch and Powell drainages in the vicinity of Cumberland Gap. That is to say, this form is found on the eastern side of Cumberland Mountain and Walden Ridge. I did not find it in this region, although I collected typical *bartoni* here (in peculiar forms), and members of the *montanus*- and *longulus*-association. But then I found *cavatus*, or a form standing very close to it, on the west side of Walden Ridge, in the drainage of upper Caney Fork (above the falls), and in close vicinity, in the headwaters of Duck River. These latter localities all belong to the "Highland Rim," surrounding the Central Basin of Tennessee.

Ecology. In distinction from typical *bartoni* and other forms belonging here, *C. bartoni cavatus* is not a form of springs and very small runs, but belongs to creeks of a fair size, or small rivers: it even has been reported from the Tennessee River proper at Knoxville and Chattanooga. This ecological preference was most evident at Sparta and Amanda, where it exists in Town Creek and Calfkiller River. In springs coming out near the banks of the Calfkiller River, there was another form, which, although showing certain peculiarities, should be united with *C. bartoni bartoni*. *C. bartoni cavatus* lives under stones, as usual, and sometimes it constructs burrows of small dimensions on the banks.

TAXONOMIC REMARKS.

This form has not been described in detail: Hay only gives the characters by which he believed it to be distinguished from the normal *bartoni*, namely, the "broad, parallel sided, deeply excavated rostrum," "the appearance of the deep excavation being partially given by the unusually high elevation of the margins of the rostrum."

In addition, it is said that the areola is narrower and more thickly punctate than in *C. bartoni bartoni*; that the epistoma is "triangular"; that the antennæ extend almost to the end of the abdomen; and that the carapace is more nearly cylindrical.

We cannot rely much on the latter characters. In my specimens, the areola, indeed, is rather narrow, but the dots are not more crowded. The rostrum is peculiar, and agrees quite well with the description given by Hay. Yet there is some variation in the margins as regards their convergence; they may be nearly parallel, or they may converge more or less. The excavation of the upper surface, produced by the elevation of the margins, is quite striking, and I notice in my specimens from the Caney Fork drainage, that the strong development of the margins generally causes, at the anterior end of them (base of acumen), a sharp angle (in typical *bartoni*, this angle is rounded), which may even appear as a small spine. It is never provided, however, with a horny tip, and is never upturned (as it is, more or less, in *C. extraneus*). This latter feature of the margins is not so evident in specimens from the Duck River drainage.

This peculiarity of the rostrum induces me to place my specimens with the var. *cavatus* of Hay, although I am not fully convinced that they actually are the identical form, having been found in another, yet not very distant, region. That my specimens are not absolutely the same form as *cavatus*, is further indicated by certain characters not especially mentioned by Hay.

As has been said, the areola is somewhat elongated (34–37.7 per cent of the carapace), and comparatively narrow (with two to four dots, rarely with five). The lateral spines of the carapace may be absent or present, small, or well developed. The chelæ have on the inner margin of the palm, very generally, a more or less distinct second row of tubercles, visible chiefly in large specimens, but obscure in younger ones. The fingers of the chelæ are not gaping, and are usually somewhat bearded on the base of the outer finger; yet the beard may be absent (so in my largest female from Sparta). The extraorbital angle may be simply angular, but in the most cases it has a small and sharp spine.

All of these characters constitute minor deviations from the typical conditions seen in *C. bartoni bartoni*, and are variable.

My largest male (II) (Manchester) measures: 69 mm., my largest female (Sparta) 97 mm.

Cambarus (Cambarus) bartoni bartoni (Fabricius) (1798).
(Partial Bibliography).

Astacus bartoni FABRICIUS, 1798, p. 407.

Cambarus bartoni GIRARD, '52, p. 88;—HAGEN, '70, p. 75, Pl. 1, figs. 47-50, Pl. 2, figs. 135-139, Pl. 3, fig. 166;—FAXON, '85a, p. 59;—HARRIS, '03, p. 72;—ORTMANN, '13, pp. 335, 337 (*pro parte*);—FAXON, '14, pp. 383, 423.

C. (*Bartonius*) *bartoni* ORTMANN, '05b, pp. 120, 134;—ORTMANN, '06, p. 377, Pl. B, fig. 1, Pl. 39, figs. 1a-1f, fig. 8, Pl. 40, fig. 2.

Type-locality: North America (Fabricius). *First exact locality:* Philadelphia, Pennsylvania. (Harlan, '30).

LOCALITIES IN THE APPALACHIANS AND VICINITY, SOUTH OF THE POTOMAC, CHEAT, AND LITTLE KANAWHA RIVERS.
EASTERN WATERSHED.

Potomac drainage.

Broad Run, Fauquier Co., Virginia. (Faxon) (to Occoquam and Potomac Rivers).

Alexandria Co., Virginia. (Faxon).

Gap Run (near Rectortown), Fauquier Co., Virginia. (Faxon) (to Goose Creek and Potomac River).

Clarke Co., Virginia. (Faxon) (lower Shenandoah River).

Waynesboro, Augusta Co., Virginia. (Faxon) (upper Shenandoah).

Orkney Springs, Shenandoah Co., Virginia. (Faxon) (upper Shenandoah).

Small run, Cherry Run, Morgan Co., West Virginia. (1 ♂ I, 3♀♀, Sept. 23, '04) (to Potomac).

West Branch Potomac River, Circleville, Pendleton Co., West Virginia. (Faxon).

Patterson Creek, Mineral Co., West Virginia. (Faxon) (to North Branch Potomac).

Patterson Creek, Williamsport, Grant Co., West Virginia. (Faxon).

North Branch Potomac River, South Cumberland, Allegany Co., Maryland. (2 ♂♂ II, 1♀, May 9, '05).

Small Run, Rawlings, Allegany Co., Maryland. (3 ♂♂ I, 3 ♂♂ II, 4♀♀, May 9, '05) (to North Branch Potomac).

Small run and springs, Stoyer, Garrett Co., Maryland. (1 ♂ I, 2 ♂♂ II, Aug. 1, '05) (to North Branch Potomac).

Rappahannock drainage.

Stafford Co., Virginia. (Faxon) (Rappahannock or Potomac drainage?).

Stony Man Mountain, Madison Co., Virginia. (Faxon) (drainage of Hazel River, to Rappahannock).

James drainage.

Small run, Charlottesville, Albemarle Co., Virginia. (1♂ I, 1♂ II, 2♀♀, June 6, '12) (to Rivanna and James Rivers).
Spring, Lynchburg, Campbell Co., Virginia. (4♀♀, Sept. 1, '25) (to Fishing Creek and James River).
Bath Co., Virginia. (Faxon) (headwaters of Jackson River).

Chowan drainage.

Franklin, Southampton Co., Virginia. (Faxon).
Lunenburg, Lunenburg Co., Virginia. (Faxon).

Roanoke drainage.

Peaks of Otter, Bedford Co., Virginia. (Faxon) (Otter River).

Neuse drainage.

Kinston, Lenoir Co., North Carolina. (Faxon).

Catawba drainage.

Newman's Fork, Blue Ridge, McDowell Co., North Carolina. (Faxon).

INTERIOR WATERSHED.

Headwaters of Monongahela.

Blackwater River, Davis, Tucker Co., West Virginia. (3050′ elevation) (6♂♂ II, 6♀♀, Aug. 2, '05) (Cheat drainage).
Small run, Hampton, Upshur Co., West Virginia. (1♀, May 12, '11) (to Buckhannon River).
Turbin's Run, seven miles above Buckhannon, Upshur Co., West Virginia. (Faxon) (to Buckhannon River).

Kanawha drainage.

Gauley River, Gauley Bridge, Fayette Co., West Virginia. (1♂ II, 1♀, May 8, '13).
New River, Hinton, Summers Co., West Virginia. (1♂ I, Sept. 12, '12).
Rich Creek, Spanishburg, Mercer Co., West Virginia. (Faxon) (to Bluestone and New Rivers).
Pulaski, Pulaski Co., Virginia. (Faxon) (to New River).
Reed Creek, Wytheville, Wythe Co., Virginia. (Faxon) (C. M., 2♀♀, Sept. 16, '12) (to New River).
Blowing Rock, Watauga Co., North Carolina. (J. P. Moore, 1♂ I, 2♀♀, June, '93) (headwaters of New River).

In Northeastern Kentucky.[43]

"Smoky Creek," Carter Co., Kentucky. (Faxon).[44]
Little Hickman, Jessamine Co., Kentucky. (Faxon) (Kentucky River drainage).

Cumberland drainage.

Albany, Clinton Co., Kentucky. (Faxon) (to Cumberland River).
Small streams, Livingston, Rockcastle Co., Kentucky. (E. B. Williamson, 3 ♂♂ II, 1♀, June 21, '04) (to Rockcastle River).
Cumberland River, Orby, Bell Co., Kentucky. (2 ♂♂ I, 3♀♀, Sept. 10, '13).
Cumberland Gap, Bell Co., Kentucky. (Faxon).
Springs, Sparta, White Co., Tennessee. (1 ♂ II, 6♀♀, Aug. 26, '22) (banks of Calfkiller, to Caney Fork River).
Small run, Riverhill, White Co., Tennessee. (1 ♂ II, 2♀♀, Aug. 30, '22) (to Caney Fork River).
Hay's Branch, Burnside, Pulaski Co., Kentucky. (3 ♂♂ II, 1♀, Aug. 13, '23) (to South Fork Cumberland River).
New River, New River, Scott Co., Tennessee. (4 ♂♂ II,, 2♀♀, Aug. 30, '24) (to South Fork Cumberland River).

Tennessee drainage.

Springs on bluff over Tennessee River, South Florence, Colbert Co., Alabama. (1♀, Aug. 26, '24).
Spring Creek, above Estill Springs, Franklin Co., Tennessee. (3♀♀, Aug. 19, '23).
Seven miles northwest of Chattanooga, Hamilton Co., Tennessee. (Faxon) (probably streams of Walden Ridge, to Tennessee River).
Spring, Charleston, Bradley Co., Tennessee. (1♀, Aug. 30, '14) (to Hiawassee River).
Spring, Athens, McMinn Co., Tennessee. (2♀♀, May 21, '15) (to Eastanaula Creek and Hiawassee River).
Small run, Murphy, Cherokee Co., North Carolina. (1 ♂ II, 1♀, Aug. 22, '22) (to Hiawassee River).
Small run, Wartburg, Morgan Co., Tennessee. (2 ♂♂ II, 3♀♀, Aug. 16, '23) (to Emory and Clinch Rivers).
Big spring, Dossett, Anderson Co., Tennessee. (2♀♀, Sept. 2, '14) (to Brush Fork Poplar Creek and Clinch River).
Powell River, Dryden, Lee Co., Virginia. (1 ♂ II, Sept. 7, '13).
South Fork Powell River, Big Stone Gap, Wise Co., Virginia. (2 ♂♂ I, 1 ♂ II, 2♀♀, May 15, '13).

[43]The following localities are somewhat doubtful, and may not refer to typical *bartoni*.

[44]Possibly = Smoky Valley in Tygart Creek drainage. See above under *C. propinquus sanborni*.

Williams Creek, Liberty Hill, Grainger Co., Tennessee. (1 ♂ II, 1♀, Sept. 15, '15) (to Clinch River).

Dutch Valley Creek, Oakman, Grainger Co., Tennessee. (1♀, Sept. 14, '15) (to Clinch River).

Clinch River, Fink, Russell Co., Virginia. (1 ♂ II, May 12, '13).

Small run, Raven, Tazewell Co., Virginia. (1 ♂ II, 2♀♀, Sept. 21, '12) (to Clinch River).

Fourmile Creek, Vonore, Monroe Co., Tennessee. (4 ♂♂ II, Aug. 29, '14) (to Tellico and Little Tennessee Rivers).

Laurel Creek, Tellico Plains, Monroe Co., Tennessee. (2 ♂♂ II, May 22, '15) (to Tellico River).

Pistol Creek, Rockford, Blount Co., Tennessee. (1 ♂ II, Sept. 4, '14) (to Little River).

Little River, Cades Cove, Blount Co., Tennessee. (Faxon).

Spring, Fountain City, Knox Co., Tennessee. (1 ♂ II, 3♀♀, and juv. Aug. 28, '14) (to Tennessee River).

Spring, Bridgeport, Cocke Co., Tennessee. (1 ♂ II, 1♀, Sept. 3, '14) (to French Broad River).

Waynesville, Haywood Co., North Carolina. (Faxon) (drainage of Big Pigeon River, to French Broad River).

Black Mountain, Buncombe Co., North Carolina. (Faxon) (to Swananoa and French Broad Rivers).

Montreat, Buncombe Co., North Carolina. (Faxon) (Flat Creek, to Swananoa River).

Looking Glass Creek, Transylvania Co., North Carolina. (Faxon) (to French Broad River).

Stoney Creek, Mohawk, Greene Co., Tennessee. (1 ♂ II, 7♀♀, May 18, '14) (to Lick Creek, Nolichucky, and French Broad Rivers).

Small run, Chuckey, Greene Co., Tennessee. (1 ♂ II, May 19, '14) (to Nolichucky River).

Nolichucky River, Erwin, Unicoi Co., Tennessee. (1♀, May 17, '14).

Roan Mountain, Mitchell Co., North Carolina. (Faxon) (drainage of Toe River to Nolichucky River).

Small run, Hilton, Scott Co., Virginia. (1♀, July 7, '13) (to North Fork Holston River).

Summary of Distribution and Ecology.

C. bartoni bartoni is distributed all along the Allegheny Mountains, from eastern Tennessee to Pennsylvania, and far beyond. It also extends to the Cumberland and Allegheny Plateau, but very little toward the Piedmont Plateau in the southern section of its range. Farther north, *i. e.*, from middle Virginia northward, it encroaches upon the latter. In Pennsylvania, for instance, it is everywhere. In the west, it is found chiefly in the eastern part of the Cumberland

Plateau, near the mountains, and farther north it extends widely over the Allegheny Plateau in Pennsylvania and eastern Ohio.

This means, that it is found in a number of different drainage systems, with a great tendency to become locally isolated. In consequence of this, it varies a good deal, and aberrant forms are frequently found, chiefly in its southern range.

This great variability and wide distribution is closely connected with its ecological preferences. This species is very rare in rivers of good size, but when found in them, is often at places where there are springs. It prefers creeks, small runs, and is most abundant in the uppermost headwaters of streams and in springs. It lives under stones, excavating holes, and often becomes more or less a burrowing form. In this case its holes open upon dry ground, but go down to the groundwater. These habits have favored the crossing over of divides by this form (actively or passively, see: Ortmann, '06, p. 448), and account for the fact, that the distribution is rather independent of the drainage lines.

Apparently, the original home of the typical *bartoni* is in the southern part of its present range, and here it still presents the greatest variability (see below). The typical form is always the one that lives in springs and small runs. In larger streams it is generally represented by aberrant types. Often these aberrant types appear as more primitive (for instance, the form of the upper Caney-Fork region, and those of the Great Valley in east Tennessee), possessing certain similarities to the *montanus*-group. Going northward, *bartoni* becomes more sharply defined. In the larger rivers (New and James Rivers), it is represented by *C. longulus*, which we consider a different species. It sticks rather closely to these drainage systems, and does not extend farther north, probably on account of its ecological habits. The typical *bartoni*, however, having a better opportunity to cross over divides because of its habitudinal preferences, migrated extensively northward. It was the form that was able to advance beyond the Potomac River, and acquire that general distribution in Pennsylvania (and beyond), without showing the excessive variability seen in the south. Only one striking form has been differentiated in the north (Lake Basin, chiefly), *C. bartoni robustus*. Possibly the latter is not a descendant of the typical *bartoni*, but represents rather a separate wave of migration, starting from more primitive forms that approached the older *montanus*-stock.

TAXONOMIC REMARKS.

What we have to regard as the typical form of *bartoni*, are the crawfishes of this group found in eastern Pennsylvania, but this form, without appreciable change, has a much more extended range. It is characterized by the short and broad rostrum, with suddenly contracted margins, not forming sharp angles, and not being distinctly elevated, thus producing a rather flat upper surface. The acumen is comparatively short. The areola is moderately long (34-38 per cent of the carapace), and moderately wide (somewhat variable), with three or four, rarely more or less, distant and irregular dots in its narrowest part. The palm has only one row of tubercles on the inner margin (rarely traces of a second row). Generally these tubercles are weak, represented by mere serrations. The hand is covered by dots, which arrange themselves on the fingers in lines, forming furrows and ridges. The fingers are moderately long, sometimes somewhat gaping in large specimens, and are not subcylindrical. In the most cases they are not bearded, but traces of a beard may be present. The lateral spines of the carapace are typically absent, but in rare cases they may exist. The extraorbital angle is very variable, but usually present, and sometimes provided with a small spine.

Specimens representing the typical phase go very far south in the Allegheny Mountains. The southernmost localities, from which I possess such, are Athens, Tennessee, and Murphy, North Carolina; and in the southwestern direction, South Florence, Alabama. It is worth noticing, that all these came from springs or very small runs. *Individual* and *regional* variations are found corresponding to the great range, and the varying ecological conditions offered. Some of them have received names, which I am going to use (see below). But besides these, there are others, which, when regionally restricted, might also deserve names. I have refrained from naming them, because I do not want to add to the confusion already existing.

Additional cases of *individual* variation occurring among my material may be mentioned as follows:

a. Specimens with the rostrum more narrowed, longer, and with longer acumen, but in all other characters like true *bartoni*. Two males (II) belong here, one from the Clinch River at Fink, the other from Pistol Creek, at Rockford. Three specimens (out of five) from Wartburg also have this character (see below under two).

b. A male (I) from New River at Hinton, is a typical *bartoni*, but has the margins of the rostrum somewhat thickened, and the fingers

of the chelæ widely gaping and somewhat subcylindrical. These are characters of *longulus*, and I am inclined to think, in this case, of *hybridisation* with *longulus*, which is found in the same region. This, of course, is only conjectural.

The following forms are rather *regionally restricted.*

1. Three specimens (1 ♂ I, 2♀♀, from Blowing Rock, North Carolina) are typical *bartoni*, but have the tubercles on the inner margin of the palm more distinctly and strongly developed, thus they indicate an approach to the var. *asperimanus* (which see). In fact, they are transitional toward it, and are found near the home of *asperimanus*.

2. Specimens from three localities in the upper Cumberland drainage, the set from Livingston, Kentucky, from Orby, Kentucky, and from New River, Tennessee, and from one locality in the Emory drainage at Wartburg, Tennessee (3♀♀), resemble each other. The first set has been mentioned previously (Ortmann, in: Williamson, '05 p. 310). Here the rostrum is somewhat narrower and more tapering (but less so in the males from Wartburg), and the row of tubercles on the inner margin of the palm is quite distinct and sharp, with traces of a second row next to it. The rest, chiefly in the long areola, with three or four rows of irregular dots, are *bartoni*.

3. In the Great Valley in eastern Tennessee a form is frequently found which resembles *bartoni* in all respects, except that a trace of a second row of tubercles is seen on the inner margin of the palm. I have this form from Dossett, Charleston, Vonore, Tellico Plains, Mohawk, and Chucky. In every case, all specimens found at these localities were alike in this respect. The two males from Wartburg (mentioned above) would also belong here, while the three females fall under No. 2, so that this set again shows the variability of these characters.

4. In the headwaters region of Caney Fork, White Co., Tennessee, I have found two sets in springs and in a very small run (seven specimens at Sparta and three specimens at Riverhill), and one set in the headwaters of Elk River (three specimens at Estill Springs), which resemble, in the tubercles of the palm, the form just mentioned. Frequently (not always), in these a small lateral spine is present on the side of the carapace. In the specimens from Estill Springs this is well developed. It is interesting, that at least in the vicinity of Sparta (in Town Creek and in Calfkiller Creek at Amanda), the form *cavatus* is found which shows the same characters, however, the present specimens do not have the peculiar shape of the rostrum of *cavatus*.

A very similar form is from Burnside, Kentucky, but here the rostrum is a little more elongated. They are not identical with the upper Cumberland form described under 2, but form a sort of transition toward it.

It is very likely that certain localities reported for *C. bartoni* by Faxon (in southern Virginia and North Carolina) on the Piedmont Plateau, and those on the Cumberland Plateau ("Smoky Creek," Little Hickman, and Albany) do not have the typical *bartoni*. This, of course, cannot be decided without examination of the original material. I have not seen any specimens from Kentucky that represent the pure *C. bartoni bartoni*; all of them being more or less aberrant forms. The same holds good for central Tennessee, west of Cumberland Mountain and Walden Ridge. So much more astonishing is the fact, that at the locality which is the farthest in a southwesterly direction, South Florence, Alabama, and widely remote from the other localities, I found a genuine *bartoni*, (♀)! It was practically identical with the form from eastern Pennsylvania. But, this again was in a spring on the limestone bluff overlooking the Tennessee River.

Two local races of *C. bartoni* (*asperimanus* and *carinirostris*) have been distinguished by Faxon, which are recognizable. Since they have been named, they might very well be retained, although they are very restricted in their range, and are found within the area of, and in close vicinity to, *C. bartoni bartoni*.

Cambarus (Cambarus) bartoni asperimanus Faxon (1914).

C. bartoni asperimanus FAXON, '14, pp. 391, 424.

Type-locality: Flat Creek, Montreat, Buncombe Co., North Carolina. (Faxon) (to Swananoa and French Broad Rivers).

ADDITIONAL LOCALITIES.

Swananoa River, Asheville, Buncombe Co., North Carolina. (1 ♂ II, May 13, '14).
Hominy Creek, Asheville, Buncombe Co., North Carolina. (1♀, Sept. 14, '14).
Pigeon River, Canton, Haywood Co., North Carolina. (1 ♂ I, 1♀, May 14, '14).

DISTRIBUTION AND ECOLOGY.

This form is restricted to the headwaters of French Broad River in the High Mountains of North Carolina. It should be remarked, that Hominy Creek, a tributary to the French Broad, undoubtedly has captured certain small tributaries of Pigeon River, and is preparing to capture this river altogether.

I found this form in rivers of moderate size and in a rather small creek, under stones, as usual.

TAXONOMIC REMARKS.

According to Faxon, this form differs from *bartoni* as follows:

1. There are scattered coarse setæ upon the chelæ.
2. The chelæ are deeply and coarsely pitted, with a tendency toward corrugation.
3. The inner margin of the palm is furnished with a cristiform row of from five to seven teeth.
4. The dorsal surface of the carapace is extremely smooth, showing hardly a trace of the customary dots.
5. The epistoma is broadly truncate in front.

Faxon had two specimens (♂♂ I). My male, I, (Canton), has the characters listed under two and three, and, to a degree, that of four (dots poorly developed). But I do not see any setæ upon the chelæ, and the epistoma is triangular anteriorly. We know, that hairiness is a very elusive character, and that the anterior end of the epistoma is rather variable (within certain limits). But in this specimen, a very large and fine male, the character of the tubercles of the inner margin of the palm, and the general coarseness of the dots of the hand, is very striking, and so we have to take these as the main characters of the variety.[45]

The female, found with the above male, is smaller, and has these characters less distinctly developed, and might be taken simply for a normal *bartoni* with somewhat stronger tubercles on the palm. The male (II) from the Swananoa, Asheville, is intermediate in size between the two specimens from Canton, but shows the same characters of the hand as the male from Canton; in the rest of the characters, it is *bartoni*. Finally, the female from Hominy Creek is large, and in every respect like the male from Canton.

As has been said above, I have a male (I) and two females from Blowing Rock (in the headwaters of New River, some distance northeast of Asheville), in which the inner margin of the palm has the tubercles somewhat more strongly developed than is usual in *bartoni*. This indicates a transition toward *asperimanus*. However, I prefer to leave these with *bartoni*; the character being much less distinct here than in the specimens from Asheville and Canton.

[45]Specimens of *bartoni* from the upper Cumberland (Livingston, Orby, New River) approach *asperimanus* somewhat in the strong tubercles of the hand, but they have a more tapering rostrum. The rostrum of *asperimanus* is of the normal *bartoni*-type.

Cambarus (Cambarus) bartoni carinirostris Hay (1914).

C. bartoni carinirostris HAY, in: FAXON, '14, pp. 384, 423.

Type-locality: Gandy Creek, Osceola, Randolph Co., West Virginia. (Faxon) (tributary to Dry Fork of uppermost Cheat River).

ADDITIONAL LOCALITIES.

Albright, Preston Co., West Virginia. (Faxon) (on Cheat River).
Shavers Fork, Parsons, Tucker Co., West Virginia. (1 ♂ II, 2♀♀, Aug. 2, '05) (to Cheat River).
Tygart Valley River, Elkins, Randolph Co., West Virginia. (Faxon).
Tygart Valley River, Beverly, Randolph Co., West Virginia. (Faxon).
Queens, Upshur Co., West Virginia. (Faxon) (on Middle Fork, to Buckhannon River).
West Fork Greenbrier River, Durbin, Pocahontas Co., West Virginia. (Faxon).
Laurel Creek, Greenville, Monroe Co., West Virginia. (Faxon) (to Indian Creek and New River).

DISTRIBUTION AND ECOLOGY.

This is a rather insignificant local variety of *bartoni*, found in rivers and creeks in the higher mountains of West Virginia, in the region where the headwaters of the Monongahela (Cheat, Tygart, and Buckhannon) and those of the Kanawha (Greenbrier) come together. The locality in Laurel Creek at Greenville, is a little more distant, but also belongs to the New-Kanawha drainage.

TAXONOMIC REMARKS.

This form differs from *C. bartoni bartoni* only in the presence of a light longitudinal median carina on the upper surface of the rostrum, toward the tip. In addition, the rostrum is very broad here, but this shape is often found also in *bartoni bartoni*.

I have collected three specimens of this form at Parsons, in the Cheat drainage, not far from the type-locality. It should be remarked, that specimens from Blackwater River (another tributary of the Cheat) at Davis, Tucker Co., West Virginia, are the typical *bartoni*, and *not* this form. In the headwaters of Buckhannon River (Hampton, and Turbins Run, Upshur Co.) normal *bartoni* is present.

Cambarus (Cambarus) bartoni striatus (Hay) (1902).

C. latimanus (*var.*) FAXON, '85a, p. 69;—FAXON, '85b, p. 359.
C. latimanus striatus HAY, '02b, p. 437;—FAXON, '14, pp. 395, 425.

Type-locality: Nashville, Davidson Co., Tennessee. (Hay) (Cumberland drainage).

OTHER LOCALITIES.

Cumberland drainage.

Ashland, Cheatham Co., Tennessee. (Faxon).

Tennessee drainage.

Waterloo, Lauderdale Co., Alabama. (Faxon, '85b, p. 359).[46]
Keithly Branch (of Shoals Creek), Bailey Springs, Lauderdale Co., Alabama. (1♀, Aug. 25, '24)
Bridgeport, Jackson Co., Alabama. (Faxon).
Stream, mouth of Nickajack Cave, Shellmound, Marion Co., Tennessee. (Hay).

Alabama drainage.

Sand Mountain, Cullman, Cullman Co., Alabama. (Faxon).[47]
Blount Springs, Blount Co., Alabama. (Faxon).

SUMMARY OF DISTRIBUTION.

The known localities are situated on the Cumberland Plateau, west of Walden Ridge (and its southern continuation), from northern Alabama to Tennessee. They belong to the Alabama, Tennessee, and Cumberland drainages, and all seem to be in small streams. If *C. graysoni* should belong here, the range would extend farther north, into the Green River drainage of Kentucky (see below). More information about the precise range and the ecological preferences is needed.

The specimen I collected (Bailey Springs) was in a small run. It was attracted by mussel-meat thrown into the water, when I cleaned Naiades, and thus noticed and captured. I could not discover another

[46]This locality, given by Faxon for the aberrant form of *latimanus*, which has later been called *striatus*, has disappeared from the locality-records of subsequent writers (Harris, '03, p. 106, and Hay and Faxon, *l. c.*). I do not know for what reason, since the next locality (Bailey Springs) is in the same vicinity, I let it stand.

[47]Sand Mountain is north of Cullman, forming the divide between the Tennessee and Black Warrior drainages.

individual, although a specimen of *extraneus* turned up at the same place. Hay found his specimens at Nickajack Cave "under stones in a small pool formed by the stream."

TAXONOMIC REMARKS.

The original description of this form is somewhat unsatisfactory. Faxon was the first to point out certain characters of it, but he believed it to be an aberrant form of *latimanus*. Hay, who elevated it to a variety of this species, described it chiefly in terms of comparison with *latimanus*. The main characters are the long and narrow areola, and the weaker tubercles of the hand. These two characters alone preclude any possibility of connecting it with *latimanus*. The shape of the rostrum is also not typically that of *latimanus*. In all of these characters it is more closely related to *C. bartoni*, but differs again from this rather strikingly, in the areola; as *bartoni* has a moderately long (34 to 38 per cent of carapace) and moderately wide (generally with three to five dots) areola. In the present form (according to my specimen),[48] it is 40 per cent of the carapace, and is very narrow in the middle, with only one or two irregular rows of dots.

The hand has been described as having a rather strong row of tubercles along the inner margin of the palm, and next to it ("just above it") another obscure row of much weaker tubercles. Although my specimen has rather small, regenerated, chelæ, the sculpture is exactly as described, and brings this form close to *bartoni* and not to *latimanus*. The fingers of the hand are said to be shorter (than in *latimanus*), but we know that there is a good deal of variation, in this respect, in *bartoni*.

Nothing whatever is said in the description of *striatus* about the granulations of the carapace, which are extremely strong and characteristic in *latimanus*. My specimen, however (length 77 mm.), being a rather large one, shows only the normal condition seen in *bartoni;* with granulations on the sides of the carapace, but not very strongly developed. A lateral spine is missing, as is generally the case in *bartoni;* while *latimanus* has small lateral spines. The extraorbital angle is present, but rounded.

In the description of the rostrum we find some statements that seemingly disagree. Hay says, that it is "perhaps a little broader to-

[48]Hay does not give measurements; he only says, that it is longer and "almost" reduced to a line in the middle.

ward the tip" (than in *latimanus*), while Faxon says, that the rostrum is narrower. In my specimen the rostrum is indeed narrower, with somewhat convergent margins, which rather suddenly contract into the acumen, forming an angle; the acumen has straight sides. *C. latimanus* has a rostrum, the margins of which converge slightly, and pass into the acumen in a rounded curve. The acumen itself has somewhat concave margins (see Faxon's figure, '85a, Pl. 2, fig. 3). This makes the acumen somewhat narrower in *latimanus*, but broader in *striatus*, and possibly Hay's statement refers to this character. Yet, at the best, this is only a minor, and probably variable, character.

The armature of the carpopodite of the chelipeds shows a strong median, and a small proximal internal spine, and a rather blunt spine in the middle of the anterior lower margin. This does not offer any peculiarities. In my specimen, with regenerated chelipeds, these spines are present, but blunt and not large.

The general shape of the carapace of my specimen is slightly different from both *latimanus* and *bartoni*. It is not so distinctly depressed, but more subcylindrical, or rather subquadrangular. The upper surface is flattened and rather broad, and the sides are nearly vertical, exactly as described by Faxon ('14, p. 393) for *C. graysoni*. The carapace, however, has not that compressed shape seen in the *diogenes*-section, where the flat part of the upper surface is considerably narrower, passing more gradually into the vertical sides.

The species just mentioned, *C. graysoni* Faxon ('14, pp. 393, 425) is very likely the same as *striatus*. I cannot find any differences in the description given by Faxon from that of *striatus*, nor from my specimen, except that the rostrum is "short," and the acumen "upturned," which sounds somewhat different from *striatus*. This cannot be made out with certainty in view of the absence of figures of either form. The areola of *graysoni* is long, nearly as long as in my specimen of *striatus* (38.9 per cent in *graysoni*, 40 per cent in *striatus*), and is narrow, with only two rows of dots. The armature of the carpopodite and of the hand is the same, and the description of the shape of the carapace exactly fits my specimen. Faxon mentions a peculiar articulation of the hand with the carpus, which makes the former "assume a vertical position when flexed and to form with its fellow a shield or operculum appressed to the front of the body." He considers this "a sure token of the burrowing habits of this species." I do not understand this sentence. The typically burrowing species (*diogenes*-sec-

tion) hardly differ in the articulation of the carpopodite and hand from the forms of the *bartoni*-group. We also know that the latter are, more or less, habitual burrowers, though not so decidedly as the regular "chimney builders." Faxon himself admits the affinity of *graysoni* to *C. latimanus*, including the form *striatus*.

C. graysoni is from Bear Creek, Grayson Springs, Grayson Co., Kentucky, a tributary to Green River. If it actually is identical with *striatus*, the distribution of the latter would extend somewhat farther northward on the Cumberland Plateau.

Cambarus (Cambarus) bartoni laevis Faxon (1914).

C. bartoni HAY, '96, p. 487, fig. 6.
C. bartoni laevis FAXON, '14, pp. 391, 424.

Type-locality: Bloomington, Monroe Co., Indiana. (Faxon).

KNOWN LOCALITIES.

In southern Indiana. (Ohio and Wabash drainages).

Falls Creek, Indianapolis, Marion Co., Indiana. (Hay).
Irvington, Marion Co., Indiana. (Hay).
Bloomington, Monroe Co., Indiana. (Faxon, type-locality).
May's Cave, Monroe Co., Indiana. (Hay).
Mayfield's Cave, Monroe Co., Indiana. (Faxon).
Clear Creek, Monroe Co., Indiana. (Hay).
Mitchell Caves, Lawrence Co., Indiana. (Faxon).
Entrance of caves, Mitchell, Lawrence Co., Indiana. (Ferd. Payne and Newton Miller. 3 ♂♂ I, 9 ♂♂ II, 9♀♀, Aug., 1906).
Down's Cave and Conelly's Cave, Lawrence Co., Indiana. (Hay).
Paoli, Orange Co., Indiana. (Hay).
New Albany, Floyd Co., Indiana. (Hay).

South of Ohio River.

Lexington, Fayette Co., Kentucky. (Shull, '09, p. 301) (Kentucky drainage).[49]
Springs, Milton, Cabell Co., West Virginia. (3 ♂♂ II, I♀, Sept. 30, '11) (Guyandot drainage).
Springs, Poca, Putnam Co., West Virginia. (1 ♂ II, May 9, '13) (Kanawha drainage).

[49]This should be confirmed. Shull mentions this as *C. bartoni*, similar to the Indiana form.

SUMMARY OF DISTRIBUTION.

This form is most abundant in southern Indiana, but it is also probably found in northern Kentucky. The latter region is yet very poorly known with regard to its crawfish-fauna. The presence of this form in these parts is made probable by the fact, that I discovered it in western West Virginia. Thus it would be an inhabitant of the northern section of the Cumberland Plateau, in the Ohio drainage, extending across the Ohio River into southern Indiana.

The ecology has been discussed by Faxon. It is found in cave-waters and surface-waters of various character. My West Virginia specimens, however, were dug out of holes in, and close to, springs.

TAXONOMIC REMARKS.

This form is closely allied to *C. bartoni striatus*, and may only be a somewhat smoother, northern form of it. According to the description and figure given by Hay, according to Faxon's account, and my specimens from southern Indiana (Mitchell), there are only the following differences.

1. The whole carapace is smoother, i. e., the dots are less distinct, and the granulations, chiefly on the branchial regions, are very weak; only on the hepatical regions are they distinct.

2. The rostrum is more like that of typical *bartoni*. The shape figured by Hay (fig. 6 (1)), is actually found, but often the whole rostrum is shorter, and chiefly the acumen is shorter. The latter always has slightly concave margins, and the angles at its base are rounded. These differences are, however, very slight. My material from Mitchell (twenty-one specimens) shows considerable variation, and some specimens have a rostrum as figured by Hay. This shape also comes extremely close to that seen in my only specimen of *striatus*.

3. The armature of the chelipeds is practically the same as in *striatus*, only, in my specimens, the two rows of tubercles on the inner margin of the palm are not very sharp, but blunt, although well visible. Hay describes "a series of blunt serrations," while Faxon says that this margin is "more distinctly tuberculate" (than in the normal *bartoni*). Thus it seems, that this character is somewhat variable.

I cannot see any other differences, and some of the essential characters are alike in both forms. The carapace has the same subquadrangular shape, mentioned under *striatus* (and described by Faxon for *graysoni*), and the areola is practically the same. Its length is 41 per cent of the carapace according to Hay, and 42 per cent according to Faxon. About the same proportions are found in my specimens.

It is also narrow, having in the middle, room for not more than two dots.

My specimens from West Virginia (4 ♂♂ II, 1 ♀) have the comparatively smooth carapace and the long, narrow areola of *laevis*. In some of them, the areola is exactly as in *laevis*; but its length varies between 37 and 41 per cent. In one specimen, it is slightly wider, containing three rows of dots. The rostrum is more like that of typical *bartoni*, i. e., rather short, with shorter acumen, but this shape is also found in some specimens from Indiana. The chelipeds have the inner margin of the palm provided with "a series of blunt serrations," as described by Hay, and not the double row of low tubercles seen in my specimens from Indiana. It is not astonishing, however, to find differences like this in a set that comes from a locality so remote from the original one.

C. bartoni striatus and *C. bartoni laevis* are thus extremely closely allied, and might be actually identical. I do not unite them for the reason, that I have only a single individual of *striatus*, with the chelæ possibly not typical (regenerated). According to what has been said above, *striatus* has a rougher carapace, and stronger sculpture on the chelæ, and has a somewhat more elongated rostrum; while *laevis* is smoother, has weaker tubercles on the chelæ, and a somewhat shorter rostrum. Additional material may show that the two forms pass into each other, or, that the differences are only individual.

There is no doubt, that these two forms of *bartoni* constitute the transition from this species to the crawfishes of the *diogenes*-section. The latter have a still narrower areola, and the carapace is decidedly more compressed, and has the flattened dorsal area narrower. The geographical distribution of these two forms, on the Cumberland-Allegheny Plateau, is significant. The range is in close contact with, or in the vicinity of, those parts which we are to consider as the original home of the *diogenes*-section, namely, the Great Valley of eastern Tennessee, and the mountains to the east and west of it (see below).

Cambarus (Cambarus) bartoni tenebrosus Hay (1902).

C. bartoni tenebrosus HAY, '02a, p. 232;—FAXON, '14, p. 424.
C. tenebrosus GARMAN, '20, p. 42.

Type-locality: Mammoth Cave, Edmonson Co., Kentucky. (Hay). "And other underground streams in Kentucky" (Garman).

This form differs from *C. bartoni* in the eyes, which are reduced in size, in the longer areola, in the presence of lateral spines on the carapace, and in the longer antennæ.

According to Garman, this is entitled to specific rank for the reason that it does not intergrade with *bartoni*, which is a valid reason; and because the latter, "does not occur in some localities in which this small-eyed species is found," which is not convincing.

Before we decide this question, we should know more about the actual affinities of *tenebrosus* to *bartoni*, morphological and distributional. It should also be pointed out, that we have no records for the true *bartoni* from the Mammoth Cave region. Some of its local forms or varieties apparently exist here (*graysoni*, which may be the same as *striatus*), or are found at no great distance (*striatus* to the south, *laevis* to the north), but *bartoni bartoni* is not found till we come to the upper Cumberland drainage in Kentucky. Even here it is represented by peculiar forms (see above).

Forms resembling *striatus* or *laevis* are to be expected in surface waters in the Mammoth Cave region, and we know, that at least *laevis*, has, in southern Indiana, a strong tendency to enter cave-waters. Just these two forms only possess one of the characters of *tenebrosus*, the long areola. Unfortunately, no measurements (except total length) have been given for *tenebrosus*, and so we are compelled to let the matter rest, until we obtain further information.

4. SECTION OF C. DIOGENES.

Carapace ovate, compressed, and without lateral spines. Rostrum without marginal spines. Chelæ short, ovate, broad, and depressed. Areola very narrow or obliterated (linear) in the middle, always distinctly longer than one third of the carapace. Eyes well developed.

The essential characters distinguishing this section from that of *bartoni* are found in the compressed shape of the carapace and the very narrow areola. The flattened part in the middle of the carapace is rather narrow, and the sides of the carapace curve down from it decidedly and then become vertical. The narrow areola is foreshadowed by the areola of certain *bartoni*-forms (*striatus*, *laevis*), but reaches its maximum here. In some cases, where the two lines bordering the branchial regions do not meet in the middle, a very narrow areola is still present, leaving room for hardly more than one row of dots. In other (typical) cases, these lines meet in the middle, forming a single line, so that the areola is here obliterated (linear).

Two species belonging here are found in our region, but I give a key for three; the third (*monongalensis*) being closely allied to one of them. This is also advisable, because I entertain views as to their taxonomy different from those published by Faxon ('14).

a. Areola very narrow (but not obliterated), with 0—1 rows of dots. Rostrum short, not lanceolate nor elongated. Color, in life, peculiar, bright red or blue, rarely dull slate-blue.

b. Rostrum broad, acumen rather distinctly defined. Outer margin of hand subserrate, somewhat keeled. Color slate-blue, bright blue, or bright red..... *C. carolinus.*

b_1. Rostrum narrower, shorter, acumen indistinctly defined. Outer margin of hand rounded. Color bright blue..... *C. monongalensis* (extralimital).

a_1. Areola linear, obliterated in the middle, if very narrow, there is hardly any room for dots. Rostrum somewhat elongated, mostly sublanceolate, not broad and short. Color brownish or greenish olive, very rarely red (as individual or regional variation)..... *C. diogenes.*

Cambarus (Cambarus) carolinus (Erichson) (1846).

Astacus (*Cambarus*) *carolinus* ERICHSON, '46, p. 96.

Cambarus carolinus HAY, '02c, p. 38;—HARRIS, '03, p. 81;—ORTMANN, '05a, p. 393.

C. (*Bartonius*) *carolinus* ORTMANN, '05b, pp. 120, 135;—ORTMANN, '06, p. 394, Pl. A, fig. 4, Pl. 39, figs. 3a, 3b, 9, Pl. 40, fig. 4.

C. carolinus carolinus FAXON, '14, pp. 396, 399, 425.

C. dubius FAXON, '84, p. 114;—FAXON, '85a, p. 70, Pl. 4, fig. 3, Pl. 8, fig. 7;—UNDERWOOD, '86, p. 368;—FAXON, '90, p. 624;—HAY, '99, pp. 959, 965.

C. carolinus dubius FAXON, '14, pp. 399, 425.

Type-locality: Greenville, Greenville Co., South Carolina. (Erichson, Faxon) (on Piedmont Plateau).

ADDITIONAL LOCALITIES.

Piedmont Plateau.

Swampy ground near springs, Marion, McDowell Co., North Carolina. (2♀♀, May 16, '14).

High Mountains.

Cherokee Co., North Carolina. (Faxon)[50] (Hiawassee-Tennessee drainage).

[50]I thus transcribe Faxon's ('90) record: "among the Cherokees." Faxon himself ('14) says that this is probably in Swain or Jackson Co., (close to Cherokee Co.). I have seen, at Murphy, Cherokee Co., crawfish-chimneys, and tried unsuccessfully to dig out specimens (too many large rocks). The owner of the place told me, that these were *red* crawfishes, and thus probably this species. I traced chimneys, supposed to belong here, even farther South, to Blue Ridge, Fannin Co., Georgia, but had no chance to obtain specimens.

Swamp, Asheville, Buncombe Co., North Carolina. (1♀, May 10, '15) (French Broad drainage).

Blowing Rock, Watauga Co., North Carolina. (Ortmann) (headwaters of New-Kanawha).

Allegheny Valley and Mountains, between High Mountains and Cumberland Escarpment.

Swampy ground near springs, Barron, Washington Co., Virginia. (1 ♂ II, 3♀♀, May 19, '13) (upper Holston).

Springs, Gate City, Scott Co., Virginia. (1 ♂ II, May 16, '13) (upper Holston).

Springs, Speers Ferry, Scott Co., Virginia. (2 ♂♂ II, July 8, '13) (Clinch drainage).

Springs, Cleveland, Russell Co., Virginia. (1 ♂ II, 2♀♀, May 13, '13) (Clinch drainage).

Pennington Gap, Lee Co., Virginia. (Faxon) (Powell drainage).

Cumberland Gap, Claiborne Co., Tennessee. (Faxon) (Powell drainage).

Allegheny Plateau in West Virginia.

The localities given by Faxon ('14) should be quoted as follows.

Squirejim, McDowell Co., West Virginia. (Faxon) (headwaters of Big Sandy).

Yukon, McDowell Co., West Virginia. (Faxon) (headwaters of Big Sandy).

Baileyville, Wyoming. Co., West Virginia. (Faxon) (Guyandot drainage).

Lashmeet, Mercer Co., West Virginia. (Faxon) (New River drainage).[51]

Northward, no localities are known till we come to northern West Virginia, but the species probably is present all along the western side of the mountains, on the Plateau. Localities in West Virginia are:

Swampy ground, Elkins, Randolph Co., West Virginia. (2 ♂♂ II, May 11, '11) (Tygart-Monongahela).

Parsons, Tucker Co., West Virginia. (Ortmann) (Cheat-Monongahela).

Terra Alta (=Cranberry Summit), Preston Co., West Virginia. (Faxon, *type-locality* of *C. dubius*) (divide between Cheat and Youghiogheny, to Monongahela).

Reedsville, Preston Co., West Virginia. (Ortmann) (Decker's Creek, to Monongahela).

[51]I have seen numerous chimneys, probably belonging to this species, near Princeton, Mercer Co., West Virginia, but did not collect specimens.

Coopers Rock, Mount Chateau, Monongalia Co., West Virginia. (1 ♀, Aug. 7, '12) (to Cheat).

Schell, Mineral Co., West Virginia. (Ortmann) (Potomac drainage, but West of Allegheny Front).

Further, this species goes through western Maryland into southwestern Pennsylvania (see: Ortmann, '06). A new locality should be added:

Humbertston, Fayette Co., Pennsylvania. (A. K. Hampshire. 1 ♂ I, 1 ♂ II, 5 ♀♀, March 29, '07), (Chimneys seen at Hooversville, Somerset Co., Pennsylvania, surely belong to this species).

SUMMARY OF DISTRIBUTION.

It seems that the above records, although somewhat incomplete, give an adequate idea of the range of this species, which is *extremely peculiar*. From the High Mountains, formed by the southern extremity of the Blue Ridge, in North Carolina (possibly as far south as northern Georgia), and the Piedmont Plateau. Just at the foot of the mountains, in South and North Carolina, the range swings over into the headwaters region of the Tennessee River, and across the Allegheny Mountains to the Cumberland-Allegheny Plateau in southern West Virginia. To the north exists a gap, probably due to defective knowledge, but in northern West Virginia, this species is again present on the Allegheny Plateau, on the part close to the Allegheny Front, and continues northward as far as Pennsylvania (in Fayette, Somerset, and Westmoreland Cos.; for particulars *See*, Ortmann, '06, p. 451). Thus, generally speaking, *C. carolinus* is a mountain-species, but is not found everywhere in the mountains.

It should be mentioned, that Faxon ('14) gives this species also from "a tributary of Stone River twenty miles from Columbia (Maury Co.) in central Tennessee." No tributary of Stone River is anywhere within twenty miles from Columbia (nearest part of this drainage is about thirty miles northeast of Columbia), and this locality, disregarding the fact that *C. carolinus* is not found in *streams*, is very vague. Moreover, these specimens are very probably not *carolinus*, but *diogenes* (see below).

This is a burrowing species and a chimney builder, found in swampy ground in and near *cool* springs. All specimens collected by myself were dug out of burrows. (As to general ecological preferences, compare Ortmann, '06, p. 416 *et seq.*).

TAXONOMIC REMARKS.

Faxon ('14) distinguishes three varieties within this species. One is *C. carolinus monongalensis*, here treated as a species. The other two are very closely connected, and are said to differ from each other in the following characters.

C. carolinus carolinus. Rostrum moderately broad, with distinctly convergent margins, forming rounded angles at base of acumen. Outer margin of hand rounded, not serrated. More than one spine on inner margin of carpopodite of first peræopods.

C. carolinus dubius. Rostrum broader, with nearly parallel margins, forming sharper angles at base of acumen. Outer margin of hand subserrate. Only one spine on inner margin of carpopodite of first peræopods.

Of *C. carolinus carolinus*, which is found in North and South Carolina, Faxon had only one specimen, and photograph and drawings of the type-specimen. Also my material is not very rich, but I have two ♀♀ from Marion, and one ♀ from Asheville, from the general region where this form should be expected. From these, however, I have been able to ascertain that the characters given by Faxon do not hold good. The specimen from Asheville, and the smaller one from Marion, have the rostrum as described (with convergent margins and rounded lateral angles), but the larger specimen from Marion distinctly has the rostrum of the *dubius*-type. The outer margin of the hand, in all three specimens, has a slight indication of a ridge, subserrated by a row of dots, but not so well developed as in *carolinus dubius* from Pennsylvania. The armature of the inner margin of the carpopodite is quite variable. The Asheville specimen corresponds to Faxon's description of *carolinus carolinus*. The larger one from Marion differs in the right and left cheliped, having two spines on the right, of which, however, the smaller stands anterior to the larger (normal) one, and posterior to the latter is a tubercle. On the left cheliped there is only one spine and two sharp tubercles. The smaller specimen from Marion has only one spine on either side and two tubercles.

In addition to these, I have collected four ♂♂ II, and five ♀♀ at four localities in the upper Holston and Clinch drainages in Virginia. This largely fills out the gap between the range of "*carolinus*" in North Carolina and that of "*dubius*" in West Virginia and northward. Some of these specimens have the rostrum of the *dubius*-type (sharp angles at base of acumen). In others the margins are more convergent

and the angles are rounded off, with all transitional conditions. The outer margin of the hand is more or less subserrate, and the spines on the inner side of the carpopodite are again very variable. Rarely there are two spines, usually only one, with one or two tubercles which may be weak or sharp (condition seen in *dubius* from Pennsylvania).

Thus it is clear, that in specimens from North Carolina the characters of *carolinus carolinus* as given by Faxon, are not always found, and, on the other hand, that specimens from northern Virginia lead to the typical condition seen in the northern *dubius*. No sharp line can be drawn between them, and the only feature that deserves attention, is the fact, that the tendency to have the *carolinus*-type of rostrum prevails in the southern part of the range. But even here, occasionally, the *dubius*-type is found. Thus all of these characters are merely individual.

The *colors* exhibited by these crawfishes are very interesting. Faxon, having only preserved material, was unable to say much about them. All specimens, however, collected by myself, were dug out alive and the colors noted. In the northern part of the range, in Pennsylvania, Maryland, and northern West Virginia, the color is always *red* (see Ortmann, '06); the same color I observed in three specimens dug out at Cleveland (Clinch Valley), and in the one specimen from Asheville. The specimens from Speers Ferry, Gate City, and Barron, were *blue*, exactly like *C. monongalensis* of southwestern Pennsylvania. Finally, the two specimens from Marion, on the Piedmont Plateau, had a peculiar *slate-blue* color, rather *dull*, and not, by any means, as vivid as the red and blue ones. There was, however, no indication of the brownish or greenish olive tints usually seen in crawfishes. My material is too meagre to draw any conclusions from these records, but attention should be paid to this (color) in the future, and the distribution of the different color-types ascertained.

Of the southern form, my largest male (II, from Speers Ferry) is 59 mm., long; my largest female (Marion) 52 mm.

In the three specimens mentioned above as recorded by Faxon from central Tennessee, certain peculiar characters have been pointed out, chiefly the narrow rostrum with less abrupt acumen, and the very narrow areola reduced "to a narrow line." This leads me to believe that these specimens are actually *C. diogenes*. I have a specimen of the latter from central Tennessee (Raus, Bedford Co.), which could very well answer the description of Faxon's specimens, as far as it goes, and

which resembles *carolinus* in one particular point, the inner margin of the palm has only one row of distinct tubercles. In all other respects, and in color also, it is a *diogenes*, and *not* a *carolinus* (see below).

Cambarus (Cambarus) monongalensis Ortmann (1905).

C. dubius WILLIAMSON (not FAXON), '01, p. 11.
C. monongalensis ORTMANN, '05a, p. 395.
C. (*Bartonius*) *monongalensis* ORTMANN, '05b, p. 120;—ORTMANN, '06, p. 398, Pl. B, fig. 4, Pl. 39, figs. 4a, 4b, 10, Pl. 40, fig. 5.
C. carolinus monongalensis FAXON, '14, pp. 399, 425.

This form is not found in the region under discussion, but is more northern. It is shortly introduced here, to set forth its relation to *C. carolinus*. The differences pointed out by me ('06) hold good in every case, the rostrum, armature of carpopodite and meropodite being always different from *C. carolinus* in its southern as well as in its northern phase. In color only, are some southern *carolinus* like *monongalensis*, but in every other detail these blue *carolinus* are true *carolinus*. *C. monongalensis* is always blue, and other shades have never been observed. In Pennsylvania as well as in West Virginia, there is no evidence of any intergrading of the two species.

This species belongs to the Allegheny Plateau in southwestern Pennsylvania and northern West Virginia (for particulars see: Ortmann, '06). I should like to add here an unpublished new locality, which is the most southern known:

Burnsville, Braxton Co., West Virginia. (1 ♂ II, May 24, '11) (Little Kanawha drainage).

Cambarus (Cambarus) diogenes Girard (1852).

For references see:

C. (*Bartonius*) *diogenes* ORTMANN, '06, p. 402, Pl. A, fig. 3, Pl. 39, fig. 11, Pl. 40, figs. 6, 7, in addition:
Bartonius diogenes WILLIAMSON, '07, p. 760.
Cambarus diogenes HANKINSON, '08, p. 233;—PEARSE, '10a, p. 74;—PEARSE, '10b, p. 20;—PEARSE, '13, p. 4;—FAXON, '14, pp. 400, 426.
C. (*Bartonius*) *diogenes* GRAENICHER, '13, p. 122.

Type-locality: Washington, D. C. (Girard).

DISTRIBUTION.

The distribution of this species, as known hitherto, is largely extralimital to our region. I shall give here only a rough sketch,

mentioning only such special localities as are apt to have certain relationships to our area.

The eastern form of *diogenes* belongs to the Atlantic Coastal Plain from New Jersey to North Carolina.[52] The western form goes from western Pennsylvania through the states north of the Ohio (northward to Michigan, Wisconsin, and Minnesota) to the Mississippi River, and beyond (to Nebraska and Colorado). South of the Ohio, comparatively few localities are known in *northern West Virginia*, and the most southern of these (on the Allegheny Plateau) is a new one, as follows:

Buckhannon, Upshur Co., West Virginia. (3 ♀♀, May 12, '11).

From *Kentucky*, it has been reported from the following places:

Louisville, Jefferson Co., Kentucky. (Faxon) (Ohio valley).

Beespring, Edmonson Co., Kentucky. (Faxon) (Cumberland Plateau, Green River drainage).

Mammoth Cave, Edmonson Co., Kentucky. (Faxon) (do.).

In addition, there are localities known in *Mississippi*, *Alabama*, and *Louisiana*. The following are from the first two states:

Mulden, Monroe Co., Mississippi. (Faxon) (Cretaceous Mississippi Embayment, Tombigbee drainage).

Agricultural College, Oktibeha Co., Mississippi. (Faxon) (do.).

Monticello, Lawrence Co., Mississippi. (Hagen) (Tertiary Gulf Coastal Plain, Pearl River drainage).

Auburn, Lee Co., Alabama. (Faxon) (southern extremity of Piedmont Plateau).[53]

These southern localities stand rather isolated, and moreover, there was, before this, no connection of the western-southern range with the eastern, no localities having been reported from the states of Tennessee, Georgia, and South Carolina. I am, however, able to fill out this gap, at least in part, by the following localities in *Tennessee*.

[52]New localities are:

New Altona Beach, Anne Arundel Co., Maryland (1 ♀, Sept. 6, '25).

Pilkinton, Powhatan Co., Virginia (1 ♀ juv., Aug. 24, '25).

At the former place, I found it in close vicinity to salt (or brackish) water of Stony Creek, hardly a foot over high tide level. The other locality is remarkable for the fact that it is on the *Piedmont Plateau*, and not on the Coastal Plain. Here it was in burrows along muddy and swampy banks of a small stream tributary to Appomattox River.

[53]The var. *ludovicianus* Faxon is known from Louisiana, and from Rosedale, Bolivar Co., Mississippi (Faxon) (Mississippi Bottoms).

Mississippi Bottoms.

Banks of Bayou de Chien, Walnut Log, Obion Co., Tennessee. (1♀ juv., Aug. 13, '24).[54]

Mississippi Embayment (Cretaceous).

Big Sandy Bottoms, Hollow Rock Junction, Carroll Co., Tennessee. (1♀, Aug. 19, '24).

Cumberland Plateau.

Raus, Bedford Co., Tennessee. (1 ♂ II, Aug. 20, '23) (Central Basin).
Clifty, Cumberland Co., Tennessee. (1 ♂ II, Aug. 28, '22).

Great Valley of Eastern Tennessee.

Harriman, Roane Co., Tennessee. (2 ♂♂ II, May 16, '15) (foot of Walden Ridge).
Dossett, Anderson Co., Tennessee. (1♀, Sept. 2, '14) (foot of Walden Ridge).
Athens, McMinn Co., Tennessee. (1 ♂ I, 1♀, May 21, '15).
Tellico Plains, Monroe Co., Tennessee. (1 ♂ I, May 22, '15) (foot of High Mountains).
Vonore, Monroe Co., Tennessee. (1♀, May 14, '15).
Fountain City, Knox Co., Tennessee. (1♀, Aug. 28, '14).
Mohawk, Greene Co., Tennessee. (1 ♂ II, 1♀, May 18, '14).

These new localities indicate an apparently continuous area, which, however, is not very closely connected with the older records. Chiefly the connection toward the Alabama locality (Auburn) is missing, and more information is needed from central Tennessee. It is perfectly clear, then, that my locality at Hollow Rock Junction, in western Tennessee, is to be grouped with the localities, Mulden and Agricultural College in Mississippi, being situated on the same geological formation (Cretaceous belt of Mississippi Embayment). The localities in the Great Valley form a distributional unit, covering the whole width of the valley, and going northward to Greene Co. (northeast of Knoxville).[55]

Additional records are also wanted in Kentucky, which may demonstrate, that the localities in central Tennessee are connected in a northwesterly direction, with the main western range of the species in the states north of the Ohio.

Evidently there is no connection, of the area in the Great Valley,

[54]This young specimen probably belongs to the var. *ludovicianus* Faxon.

[55]Beyond this, in the headwaters of the Tennessee, *C. carolinus* is the burrowing crawfish.

with the eastern range, beginning in the Coastal Plain of North Carolina, as the mountains (and the Piedmont Plateau) have *C. carolinus* as the burrowing species. Thus the eastern *diogenes* is still separated from the localities in eastern Tennessee and Alabama (Auburn). The states of Georgia and South Carolina should be searched for it.

Below the fact will be brought out, that the Tennessee-*diogenes* morphologically connects the eastern and western race of the species, and thus it is suggested, that it represents the original stock, from which the others descended, and that its area probably represents the center of radiation of this form. This is also supported by the fact, that, in this region, *diogenes* is in close proximity to the range of the species most closely allied to it, namely *C. carolinus*, and to the supposed original home of the *bartoni*-section, and that of the subgenus of *Cambarus* in general, where we are to look for the forms, which are ancestral to *diogenes*.

C. diogenes is a burrowing species (chimney builders), living in swampy ground. All my specimens were dug out of holes, with the exception of the one from Clifty. This was found in a small stream, badly charged with mine-water, in a dying condition. Probably it was not living in the stream, but had strayed into it by accident.

Males of the I form were found in May, and females with eggs in the same month (at Buckhannon, West Virginia).

Taxonomic Remarks.

C. diogenes is distinguished from *C. carolinus* by the areola, which is, in most cases, obliterated in the middle (linear), and by the rostrum, which is narrower, more or less lanceolate, with an indistinct, or poorly marked acumen; by certain characters of the chelæ (more sculptured), and the color, which, with rare exceptions to be mentioned below, is of the usual tints seen in crawfishes (greenish or brownish olive).

Since the new localities here recorded from Tennessee are intermediate between the eastern and western range of the species, it is desirable to examine my material more closely, in order to ascertain its relation to the two forms. [56]

I have pointed out (Ortmann, '06, p. 407) certain differences between

[56]In the following discussion the specimen from Hollow Rock Junction, western Tennessee, is not considered, since it unqualifiedly represents the western form. The specimen from Walnut Log is young, but probably of the var. *ludovicianus*.

the eastern and western form of *diogenes*.[57] They are as follows:

1. Areola in the western form is more frequently not-entirely-obliterated, than in the eastern.

2. Rostrum, in the western specimens, with a tendency to obscure the acumen, so as to make the whole rostrum rather regularly lanceolate. In eastern specimens, the acumen is more distinct.

3. Chelæ, with the fingers proportionally longer in the eastern form, and the inner margin of the palm shorter. The latter, in the eastern form always with two rows of tubercles; in the western, there are one or two rows, and additional scattered tubercles on the upper surface of the palm. In the eastern form, the teeth of the cutting edge of the dactylopodite are interrupted near the base by a slight excision (as if one of the teeth had been suppressed). This character is missing in the western form.

With regard to these characters, the Tennessee-specimens are truly intermediate. A few of them (from Mohawk, Vonore, Tellico Plains) are the western form in every respect, while some others (Dossett, Harriman) closely approach the eastern in areola, rostrum, shape and armature of hand, but the excision at the base of the inner edge of the dactylopodite is missing. The rest have some characters of the western, and some of the eastern form. The hand has rather long fingers, the inner margin of the palm has two rows of tubercles, with only a few small ones near the base of the dactylopodite, and the rostrum has a well defined acumen (eastern characters). The areola, however, is mostly not-entirely-obliterated, and in one case (Clifty), it is narrow, but wide enough for one row of dots. Further, the excision at the base of the moveable finger is always absent (western character). In one case (Raus), there is only *one* row of tubercles on the inner margin of the palm, with one or two additional tubercles of a second row.[58]

Thus it is clear that the Tennessee-specimens are intergrading be-

[57]There is another difference in the color of the newly-laid eggs, which are buff in the western form, but blackish in the eastern. This was first pointed out by Andrews ('07, p. 263), and subsequently confirmed by myself. I cannot use this character here, since I did not find specimens with eggs in Tennessee.

[58]This specimen, in this character, resembles *C. carolinus*, and I suspect that specimens of *carolinus* (*dubius*) mentioned by Faxon ('14, p. 397) from central Tennessee actually belong here. For the characters of the narrower rostrum, with less distinct acumen (as compared with *carolinus*), and the narrow areola ("reduced to a narrow line") agree rather with *diogenes* than with *carolinus*. My specimen from Raus has the areola obliterated in the middle, forming only *one* line, and the rostrum is of the type of the eastern *diogenes*.

tween the eastern and western *diogenes*. Some are purely western; others more or less closely approach the eastern type, without, however, fully corresponding to the latter.

In *color*, the Tennessee crawfishes of this species are generally normal, having the greenish or brownish olive tints as are found elsewhere. In one case (Raus), the ground color has been recorded as "dark green, almost black." However, at the eastern foot of Walden Ridge, at Harriman and Dossett, all specimens found (2 ♂♂ II, 1 ♀) had a *reddish* ground color. While the female from Dossett has been recorded as completely "bright red," the males from Harriman are recorded as, "body olive-brown to reddish-brown (on carapace); rostrum and chelæ orange-red; sides of carapace pale grayish-olive." These are colors found to prevail in *C. carolinus*.[59] More information about this red phase is desired, and it should be pointed out that, morphologically, these red specimens approach most closely the eastern form (see above).

My largest male (I) from Tennessee (Athens) is 62 mm., long; the largest male (II) (Clifty) is 76 mm.; and the largest female (Fountain City) is 104 mm.

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[59]A red specimen of *C. diogenes* has previously been found at Dunbar, Fayette Co., Pennsylvania, among normal ones (Ortmann, '06, p. 410).

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ARTICLE V.
ANNALS CARNEGIE MUSEUM
Vol. XX, January, 1931*

III.

LIST OF TYPES OF CRUSTACEA

IN THE COLLECTION OF THE

CARNEGIE MUSEUM

on January 1, 1931

*The student will observe that the pagination in the following article is double. The first numeral indicates the regular pagination in the volume of the ANNALS in which the list originally appeared; the second numeral in parentheses is the pagination to be employed when these lists shall ultimately be gathered together and bound in a separate volume.

Introductory

*The very modern system, pursued by numerous recent writers, of designating an individual specimen as the "holotype" of a species and the other specimens as "paratypes" has not generally prevailed among carcinologists and conchologists. They have based their descriptions of species not upon an individual specimen, but upon a group of specimens and their publications have often referred to the material before them as a body of "cotypes." As is well known to students it has become customary to substitute the word *paratype*, or *syntype*, for the word *cotype*, the latter word being regarded as less correct grammatically than the former. In the lists of the *Crustacea* and *Pelecypoda* herein given we conform to long established usage in regarding specimens before the author at the time of writing his description as types.

W. J. Holland, Editor

V. LIST OF TYPES OF CRUSTACEA IN THE CARNEGIE MUSEUM ON JANUARY 1, 1931.

Stanley T. Brooks, Ph.D.

Class CRUSTACEA.

Order MYSIDACEA.

Family MYSIDÆ.

Holmesiella anomala Ortmann, Proc. U. S. N. M., XXXIV, 1908, 6.
Part of type-lot. C. M., No. 73.12, one specimen from Stephens Passage, south of Juneau, Alaska (Albatross Station 4251). Paratypic of genus.

Order DECAPODA.

Family ÆGLEIDÆ.

Æglea odebrechti Müller = **Æglea intermedia** Girard, Jena. Z. f. Natur., X, 1876, 13.
Part of type-lot. C. M., No. 74.218, two specimens from Sierra do Mar, Santa Catharina, Brazil. F. Müller coll.

Family ATYIDÆ.

Atyella brevirostris Calman, Proc. Zoöl. Soc. London, 1906, 201.
Part of type-lot. C. M., No. 74.848, five specimens from River Lofu, Tanganyika, Africa. Dr. W. A. Cunnington coll.

Caridella cunningtoni Calman, Proc. Zoöl. Soc. London, 1906, 199.
Part of type-lot. C. M., No. 74.859, two specimens, and C. M., No. 74.847, two specimens from Kirando, and Utinta, Lake Tanganyika, Africa. Dr. W. A. Cunnington coll.

Limnocaridina latipes Calman, Proc. Zoöl. Soc. London, 1906, 196.
Part of type-lot. C. M., No. 74.844, one specimen from River Lofu, Tanganyika, Africa. Dr. W. A. Cunnington coll.

Limnocaridina parvula Calman, Proc. Zoöl. Soc. London, 1906, 193.
Part of type-lot. C. M., No. 74.841, thirteen specimens from Karema, Lake Tanganyika, Africa. Dr. W. A. Cunnington coll.

Limnocaridina retiarius Calman, Proc. Zoöl. Soc. London, 1906, 192.
Part of type-lot. C. M., No. 74.840, one specimen from Mbete, Lake Tanganyika, Africa. Dr. W. A. Cunnington coll.

Limnocaridina similis Calman, Proc. Zoöl. Soc. London, 1906, 195.
Part of type-lot. C. M., No. 74.843, two specimens from Rusisi River, Lake Tanganyika, Africa. Dr. W. A. Cunnington coll.

Limnocaridina socius Calman, Proc. Zoöl. Soc. London, 1906, 196.
Part of type-lot. C. M., No. 74.845, seven specimens from Niamkolo Harbor, Lake Tanganyika, Africa. Dr. W. A. Cunnington coll.

Limnocaridina spinipes Calman, Proc. Zoöl. Soc. London, 1906, 197.
Part of type-lot. C. M., No. 74.846, one specimen from Utinta, Lake Tanganyika, Africa. Dr. W. A. Cunnington coll.

Ortmannia potimirim F. Müller, Arch. Mus. Nac., Rio de Janeiro, VIII, 1892, 155.
Part of type-lot. C. M., No. 74.177, six specimens from Rio Itajahy, Santa Catharina, Brazil. Dr. H. von Ihering coll.

Family PALÆMONIDÆ.

Leander potitinga (F. Müller) Ortmann, Zoöl. Anzeig., III, 1880, 153. (*Descriptio nulla*); Ortmann in Rev. Mus. Paulista, II, 1897, 139.
Part of type-lot. C. M., No. 74.176, eight specimens from Blumenau, Santa Catharina, Brazil. F. Müller coll.

Palæmon iheringi Ortmann, Rev. Mus. Paulista, II, 1897, 211.
Part of type-lot. C. M., No. 74.174, two specimens from Rio Tiete, São Paulo, Brazil. Dr. H. von Ihering coll.

Palæmon potiuna F. Müller, Arch. Mus. Nac., Rio de Janeiro, VIII, 1892, 179.
Part of type-lot. C. M., No. 74.175, one specimen from Rio Itajahy, Santa Catharina, Brazil. F. Müller coll.

Family PORCELLANIDÆ.

Petrolisthes iheringi Ortmann, Zoöl. Jahrb. Syst., X, 1897, 286.
Type. C. M., No. 74.228, one specimen from São Sebastião, São Paulo, Brazil. Dr. H. von Ihering coll.

Family POTAMONIDÆ.

Pseudothelphusa æquatorialis Ortmann, Zool. Jahrb. Syst., X, 1897, 319.
Type. C. M., No. 74.119, from Eastern Cordilleras, Ecuador.

Family POTOMOBIIDÆ.

Cambarus atkinsoni Ortmann, Annals Carn. Mus., VIII, 1913, 414.
Type-lot. C. M., No. 74.924, four specimens from Rio de los Indios, Isle of Pines, Cuba. Dr. D. A. Atkinson coll.

Cambarus bouvieri Ortmann, Ann. Sci. Nat. Zool., Paris, IX, 1909, 159.
Part of type-lot. C. M., No. 74.864, one specimen from Uruapan, Michoacan, Mexico. L. Diguet coll.

Cambarus digueti Bouvier, Bull. Mus. Paris, 1897, 224.
Part of type-lot. C. M., No. 74.483, two specimens from Rio Santiago, State of Jalisco, Mexico. L. Diguet coll.

Cambarus monongalensis Ortmann, Annals Carn. Mus.. III, 1905, 395.
Type-lot. C. M., No. 74.316, three specimens from Gordon's Valley, Edgewood Park, Allegheny County, Pennsylvania. Dr. A. E. Ortmann coll.

Cambarus ortmanni Williamson, Annual Rept. Dept. Geol. and Nat. Res. Indiana, XXXI, 1906-1907, 75.
Part of type-lot. C. M., No. 74.826, two specimens from Bluffton, Wells County, Indiana. E. B. Williamson coll.

Cambarus paradoxus Ortmann, Proc. Wash. Acad. Sci., VIII, 1906, 3.
Type-lot. C. M., No. 74.677, five specimens from Sierra de Zacapoaxtla, Puebla, Mexico. L. Diguet coll.

Cambarus pilosimanus Ortmann, Proc. Wash. Acad. Sci., VIII, 1906, 6.
Type-lot. C. M., No. 74.678, two specimens from Alta Vera Paz, Guatemala. Exped. Mexique Mus. Paris coll.

Cambarus rusticus mirus Ortmann, Annals Carn. Mus., XX, 1931, p. 81.
Type-lot. C. M., No. 74.1378, five specimens from Hurricane Creek, Cumberland Springs, Moore County, Tennessee. Dr. A. E. Ortmann coll.

Cambarus williamsoni Ortmann, Annals Carn. Mus., III, 1905, 439.
Type-lot. C. M., No. 74.560, three specimens from Los Amates, Izabal, Guatemala. E. B. Williamson coll.

VI. LIST OF TYPES OF PELECYPODA IN THE CARNEGIE MUSEUM ON JANUARY 1, 1931.

Stanley T. Brooks, Ph.D.
and
Betty Watt Brooks, M.A.

Class PELECYPODA.

Order PRIONODESMACEA.

Family OSTREIDÆ.

Ostrea circumpicta Pilsbry, Proc. Acad. Nat. Sci. Phila., LVI, 1904, 559.

Part of type-lot. C. M., No. 61.9034, one specimen from Hirado, Prov. Hizen, Japan. Y. Hirase coll.

Family UNIONIDÆ.

Subfamily Unioninæ.

Elliptio dilatatus sterkii Grier, Nautilus, XXXII, 1918, 9.

Type-lot. C. M., No. 61.4628, eleven specimens from Presque Isle Bay, Lake Erie, Erie, Erie County, Pa. Dr. A. E. Ortmann coll.

Elliptio ortmanni Frierson, Nautilus, XXVII, 1913, 14.

Part of type-lot. C. M., No. 61.6196, eight specimens, and type-lot. C. M., No. 61.6197, sixteen specimens from Rio Conchius, Maya Farm, Quirigua, Guatemala. A. A. Hinkley coll.

Elliptio oscari B. H. Wright, Nautilus, V, 1892, 124.

Part of type-lot. C. M., No. 61.11808, one specimen from Creek from Lake Osceola, Winter Park, Florida. L. E. Daniels coll.

Elliptio waltoni B. H. Wright, Proc. Acad. Nat. Sci. Phila., 1888, 114.

Part of type-lot. C. M., No. 61.11835, one specimen from Lake Woodruff, Volusia Co., Florida. L. E. Daniels coll.

Fusconaia edgariana analoga Ortmann, Proc. Amer. Philos. Soc., LVII, 1918, 533.

Type-lot. C. M., No. 61.6326, eight specimens from Clinch River, Speer's Ferry, Scott Co., Virginia. Dr. A. E. Ortmann coll.

Fusconaia flava parvula Grier, Nautilus, XXXII, 1918, 11.

Type-lot. C. M., No. 61.4513, eighteen specimens from Lake Erie, Presque Isle Bay, Erie, Erie Co., Pennsylvania. Dr. A. E. Ortmann coll.

Fusconaia flava trigona Lea *See* **Fusconaia selecta** Wheeler.

Fusconaia lananensis Frierson, Nautilus, XV, 1901, 76.

Part of type-lot. C. M., No. 61.5006, two specimens from Lanona Creek, Nacogdoches, Nacogdoches Co., Texas. L. S. Frierson coll.

Fusconaia selecta Wheeler = **Fusconaia flava trigona** Lea, Nautilus, XXVIII, 1914, 76.

Part of type-lot. C. M., No. 61.7723, one specimen from Cache River, Nemo, Craighead Co., Arkansas. H. E. Wheeler coll.

Fusconaia subrotunda leucogona Ortmann, Nautilus, XXVII, 1913, 89.

Type-lot. C. M., No. 61.5239, twelve specimens from Elk River, Gassaway, Braxton Co., West Virginia. Dr. A. E. Ortmann coll.

Quadrula metanevra wardii Lea, Observations on the Genus Unio, IX, 1863, 187.

Type-lot. C. M., No. 61.1063, three specimens from Little Coal River, West Virginia. Hartman Collection. (Note:—"These are undoubtedly the specimens in the Hartman Collection mentioned by Lea, *l.c.*" A. E. Ortmann).

Quadrula quadrula contraryensis Utterback, Amer. Midl. Natural., IV, 1916, 56.

Part of type-lot. C. M., No. 61.6892, three specimens from Lake Contrary, St. Joseph, Buchanan Co., Missouri. W. I. Utterback coll.

Quincuncina burkei Walker, Nautilus, XXXVI, 1922, 3.

Part of type-lot. C. M., No. 61.8622, two specimens, and part of type-lot. C. M., No. 61.8622a, six specimens from Choctawhatchee River, Blue Springs, Barbour Co., Alabama. H. H. Smith coll.

Unio borealis A. F. Gray = **Lampsilis radiata** Gmelin, Trans. Ottawa, Field Nat. Club, 1882, 53.

Part of type-lot. C. M., No. 61.9926, one specimen from Ottawa River, Duck Island, Carleton Co., Ontario, Canada. F. R. Latchford coll. (Note:—"*Unio borialis* A. F. Gray, is a swollen form of *Lampsilis radiata* Gmelin." A. E. Ortmann).

Unio caipiro von Ihering, Archiv. für Naturgeschichte, I, 1893, 98.
Paratype. C. M., No. 61.12821, one specimen from Tangue Paraiso, Piracicaba, São Paulo, Brazil. von Ihering coll.

Subfamily Anodontinæ.

Alasmidonta marginata susquehannæ Ortmann, Memoirs Carn. Mus., VIII, 1919, 187.
Type-lot. C. M., No. 61.4679, eight specimens from Susquehanna River, Selinsgrove, Snyder Co., Pa. Dr. A. E. Ortmann coll.

Anodontoides showalteri Lea, Observations on the Genus Unio, IX, 1863.
Type-lot. C. M., No. 61.805, two specimens from Big Prairie Creek, Hale Co., Alabama. (Note:—Mentioned as being in the Hartman collection by Lea. *l.c.* 216).
Part of type-lot. C. M., No. 61.8377, one specimen, from Big Prairie Creek, Hale Co., Alabama. Dr. E. R. Showalter coll. (Note:—"This is from the original lot which furnished the types." H. H. Smith).

Arkansia wheeleri Ortmann and Walker, Nautilus, XXV, 1912, 97.
Type-lot. C. M., No. 61.5358, four specimens from "Old River" of Quachita River, Arkadelphia, Clark Co., Arkansas. H. E. Wheeler coll.

Lasmigona costata eriganensis Grier, Nautilus, XXXII, 1918, 10.
Type-lot. C. M., No. 61.4223, eight specimens from Presque Isle Bay, Lake Erie, Erie, Erie Co., Pa. Dr. A. E. Ortmann coll.

Subfamily Lampsilinæ.

Actinonaias flucki Bartsch *See* **Nephronaias flucki** Bartsch.

Diplodon berthæ Ortmann, Memoirs Carn. Mus., VIII, 1921, 528.
Type-lot. C. M., No. 61.5865, sixteen specimens from Rio Jacuhy, Cachocira, Rio Grande do Sul, Brazil. J. D. Haseman coll.

Diplodon decipiens Ortmann, Memoirs Carn. Mus., VIII, 1921, 499.
Type-lot. C. M., No. 61.9253, thirteen specimens from Rio Iguassu, Serrinha, Parana, Brazil. J. D. Haseman coll.

Diplodon ellipticus santanus von Ihering, Abh. Senckenberg. Naturf. Ges., XXXII, 1910, 134.
Paratypes. C. M., No. 61.12827, two specimens from Rio Santa Maria, Espirito Santo, Drainage of Rio Doce, Brazil. von Ihering coll.

Diplodon enno Ortmann, Memoirs Carn. Mus., VIII, 1921, 531.
Type-lot. C. M., No. 61.9264, eighteen specimens from Rio Grande, Boqueirão, Bahia, Brazil. J. D. Haseman coll.

Diplodon garbei von Ihering, Abh. Senckenberg. Naturf. Ges., XXXII, 1910, 133.
Paratypes. C. M., No. 61.12826, two specimens from Lagoa Juperana of Rio Doce, Espirito Santo, Brazil. von Ihering coll.

Diplodon hartwrighti von Ihering, Abh. Senckenberg. Naturf. Ges., XXXII, 1910, 135.
Paratypes. C. M., No. 61.12823, two specimens from the Lagoa Alagadinha in Goyaz of the Rio Araguaya, Brazil. Dr. H. von Ihering coll.

Diplodon hasemani Ortmann, Memoirs Carn. Mus., VIII, 1921, 478.
Type-lot. C. M., No. 61.5857, twelve specimens from Centre of Rio Guapori, Near Rio São Simão, Matto Grosso, Brazil. J. D. Haseman coll.

Diplodon hildæ Ortmann, Memoirs Carn. Mus., VIII, 1921, 514.
Type-lot. C. M., No. 61.5864, fourteen specimens from Rio Jacuhy, Cachocira, Rio Grande do Sul, Brazil. J. D. Haseman coll.

Diplodon imitator Ortmann, Memoirs Carn. Mus., VIII, 1921, 491.
Type-lot. C. M., No. 61.9248, twenty-three specimens from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. J. D. Haseman coll.

Diplodon mogymirim Ortmann, Memoirs Carn. Mus., VIII, 1921, 520.
Type-lot. C. M., No. 61.9260, fourteen specimens, and type-lot. C. M., No. 61.9261, sixteen specimens from Creek, Mogy Mirim, São Paulo, Brazil. J. D. Haseman coll.

Diplodon paulista von Ihering = **Unio paulista** von Ihering, Arch. f. Naturgesch., I, 1893, 93.
Paratypes. C. M., No. 61.12822, three specimens from Piracicaba, São Paulo, Brazil. von Ihering coll.

Diplodon simillimus Ortmann, Memoirs Carn. Mus., VIII, 1921, 495.
Type-lot. C. M., No. 61.9250, thirty-two specimens from Rio Nhundiaquara, Marretes, Parana, Brazil. J. D. Haseman coll.

Diplodon vicarius Ortmann, Memoirs Carn. Mus., VIII, 1921, 497.
Type-lot. C. M., No. 61.9251, fifteen specimens from Aqua Quente (eight miles from Iporanga), São Paulo, Brazil. J. D. Haseman coll.

Dysnomia florentina walkeri Wilson and Clark = **Truncilla walkeri** Wilson and Clark, Bur. Fish. Doc., 781, 1914, 46. *See* Ortmann, Proc. Amer. Phil. Soc., LVII, 1918, 591.

Part of type-lot. C. M., No. 61.6769, four specimens from east fork of Stones River, Walterhill, Rutherford Co., Tennessee. C. B. Wilson and H. W. Clark coll.

Friersonia iridella Pilsbry and Frierson, Nautilus, XXII, 1908, 81.

Part of type-lot. C. M., No. 61.4495, five specimens from Valles River, Valles, San Luis Potosi, Mexico. A. A. Hinkley coll.

Lampsilis borealis A. F. Gray. *See* **Unio borealis** A. F. Gray.

Lampsilis fimbriata Frierson, Nautilus, XXI, 1907, 86.

Part of type-lot. C. M., No. 61.4496, one specimen from Valles River, Valles, Mexico. A. A. Hinkley coll. (Note:—Referred, in Carnegie Museum catalogues, to *Leptodea fimbriata* Frierson and *Paraptera fimbriata* Frierson).

Lampsilis ovata cohongoronta Ortmann, Nautilus, XXVI, 1912, 53.

Type-lot. C. M., No. 61.3999 (male), twelve specimens, and type-lot. C. M., No. 61.4000 (female), eleven specimens from Potomac River, Hancock, Washington Co., Maryland. Dr. A. E. Ortmann coll.

Lampsilis radiata Gmelin *See* **Unio borealis** A. F. Gray.

Leptodea fimbriata Frierson *See* **Lampsilis fimbriata** Frierson.

Nephronaias flucki Bartsch = **Actinonaias flucki** Bartsch, Proc. U. S. Natl. Mus., XXX, 1906, 393.

Part of type-lot. C. M., No. 61.3953, two specimens from Wounta River, northwest of Kukallaya, Nicaragua. W. F. Fluck coll.

Paraptera fimbriata Frierson *See* **Lampsilis fimbriata** Frierson.

Truncilla walkeri Wilson and Clark *See* **Dysnomia florentina walkeri** Wilson and Clark.

Family MUTELIDÆ.

Subfamily Mutelinæ.

Anodontites hasemani Ortmann, Memoirs Carn. Mus., VIII, 1921, 609.

Type-lot. C. M., No. 61.5832, four specimens from head-waters of Rio Paraguay, Santa Rita, Matto Grosso, Brazil. J. D. Haseman coll.

Anodontites hyrioides Ortmann, Memoirs Carn. Mus., VIII, 1921, 604.

Type-lot. C. M., No. 61.5829, six specimens from Rio Japajos, Santarem, Para, Brazil. J. D. Haseman coll.

Anodontites riograndensis von Ihering, Arch. f. Naturgesch., 1890, 154. *See* Ortmann, Memoirs Carn. Mus., VIII, 1921, 624.

Part of type-lot. C. M., No. 61.11134, eight specimens from Rio Camaquam, Rio Grande do Sul, Brazil. H. von Ihering coll. (Note:—Original label in von Ihering's handwriting.)

Castalina martensi von Ihering, Arch. f. Naturgesch., 1893, 81. *See* Ortmann, Memoirs Carn. Mus., VIII, 1921, 551.

Part of type-lot. C. M., No. 61.11127, six specimens from Rio Camaquam, Rio Grande do Sul, Brazil. H. von Ihering coll. (Note:—H. von Ihering's original label.)

Castalina nehringi von Ihering, Arch. f. Naturgesch., 1893, 75. *See* Ortmann, Memoirs of Carn. Mus., VIII, 1921, 548.

Part of type-lot. C. M., No. 61.5118, two specimens from Rio Piracicaba, São Paulo, Brazil. H. von Ihering coll. (Note: Labelled by and received from Dr. H. von Ihering.)

Monocondylæa hollandi Ortmann, Memoirs Carn. Mus., VIII, 1921, 585.

Type. C. M., No. 61.5846, from Rio Guapore, near Rio São, Simão, Matto Grosso, Brazil. J. D. Haseman coll.

Monocondylæa obesa Ortmann, Memoirs Carn. Mus., VIII, 1921, 583.

Type-lot. C. M., No. 61.5850, twelve specimens from Rio Tapajos, Santarem, Para, Brazil. J. D. Haseman coll.

Spatha kamerunensis Walker, Nautilus, XXIV, 1910, 38.

Part of type-lot. C. M., No. 61.4489, three specimens from Kribi River, seventeen miles from Efulen, Kamerun, Africa. George Schwab coll.

Family LIMIDÆ.

Lima hians hirasei Pilsbry, Proc. Acad. Nat. Sci. Phila., LIII, 1901, 209, 402.

Part of type-lot. C. M., No. 61.9041, six specimens from Hirado, Prov. Hizen, Japan. Y. Hirase coll.

Family MYTILIDÆ.

Lithophagus lithurus Pilsbry, Proc. Acad. Nat. Sci. Phila., LVII, 1905, 119.

Part of type-lot. C. M., No. 61.9045, four specimens from Kikai, Prov. Osumi, Japan. Y. Hirase coll.

Order **TELEODESMACEA.**

Family PLEUROPHORIDÆ.

Trapezium japonicum Pilsbry, Proc. Acad. Nat. Sci. Phila., LVII, 1905, 119.

Part of type-lot. C. M., No. 61.9049, six specimens from Fukura, Awaji Island, Japan. Y. Hirase coll.

Family SPHÆRIIDÆ.

Sphærium niceri Geyer, No reference found.

Part of type-lot. C. M., No. 61.11320, ten specimens from Neckar River, Lauffen, Württemberg, Germany. Exchange from Dr. W. Blume.

Family VENERIDÆ.

Subfamily Venerinæ.

Paphia phenax Pilsbry, Proc. Acad. Nat. Sci. Phila., LIII, 1901, 207, 400.

Part of type-lot. C. M., No. 61.9064, four specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Family PETRICOLIDÆ.

Petricola cyclus Pilsbry, Proc. Acad. Nat. Sci. Phila., LIII, 1901, 204, 400.

Part of type-lot. C. M., No. 61.9065, three specimens from Hirado, Prov. Hizen, Japan. Y. Hirase coll.

Family DONÆIDÆ.

Donax kiusiuensis Pilsbry, Proc. Acad. Nat. Sci. Phila., LIII, 1901, 207, 400.

Part of type-lot. C. M., No. 61.9074, six specimens from Hirado, Prov. Hizen, Japan. Y. Hirase coll.

Donax mediamericana Pilsbry, Proc. Acad. Nat. Sci. Phila., LXXI, 1919, 222.

Part of type-lot. C. M. No. 61.7930, forty-two specimens from Beach, Livingston, Guatemala. A. A. Hinkley coll.

Family SOLENIDÆ.

Solen roseomaculatus Pilsbry, Proc. Acad. Nat. Sci. Phila., LIII, 1901, 399.

Part of type-lot. C. M., No. 61.9076, three specimens from Hirado, Prov. Hizen, Japan. Y. Hirase coll.

Solen rudis C. B. Adams, Am. Lyc. N. Y., V, 1852, 524, 548.

Part of type-lot. C. M., No. 61.12, two specimens from Panama. C. B. Adams coll.

Family MACTRIDÆ.

Spisula bernardi Pilsbry, Proc. Acad. Nat. Sci. Phila., LVI, 1904, 550.

Part of type-lot. C. M., No. 61.9082, three specimens from Fukura, Awadschi, Japan. Y. Hirase coll.

ARTICLE VII.
ANNALS CARNEGIE MUSEUM
Vol. XX, June, 1931*

V.

LIST OF TYPES OF AMPHINEURA AND GASTROPODA

IN THE COLLECTION OF THE

CARNEGIE MUSEUM

on January 1, 1931

*The student will observe that the pagination in the following article is double. The first numeral indicates the regular pagination in the volume of the ANNALS in which the list originally appeared; the second numeral in parentheses is the pagination to be employed when these lists shall ultimately be gathered together and bound in a separate volume.

VII. LIST OF TYPES OF AMPHINEURA AND GASTROPODA CATALOGUED IN THE COLLECTION OF THE CARNEGIE MUSEUM ON JANUARY 1, 1931.

By Stanley T. Brooks, Ph.D.
and
Betty Watt Brooks, M.A.

Class AMPHINEURA.

Order POLYPLACOPHORA.

Suborder *MESOPLACOPHORA*.

Family CRYPTOPLACIDÆ.

Cryptoplax japonicus Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 204.

Part of type-lot. C. M., No. 62.9859, four specimens from Hirado, Prov. Hizen, Japan. Y. Hirase coll.

Cryptoplax rhodoplax Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 204.

Part of type-lot. C. M., No. 62.9858, six specimens from Hirado, Hizen, Japan. Y. Hirase coll.

Class GASTROPODA.

Subclass STREPTONEURA.

Order ASPIDOBRANCHIA.

Family PHASIANELLIDÆ.

Phasianella tristis Pilsbry, Nautilus, XVII, 1903, 69.

Part of type-lot. C. M., No. 62.9875, six specimens from Rishiri, Kitami, Hokkaido, North Japan. Y. Hirase coll.

Family TROCHIDÆ.

Euchelus hachijoensis Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 35.

Part of type-lot. C. M., No. 62.9880, three specimens from Hachijo, Izu, Japan. Y. Hirase coll.

Gibbula vittata Pilsbry, Nautilus, XVII, 1903, 69.

Part of type-lot. C. M., No. 62.9886, four specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Order **CTENOBRANCHIATA.**

Family EULIMIDÆ.

Eulima luchuana Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 396.

Part of type-lot. C. M., No. 62.9898, six specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Family PYRAMIDELLIDÆ.

Syrnola bacillum Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 394.

Part of type-lot. C. M., No. 62.9900, three specimens from Hirado, Prov. Hizen, Japan. Y. Hirase coll.

Family TURBONILLIDÆ.

Turbonilla varicifera Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 198.

Part of type-lot. C. M., No. 62.9901, three specimens from Hirado, Prov. Hizen, Japan. Y. Hirase coll.

Family PLANAXIDÆ.

Planaxis abbreviatus ogasawarana Pilsbry, Proc. Acad. Nat. Science Phila., LVII, 1905, 105.

Part of type-lot. C. M., No. 62.9908, six specimens from Hahajima, Ogasawara-shima, Bonin Islands, Japan. Y. Hirase coll.

Family ANNULARIDÆ.

Chondropoma caribbæum W. F. Clapp, Nautilus, XXVII, 1914, 100.

Part of type-lot. Clapp, No. 15264, one specimen from Swan Island, Caribbean Sea. George Nelson coll.

Colobostylus nelsoni W. F. Clapp = **Tudora nelsoni** W. F. Clapp, Nautilus, XXVII, 1914, 99. *See* Henderson and Bartsch, Proc. U. S. Natl. Mus., LVIII, 1921, 75.

Part of type-lot. Clapp, No. 15265, two specimens from Swan Island, Caribbean Sea. George Nelson coll.

Family CYCLOPHORIDÆ.

Subfamily Cyclophorinæ.

Cyathopoma iota Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 619.

Part of type-lot. C. M., No. 62.15451, six specimens from Kumejima, Riu Kiu Islands, Japan. Y. Hirase coll.

Cyathopoma micron Pilsbry, Nautilus, XIV, 1900, 12.

Part of type-lot. C. M., No. 62.15452, ten specimens from Kashima, Harima, Japan. Y. Hirase coll.

Cyclophorus hirasei Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 348.

Part of type-lot. C. M., No. 62.15455, four specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Cyclophorus kikaiensis Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 27.

Part of type-lot. C. M., No. 62.15456, six specimens from Kikai, Osumi, Japan. Y. Hirase coll.

Cyclophorus turgidus angulatus Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 549.

Part of type-lot. C. M., No. 62.15459, four specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Cyclotus hirasei Pilsbry, Nautilus, XV, 1901, 22.

Part of type-lot. C. M., No. 62.15462, twelve specimens, Loo Choo Islands, Japan. Y. Hirase coll.

Cyclotus sanctæmarthæ Pilsbry and Clapp, Nautilus, XV, 1902, 134.

Type. C. M., No. 62.15065, from Las Nubes Estate, Sierrade, Santa Marta, Colombia. C. L. Hurd coll.

Japonia sadoensis Pilsbry and Hirase, Nautilus, XVII, 1903, 31.

Part of type-lot. C. M., No. 62.15657, three specimens from Niibomura, Sadô, Japan. Y. Hirase coll.

Japonia tokunoshimana Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 616.

Part of type-lot. C. M., No. 62.15659, four specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Leptopoma fultoni Aldrich, Nautilus, XII, 1898, 3.

Part of type-lot. Clapp, No. 14709, one specimen from Marang, Sumatra. W. D. Doherty coll.

Spiropoma nakadai Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 496.

Part of type-lot. C. M., No. 62.15747, six specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Family ALYCÆINÆ.

Alycæus awænsis Pilsbry and Hirase, Nautilus, XVII, 1904, 117.

Part of type-lot. C. M., No. 62.15432, six specimens from Hiyama, Awa, Shikoku, Japan. Y. Hirase coll.

Alycæus biexcisus Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 26.

Part of type-lot. C. M., No. 62.15428, six specimens from Suimura, Awa, Shikoku, Japan. Y. Hirase coll.

Alycæus harimensis Pilsbry, Proc. Acad. Nat. Science Phila. LII, 1900, 381.

Part of type-lot. C. M., No. 62.15420, four specimens from Kashima, Harima, Japan. Y. Hirase coll.

Alycæus hirasei Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 382.

Part of type-lot. C. M., No. 62.15426, six specimens from Kyoto, Yamashiro, Japan. Y. Hirase coll.

Alycæus lævicervix Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 618.

Part of type-lot. C. M., No. 62.15429, three specimens from Kuchinoerabushima, Osumi, Japan. Y. Hirase coll.

Alycæus oshimanus Pilsbry and Hirase, Nautilus, XVIII, 1904, 7.

Part of type-lot. C. M., No. 62.15433, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Alycæus purus Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 617.

Part of type-lot. C. M., No. 62.15430, six specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Alycæus reinhardti Pilsbry = **Alycæus pilsbryi** Kobelt, Proc. Acad. Nat. Science Phila., LII, 1900, 381.

Part of type-lot. C. M., No. 62.15422, six specimens from Kashima, Harima, Japan. Y. Hirase coll.

Alycæus tokemoshimanus Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 617.

Part of type-lot. C. M., No. 62.15431, six specimens from Tokemoshima, Osumi, Japan. Y. Hirase coll.

Alycæus vinctus Pilsbry, Nautilus, XVI, 1902, 53.

Part of type-lot. C. M., No. 62.15434, four specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Subfamily Pupininæ.

Pupinella funatoi Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 497.

Part of type-lot. C. M., No. 62.15731, six specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Pupinella oshimæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 349.

Part of type-lot. C. M., No. 62.15729, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Pupinella oshimæ tokunoshimana Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 618.

Part of type-lot. C. M., No. 62.15732, six specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Pupinella rufa alba Pilsbry, Cat. Land Shells of Japan, 1903, 21. *See* **Nautilus,** XLV, 1931.

Part of type-lot. C. M., No. 62.15733, six specimens from Hirado, Hizen, Japan. Y. Hirase coll.

Pupinella rufa tanegashimæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 497.

Part of type-lot. C. M., No. 62.15730, six specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Subfamily Pomatiasinæ.

Omphalotropis dohertyi Aldrich, Nautilus, XII, 1898, 3.

Part of type-lot. Clapp, No. 14710, one specimen from Marang, Sumatra. W. D. Doherty coll.

Omphalotropis japonica Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 405.

Part of type-lot. C. M., No. 62.15712, sixteen specimens from Kashiwashima, Tosa, Japan. Y. Hirase coll.

SUBFAMILY DIPLOMMATININÆ.

Diplommatina cassa Pilsbry, Nautilus, XV, 1901, 23.

Part of type-lot. C. M., No. 62.15620, twenty-four specimens from Kodakari, Hida, Japan. Y. Hirase coll.

Diplommatina concinna Godwin-Austen, Proc. Zoöl. Soc. London, 1892, 519.

Part of type-lot. Clapp, No. 14703, two specimens from Naga Hills, India. W. Doherty coll.

Diplommatina decorosus Godwin-Austen, Proc. Zoöl. Soc. London, 1892, 510.

Part of type-lot. Clapp, No. 14704, one specimen from Naga Hills, India. W. Doherty coll.

Diplommatina dohertyi Godwin-Austen, Proc. Zoöl. Soc. London, 1892, 513.

Part of type-lot. Clapp, No. 14707, two specimens from Margarita, Assam, India. W. Doherty coll.

Diplommatina domuncula Godwin-Austen, Proc. Zoöl. Soc. London, 1892, 518.

Part of type-lot. Clapp, No. 14705, one specimen from Naga Hills, India. W. Doherty coll.

Diplommatina gibbera Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 620.

Part of type-lot. C. M., No. 62.15477, six specimens from Nomimura, Tosa, Japan. Y. Hirase coll.

Diplommatina goniobasis onoensis Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 621.

Part of type-lot. C. M., No. 62.15478, six specimens from Onomura, Tosa, Japan. Y. Hirase coll.

Diplommatina immersidens Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 623.

Part of type-lot. C. M., No. 62.15482, six specimens from Miyakojima, Riukiu, Loo Choo Islands, Japan. Y. Hirase coll.

Diplommatina insularum Pilsbry, Nautilus, XV, 1901, 22.
Part of type-lot. C. M., No. 62.15619, twelve specimens from Yaeyama, Loo Choo Islands, Japan. Y. Hirase coll.

Diplommatina kobelti Ehrmann, Cat. Land Shells of Japan, 1903, 12.
Part of type-lot. C. M., No. 62.15473, twelve specimens from Kashima, Harima, Japan. Y. Hirase coll.

Diplommatina kobelti ampla Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 28.
Part of type-lot. C. M., No. 62.15474, six specimens from Goto, Hizen, Japan. Y. Hirase coll.

Diplommatina kumejimana Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 623.
Part of type-lot. C. M., No. 62.15481, six specimens from Kumejima, Loo Choo Islands, Japan. Y. Hirase coll.

Diplommatina oshimæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 351.
Part of type-lot. C. M., No. 62.15468, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Diplommatina pudica Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 28.
Part of type-lot. C. M., No. 62.15475, six specimens from Nachi, Kii, Japan. Y. Hirase coll.

Diplommatina pusilla omiensis Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 382.
Part of type-lot. C. M., No. 62.15465, ten specimens from Ibuki, Omi, Japan. Y. Hirase coll.

Diplommatina septentrionalis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 352.
Part of type-lot. C. M., No. 62.15470, twenty-two specimens from Kayabe, Ojima, Japan. Y. Hirase coll.

Diplommatina subtilis Godwin-Austen, Proc. Zoöl. Soc. London, 1892, 517.
Part of type-lot. Clapp, No. 14708, two specimens from Margarita, Assam, India. W. Doherty coll.

Diplommatina tanegashimæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 497.

Part of type-lot. C. M., No. 62.15471, ten specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Diplommatina tokunishimana Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 622.

Part of type-lot. C. M., No. 62.15480, six specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Diplommatina tosana Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 620.

Part of type-lot. C. M., No. 62.15476, six specimens from Nogawa, Tosa, Japan. Y. Hirase coll.

Diplommatina turris Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 350.

Part of type-lot. C. M., No. 62.15466, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Diplommatina uzenensis Pilsbry, Nautilus, XIV, 1900, 88.

Part of type-lot. C. M., No. 62. 15618, twelve specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Diplommatina yakushimæ Pilsbry, Nautilus, XV, 1901, 64.

Part of type-lot. C. M., No. 62.15621, six specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Family HELICINIDÆ.

SUBFAMILY HELICININÆ.

Helicina albescens Hartman, Proc. Acad. Nat. Science Phila., 1890, 285.

Type. C. M., No. 62.15313, from Segou Island, New Hebrides. E. L. Layard coll.

Helicina capsula Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 25.

Part of type-lot. C. M., No. 62.15645, three specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Helicina clappi Pilsbry, Nautilus, XXIII, 1909, 90.

Part of type-lot. Clapp, No. 2461, three specimens from Miami, Florida. S. N. Rhoades coll.

Helicina grenadensis E. A. Smith, Proc. Malacol. Soc. London, I, 1895, 318.

Part of type-lot. C. M., No. 62.2986, ten specimens from Grenada, West Indies. H. H. Smith coll.

Helicina hakodadiensis Hartman, Proc. Acad. Nat. Science Phila., 1890, 286.

Part of type-lot. C. M., No. 62.15642, three specimens from Hakodadi, Japan. B. Schmacker coll.

Helicina hirasei Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 25.

Part of type-lot. C. M., No. 62.15647, four specimens from Hahajima, Ogasawara, Japan. Y. Hirase coll.

Helicina japonica uzenensis Pilsbry, Nautilus, XIV, 1901, 128.

Part of type-lot. C. M., No. 62.15652, twelve specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Helicina layardi Hartman, Proc. Acad. Nat. Science Phila., 1888, 251.

Part of type-lot. C. M., No. 62.15656, three specimens from Aura Islands, New Hebrides. E. L. Layard coll.

Helicina ogasawarana Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 25.

Part of type-lot. C. M., No. 62.15646, three specimens from Hahajima, Ogasawara, Japan. Y. Hirase coll.

Helicina osumiensis Pilsbry, Nautilus, XIV, 1901, 127.

Part of type-lot. C. M., No. 62.15640, sixteen specimens from Kikai, Osumi, Japan. Y. Hirase coll.

Helicina reini expolita Pilsbry, Nautilus, XVI, 1903, 131.

Part of type-lot. C. M., No. 62.15654, six specimens from Sezan, Awaji, Japan. Y. Hirase coll.

Helicina sadoensis Pilsbry and Hirase, Nautilus, XVI, 1903, 128.

Part of type-lot. C. M., No. 62.15651, six specimens from Sotokaifu, Sado, Japan. Y. Hirase coll.

Helicina sanctæmarthæ Pilsbry and Clapp, Nautilus, XV, 1902, 136.

Part of type-lot. Clapp, No. 4535, ten specimens from El Libano, State of Santa Marta, U. S. of Colombia. H. H. Smith coll.

Helicina verecunda degener Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 625.

Part of type-lot. C. M., No. 62.15655, four specimens from Okinoerabushima, Osumi, Japan. Y. Hirase coll.

Helicina yæyamensis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 497.

Part of type-lot. C. M., No. 62.15644, ten specimens from Yæyama, Loo Choo Islands, Japan. Y. Hirase coll.

Helicina yoshiwarana arata Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 26.

Part of type-lot. C. M., No. 62.15648, four specimens from Hahajima, Ogasawara, Japan. Y. Hirase coll.

Helicina yoshiwarana microtheca Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 26.

Part of type-lot. C. M., No. 62.15649, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Family AMPULLARIIDÆ.

Ampullaria miamiensis Pilsbry, Proc. Acad. Nat. Science Phila., 1899, 365.

Part of type-lot. Clapp, No. 19966, one specimen from Miami River Confluent, Florida. S. N. Rhoades coll.

Family VALVATIDÆ.

Valvata micra Pilsbry and Ferriss = **Horatia micra** Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1906, 172, and Nautilus, XXX, 1916, 83.

Part of type-lot. C. M., No. 62.20173, ten specimens from drift of Guadelupe River, four miles above New Braunfels, Texas. H. A. Pilsbry coll.

Family VIVIPARIDÆ.

Viviparus georgianus altior Pilsbry = **Vivipara georgiana altior** Pilsbry, Nautilus, V, 1892, 142.

Part of type-lot. C. M., No. 62.7023, seventeen specimens from Shell-heap (Indian), Hitchen's Creek, Volusia County, Florida. H. A. Pilsbry coll.

Viviparus walkeri Pilsbry and Johnson = **Viviparus georgianus** Lea, Nautilus, XXVI, 1912, 48.

Part of type-lot. C. M., No. 62.12706, six specimens from Juniper Creek, Lake County, Florida. H. A. Pilsbry and C. W. Johnson coll.

Family AMNICOLIDÆ.

Amnicola cisternina Walker, Occas. Papers Mus. Univ. Mich., 73, 1919, 1.

Part of type-lot. C. M., No. 62.16423, many specimens from Reservoir, four miles north of Guatemala City, Guatemala. A. A. Hinkley coll.

Amnicola conchensensis Walker, Occas. Papers Mus. Univ. Mich., 73, 1919, 3.

Part of type-lot. C. M., No. 62.16425, many specimens from Conchins River, Maya Farm, Quirigua, Guatemala. A. A. Hindley coll.

Amnicola hinkleyi Walker, Occas. Papers Mus. Univ. Mich., 73, 1919, 4.

Part of type-lot. C. M., No. 62.16424, many specimens from Guatemala City, Guatemala. A. A. Hinkley coll.

Amnicola melanioides v. Martens, Biologia Centr. Amer. (L. and Fr. Moll.), 1899, 436.

Part of type-lot. C. M., No. 62.16285, seven specimens from Rio Platanales, Golfo Dulce, Costa Rica, (Pacific side).

Amnicola panzoënsis Walker, Occas. Papers Mus. Univ. Mich., 73, 1919, 3.

Part of type-lot. C. M., No. 62.16286, five specimens from Panzos, Guatemala. A. A. Hinkley coll.

Blanfordia simplex Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 26.

Part of type-lot. C. M., No. 62.15438, six specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Clappia clappi Walker, Nautilus, XXII, 1909, 89.

Part of type-lot. C. M., No. 62.16310, many specimens from Coosa River, Duncan's Riffle, Chilton County, Alabama. H. H. Smith coll.

Lartetia clessini postera Geyer, Süsswasserfauna Deutsch. XIX, 1909, 24.

Part of type-lot. C. M., No. 62.16774, one specimen from Backnang, Württemberg, Germany.

Lartetia goviensis Geyer = **Lartetia suevica** form **goviensis** Geyer, Land und Süsswasser Mollusken Deutsch., XIX, 1909, 99.

Part of type-lot. C. M., No. 62.16777, two specimens from Reusten am Herrenberg, near Tübingen, Württemberg, Germany.

Lartetia labiata Geyer, Thiele, Süsswasserfauna Deutschl., XIX, 1909, 23.

Part of type-lot. C. M., No. 62.16769, two specimens from Degerfeld, Württemberg, Germany.

Lartetia pellucida acuta Geyer, Thiele, Süsswasserfauna Deutschl., XIX, 1909, 20.

Part of type-lot. C. M., No. 62.16764, one specimen from Elsachquelle, Urach, Württemberg, Germany.

Lartetia pellucida ara Geyer, Thiele, Süsswasserfauna Deutschl., XIX, 1909, 20.

Part of type-lot. C. M., No. 62.16765, two specimens from Reissenbadquelle, Reutlingen, Württemberg, Germany.

Lartetia pellucida weinlandi Geyer, Thiele, Süsswasserfauna Deutschl., XIX, 1909, 21.

Part of type-lot. C. M., No. 62.16766, two specimens from Urach, Württemberg, Germany.

Lartetia photophila Geyer, Thiele, Süsswasserfauna Deutschl., XIX, 1909, 22.

Part of type-lot. C. M., No. 62.16768, one specimen from Gruibingen, Württemberg, Germany.

Lartetia putei Geyer, Thiele, Süsswasserfauna Deutschl., XIX, 1909, 23.

Part of type-lot. C. M., No. 62.16770, one specimen from Kohlberg, Württemberg, Germany.

Lartetia putei rösleri Geyer, Thiele, Süsswasserfauna Deutschl., XIX, 1909, 24.

Part of type-lot. C. M., No. 62.16771, one specimen from Ofterdingen, Württemberg, Germany.

Lartetia saxigena tenuis Geyer, Thiele, Süsswasserfauna Deutschl., XIX, 1909, 21.

Part of type-lot. C. M., No. 62.16767, three specimens from Mühlheim, a.d. Donau, Württemberg, Germany.

Lartetia suevica Geyer, Thiele, Süsswasserfauna Deutschl., XIX, 1909, 24.

Part of type-lot. C. M., No. 62.16772, one specimen from Herrenberg, Württemberg, Germany.

Pyrgula pfeifferi Weber, Zoöl. Anzeig., LXX, 1927, 313.

Type-lot. C. M., No. 62.19859, two specimens from south end of Lake Egerdir, Anatolia, (Asia Minor). E. Pfeiffer coll.

Pyrgulopsis ozarkensis Hinkley, Proc. U. S. Natl. Mus., XLIX, 1916, 588.

Part of type-lot. C. M., No. 62.8928, six specimens from White Fork, White River, Norfolk, Baxter County, Arkansas. A. A. Hinkley coll.

Somatogyrus decipiens Walker, Nautilus, XXII, 1909, 86.

Part of type-lot. C. M., No. 62.16336, many specimens from Coosa River, Yellow Leaf Creek, Chilton County, Alabama. H. H. Smith coll.

Somatogyrus hendersoni Walker, Nautilus, XXII, 1909, 87.

Part of type-lot. C. M., No. 62.16342, five specimens from Coosa River, Duncan's Riffle, Chilton County, Alabama. H. H. Smith coll.

Somatogyrus pygmæus Walker, Nautilus, XXII, 1909, 88.

Part of type-lot. C. M., No. 62.16358, seven specimens from Coosa River, Yellow Leaf Creek, Chilton County, Alabama. H. H. Smith coll.

Family RISSOIIDÆ.

Rissoia ogasawarana Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 26.

Part of type-lot. C. M., No. 62.9916, twelve specimens from Hahajima, Ogasawara Shima, Bonin Islands, Japan. Y. Hirase coll.

Family MELANIIDÆ.

Pachychilus vallesensis Hinkley, Nautilus, XXI, 1907, 25.

Part of type-lot. C. M., No. 62.7962, thirteen specimens from Valles River, Valles, San Luis Potosi, Mexico. A. A. Hinkley coll.

Family PLEUROCERIDÆ.

Anculosa arkansensis Hinkley, Proc. U. S. Natl. Mus., XLIX, 1916, 587.

Part of type-lot. C. M., No. 62.8937, fifty specimens from North Fork, White River, Norfolk, Baxter County, Arkansas. A. A. Hinkley coll.

Anculosa clipeata H. H. Smith, Misc. Publ. Univ. Mich. Mus., VII, 1922, 19.

Part of type-lot. C. M., No. 62.17421, seventeen specimens from Coosa River, Fort William Shoals, Shelby County, Alabama. H. H. Smith coll.

Anculosa choccoloccoënsis H. H. Smith, Misc. Publ. Univ. Mich. Mus., VII, 1922, 34.

Part of type-lot. C. M., No. 62.17476, six specimens from Choccolocco Creek, Jackson Shoals, Talladega County, Alabama. H. H. Smith coll.

Anculosa flexuosa H. H. Smith, Misc. Publ. Univ. Mich. Mus., VII, 1922, 34.

Part of type-lot. C. M., No. 62.17475, two specimens from Coosa River, Wetumpka, Elmore County, Alabama. H. H. Smith coll.

Anculosa sulcata H. H. Smith, Misc. Publ. Univ. Mich. Mus., VII, 1922, 46.

Part of type-lot. C. M., No. 62.17489, nine specimens from Coosa River, Ten Islands Shoals, St. Clair County, Alabama. H. H. Smith coll.

Goniobasis goodrichi Hinkley, Occas. Papers Univ. Mich. Mus., LXXVIII, 1920, 1.

Part of type-lot. C. M., No. 62.8127, five specimens from Branch of Swan Creek, near Aetna, Hickman County, Tennessee. A. A. Hinkley coll.

Gyrotoma walkeri H. H. Smith, Misc. Publ. Univ. Mich. Mus., No. 12, 1924, 25.

Part of type-lot. C. M., No. 62.18944, six specimens from Coosa River, Cedar Island, Chilton County, Alabama. H. H. Smith coll.

Strephobasis walkeri Goodrich = **Pleurocera walkeri** Goodrich, Univ. of Mich. Occas. Pap. Mus. Zool., No. 192, 1928, 14.

Part of type-lot. C. M., No. 62.18518, five specimens from Sequatchie River, Jasper, Marion County, Tennessee. C. Goodrich coll.

Family CERITHIIDÆ.

Cerithium chemnitzianum Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 393.

Part of type-lot. C. M., No. 62.9923, six specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Cerithium modestum Adams = **Triforis modestus** C. B. Adams, Tryon, Man. Conch., IX, 1887, 188.

Part of type-lot. C. M., No. 62.3774, one specimen from Jamaica. Holland Collection.

Cerithium nigrocinctum Adams = **Triforis nigrocinctus** C. B. Adams, Tryon, Man. Conch., IX, 1887, 188.

Part of type-lot. C. M., No. 62.3773, one specimen from Massachusetts. Holland Collection.

Family BUCCINIDÆ.

Subfamily Pisaniinæ.

Cantharus submenkeanus Pilsbry, Proc. Acad. Nat. Science Phila., 1901, 387.

Part of type-lot. C. M., No. 62.9946, six specimens from Hirado, Hizen, Japan. Y. Hirase coll.

Family PLEUROTOMIDÆ.

Clathurella linearis violacea Monteros, Man. Conch., VI, 1884, 277.

Part of type-lot. C. M., No. 62.17269, one specimen from Palermo, Sicily.

Daphnella fragilis articulata Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 385.

Part of type-lot. C. M., No. 62.9987, four specimens from Hirado, Hizen, Japan. Y. Hirase coll.

Daphnella nebula pallida Monteros, Man. Conch., VI, 1884, 308.

Part of type-lot. C. M., No. 62.17272, two specimens from Palermo, Sicily.

SUBCLASS EUTHYNEURA.

Order **OPISTHOBRANCHIATA.**

SUBORDER *TECTIBRANCHIATA.*

Family TORNATINIDÆ.

Tornatina decorata Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 37.

Part of type-lot. C. M., No. 62.9992, six specimens from Hirado, Prov. Hizen, Japan. Y. Hirase coll.

Order **PULMONATA.**

SUBORDER *THALASSOPHILA.*

Family SIPHONARIIDÆ.

Siphonaria rucuana Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 36.

Part of type-lot. C. M., No. 62.9993, five specimens from Loo Choo Islands, Japan. Y. Hirase coll.

SUBORDER *BASOMMATOPHORA.*

Family AURICULIDÆ.

Carychium cymatoplax Pilsbry, Nautilus, XV, 1901, 23.

Part of type-lot. C. M., No. 62.15439, ten specimens from Yaeyama, Loo Choo Islands, Japan. Y. Hirase coll.

Carychium exiguum floridanum G. H. Clapp, Nautilus, XXXI, 1918, 73.

Type-lot. Clapp, No. 8569, thirty specimens from Snapper Creek Hammock, south of Miami, Dade County, Florida. (One designated as figured type.) C. T. Simpson coll.

Carychium exile canadense G. H. Clapp, Nautilus, XIX, 1906, 139.

Type-lot. Clapp, No. 5114, fourteen specimens from Kennebunkport, York County, Maine. G. H. Clapp coll.

Carychium hachijoënse Pilsbry, Nautilus, XVI, 1902, 57.

Part of type-lot. C. M., No. 62.15440, six specimens from Hachijojima, Izu, Japan. Y. Hirase coll.

Carychium nannodes G. H. Clapp, Nautilus, XIX, 1905, 91.

Type-lot. Clapp, No. 5401, sixty or more specimens from Monte Sano, five miles from East Huntsville, Alabama. H. H. Smith coll.

Carychium pessimum Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 562.

Part of type-lot. C. M., No. 62.15444, six specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Carychium pessimum boreale Pilsbry and Hirase, Nautilus, XVII, 1904, 119.

Part of type-lot. C. M., No. 62.15442, six specimens from Harutori, Kushiro, Japan. Y. Hirase coll.

Carychium stygium Call, American Naturalist, XXXI, 1897, 377.

Part of type-lot. Clapp, No. 753, twelve specimens from Mammoth Cave, Edmonson County, Kentucky. R. E. Call coll.

Pythia nana Bavay, Conchol. Mag., II, 1908, 1.

Part of type-lot. C. M., No. 62.15741, six specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Family LYMNÆIDÆ.

Galba hendersoni Baker, Nautilus, XXII, 1909, 140.

Part of type-lot. C. M., No. 62.12535, two specimens from west of Fort Collins, Laramie County, Colorado.

Family PLANORBIDÆ.

Planorbis antrosus percarinatus Walker, Nautilus, XXIII, 1909, 6.

Part of type-lot. C. M., No. 62.13115, three specimens from Crystal Lake, Benzie County, Michigan. B. Walker coll.

Segmentina obstructa anodonta Pilsbry, Proc. Acad. Nat. Science Phila., 1919, 219.

Part of type-lot. C. M., No. 62.8420, twenty-nine specimens from four miles north of Guatemala City, Guatemala. A. A. Hinkley coll.

Family ANCYLIDÆ.

Neoplanorbis carinatus Walker, Nautilus, XXI, 1908, 127.

Part of type-lot. C. M., No. 62.13079, many specimens from Coosa River, Duncan's Riffle, Coosa County, Alabama. H. H. Smith coll.

Neoplanorbis smithi Walker, Nautilus, XXI, 1908, 126.

Part of type-lot. C. M., No. 62.13085, thirty specimens from Coosa River, Higgin's Ferry, Chilton County, Alabama. H. H. Smith coll.

Neoplanorbis umbilicatus Walker, Nautilus, XXI, 1908, 126.

Part of type-lot. C. M., No. 62.13083, fifteen specimens from Coosa River, the Bar, two and one half miles above Yellow Leaf Creek, Chilton County, Alabama. H. H. Smith coll.

SUBORDER *STYLOMMATOPHORA*.

SUPERFAMILY HOLOPODA.

Family HELICIDÆ.

Ashmunella angulata Pilsbry, Proc. Acad. Nat. Science Phila., 1905, 244.

Part of type-lot. Clapp, No. 7032, three specimens from Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Ashmunella danielsi Pilsbry and Ferriss, Nautilus, XXIX, 1915, 34.

Part of type-lot. Clapp, No. 7757, ten specimens from Cave Spring Canyon, Mogollon Mountains, New Mexico. J. H. Ferriss coll.

Ashmunella danielsi dispar Pilsbry and Ferriss, Nautilus, XXIX, 1915, 41.

Part of type-lot. Clapp, No. 7758, five specimens from Little White Water, Glenwood, New Mexico. J. H. Ferriss coll.

Ashmunella ferrissi Pilsbry, Proc. Acad. Nat. Science Phila., 1905, 247.

Part of type-lot. Clapp, No. 7038, seven specimens from Cave Creek Canyon, Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Ashmunella fissidens pomeroyi Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1910, 105.

Part of type-lot. Clapp, No. 7439, three specimens from Hand's Pass, Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Ashmunella kochii G. H. Clapp, Nautilus, XXII, 1908, 77.

Type-lot. Clapp, No. 5765, nine specimens from Black Mountain, south end of San Andreas Range, Donna Aña County, New Mexico. (One designated as *Type.*) W. E. Koch coll.

Ashmunella levettei angigyra Pilsbry, Proc. Acad. Nat. Science Phila., 1905, 240.

Part of type-lot. Clapp, No. 7019, eight specimens from Ramsey Canyon, Huachuca Mountains, Cochise County, Arizona. J. H. Ferriss coll.

Ashmunella levettei heterodonta Pilsbry, Proc. Acad. Nat. Science Phila., 1905, 241.

Part of type-lot. Clapp, No. 7022, three specimens from Huachuca Mountains, Cochise County, Arizona. J. H. Ferriss coll.

Ashmunella mearnsii Dall, Proc. U. S. Natl. Mus., XVIII, 1895, 2.

Part of type-lot. Clapp, No. 5766, one specimen, Huachuca Mountains, Arizona. Boundary Commission coll.

Ashmunella proxima emigrans Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1910, 102.

Part of type-lot. Clapp, No. 7437, four specimens from Big Emigrant Canyon, Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Ashmunella rhyssa edentata Cockerell = **Ashmunella rhyssa hypo-rhyssa** Cockerell, Pilsbry and Ferriss, Nautilus, XIV, 1900, 72.

Part of type-lot. C. M., No. 62.14630, one specimen from James Canyon, Cloudcroft, New Mexico. T. D. A. Cockerell coll.

Ashmunella tetrodon Pilsbry and Ferriss, Nautilus, XXIX, 1915, 15.

Part of type-lot. Clapp, No. 7759, five specimens from Dry Creek Canyon, Mogollon Mountains, New Mexico. J. H. Ferriss coll.

Ashmunella tetrodon fragilis Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1917, 89.

Part of type-lot. Clapp, No. 12260, three specimens from Cave Creek, Black Range, New Mexico. Station 58.

Ashmunella tetrodon inermis Pilsbry and Ferriss, Nautilus, XXIX, 1915, 33.

Part of type-lot. Clapp, No. 7761, two specimens from Dry Creek Canyon, Mogollon Mountains, New Mexico. J. H. Ferriss coll.

Ashmunella tetrodon mutata Pilsbry and Ferriss, Nautilus, XXIX, 1915, 31.

Part of type-lot. Clapp, No. 12196, two specimens from Big Dry Creek, above the Box, southwest side of Mogollon Mountains, New Mexico. Daniels and Walker coll.

Ashmunella townsendi Bartsch, Smithsonian Misc. Coll., XLVII, 1904, 13.

Part of type-lot. Clapp, No. 9990, one specimen from Sierra Blanco, above Ruidoso, New Mexico. H. A. Pilsbry coll.

Ashmunella walkeri Ferriss, Nautilus, XVIII, 1904, 53.

Part of type-lot. Clapp, No. 7039, one specimen from Florida Mountains, Luna County, New Mexico. J. H. Ferriss coll.

Buliminopsis turrita Gude, Proc. Malacol. Soc. London, IV, 1901, 75.

Part of type-lot. C. M., No. 62.15991, twelve specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Chloritis albolabris Pilsbry and Hirase, Nautilus, XVI, 1902, 76.

Part of type-lot. C. M., No. 62.15446, three specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Chloritis bracteata Pilsbry, Nautilus, XVI, 1902, 21.

Part of type-lot. C. M., No. 62.15448, two specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Chloritis goniostoma Möllendorff, Nachrbl. der Deutschen Malak. Ges., 1892, 92.

Part of type-lot. C. M., No. 62.17297, five specimens from Tenimber, Sunda Islands, Malay Archipelago.

Chloritis hirasei Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 565.

Part of type-lot. C. M., No. 62.15447, three specimens from Kurozu, Kii, Japan. Y. Hirase coll.

Chloritis perpunctata Pilsbry, Nautilus, XV, 1902, 116.

Part of type-lot. C. M., No. 62.15789, two specimens from Totsugawa, Yamato, Japan. Y. Hirase coll.

Epiphragmophora exarata rubicunda Rowell, Nautilus, XVI, 1902, 52.

Part of type-lot. Clapp, No. 5193, two specimens from Freestone, Sonoma County, California. J. Rowell coll.

Epiphragmophora hutsoni G. H. Clapp, Nautilus, XX, 1907, 136.

Type-lot. Clapp, No. 5659, five specimens from Plumosa Range, Quartzsite, Arizona. G. S. Hutson coll.

Eulota æmula Gude, Proc. Malacol. Soc. London, IV, 1900, 71.

Part of type-lot. C. M., No. 62.15515, twelve specimens from Takeya, Idzumo, Japan. Y. Hirase coll.

Eulota aperta awajiensis Gude, Proc. Malacol. Soc. London, IV, 1900, 11.

Part of type-lot. C. M., No. 62.15533, six specimens from Fukura, Awaji, Japan. Y. Hirase coll.

Eulota aperta cavata Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 564.

Part of type-lot. C. M., No. 62.15498, four specimens from Tomisato, Kii, Japan. Y. Hirase coll.

Eulota callizona dixoni Pilsbry and Hirase, Nautilus, XIV, 1900, 60.

Part of type-lot. C. M., No. 62.15550, four specimens from Inga, Hoki, Japan. Y. Hirase coll.

Eulota callizona minor Gude, Proc. Malacol. Soc. London, IV, 1900, 15.

Part of type-lot. C. M., No. 62.15552, six specimens from Hagi, Nagato, Japan. Y. Hirase coll.

Eulota cavitectum Pilsbry and Hirase, Nautilus, XVI, 1903, 134.

Part of type-lot. C. M., No. 62.15546, six specimens from Kochi, Tosa, Japan. Y. Hirase coll.

Eulota chishimana Pilsbry and Hirase, Nautilus, XVII, 1904, 116.

Part of type-lot. C. M., No. 62.15553, two specimens from Kunajiri, Chishima, Japan. Y. Hirase coll.

Eulota conella A. Adams. *See* **Eulota deflexa** Pilsbry. Topotype of **Helix conella** A. Adams.

Eulota conomphala Pilsbry and Hirase, Nautilus, XVII, 1903, 45.
Part of type-lot. C. M., No. 62.15517, four specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Eulota deflexa Pilsbry = **Eulota conella** A. Adams, Proc. Acad. Nat. Science Phila., LIV, 1902, 235.
Part of type-lot. C. M., No. 62.15516, four specimens from Tobishima, Ugo, Japan. Y. Hirase coll.

Eulota despecta ikiensis Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 627.
Part of type-lot. C. M., No. 62.15509, six specimens from Yawata, Iki, Japan. Y. Hirase coll.

Eulota elegantissima cara Pilsbry, Nautilus, XIV, 1901, 107.
Part of type-lot. C. M., No. 62.15519, four specimens from Kunchan, Loo Choo Islands, Japan. Y. Hirase coll.

Eulota endo Pilsbry and Hirase, Nautilus, XVII, 1904, 105.
Part of type-lot. C. M., No. 62.15488, six specimens from Seta, Omi, Japan. Y. Hirase coll.

Eulota euterpe Pilsbry and Hirase, Nautilus, XVII, 1903, 44.
Part of type-lot. C. M., No. 62.15556, three specimens from Kunchan, Riukiu Island, Loo Choo Islands, Japan. Y. Hirase coll.

Eulota friedeliana humerosa Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 625.
Part of type-lot. C. M., No. 62.15505, four specimens from Shimo-Koshikijima, Satsuma, Japan. Y. Hirase coll.

Eulota grata Gude = **Euhadra grata** Gude, Ann. Mag. Nat. Hist. VI, 1900, 455, and Proc. Acad. Nat. Science Phila., LXXX, 1928, 143.
Part of type-lot. C. M., No. 62.15557, nine specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Eulota horrida Pilsbry, Nautilus, XIV, 1900, 11.
Part of type-lot. C. M. No. 62.15521, six specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Eulota inornata Pilsbry, Nautilus, XIV, 1901, 129.
Part of type-lot. C. M., No. 62.15522, four specimens from Yaeyama, Loo Choo Islands, Japan. Y. Hirase coll.

Eulota intonsa Pilsbry and Hirase, Nautilus, XVI, 1902, 77.
Part of type-lot. C. M., No. 62.15534, six specimens from Suimura, Awa, Shikoku, Japan. Y. Hirase coll.

Eulota irrediviva Pilsbry and Hirase, Nautilus, XVIII, 1904, 32.
Part of type-lot. C. M., No. 62.15558, three specimens (Fossil) from Okinoerabushima, Osumi, Japan. Y. Hirase coll.

Eulota kobensis discus Pilsbry and Hirase, Nautilus, XVII, 1904, 105.
Part of type-lot. C. M., No. 62.15536, six specimens from Amasaki, Tosa, Japan. Y. Hirase coll.

Eulota kobensis gotoënsis Pilsbry and Hirase, Nautilus, XVI, 1902, 76.
Part of type-lot. C. M., No. 62.15537, six specimens from Goto, Hizen, Japan. Y. Hirase coll.

Eulota kiusiuensis Pilsbry, Nautilus, XIV, 1900, 79.
Part of type-lot. C. M., No. 62.15523, four specimens from Kikai, Osumi, Japan. Y. Hirase coll.

Eulota kiusiuensis oshimana Pilsbry and Hirase, Nautilus, XVI, 1903, 115.
Part of type-lot. C. M., No. 62.15524, four specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Eulota lepidophora Gude, Proc. Malacol. Soc. London, IV, 1901, 76.
Part of type-lot. C. M., No. 62.15525, six specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Eulota luhuana aomoriensis Pilsbry and Gulick, Nautilus, XIV, 1900, 89.
Part of type-lot. C. M., No. 62.15559, four specimens from Chojamura, Mutsu, Japan. Y. Hirase coll.

Eulota luhuana pachya Pilsbry = **Euhadra pachya** Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 614, and LXXX, 1928, 123.
Part of type-lot. C. M., No. 62.15500, six specimens from Kikai, Osumi, Japan. Y. Hirase coll.

Eulota luhuana vortex Pilsbry, Proc. Acad. Nat. Sci., Phila., 1928, 136.
Part of type-lot. C. M., No. 62.15564, three specimens from Kochi, Tosa, Japan. Y. Hirase coll.

Eulota luhuana yakushimana Pilsbry and Hirase = **Euhadra yakushimana** Pilsbry, Nautilus, XVII, 1903, 78, and Proc. Acad. Nat. Science Phila., LXXX, 1928, 124.

Part of type-lot. C. M., No. 62.15565, three specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Eulota marginata Pilsbry and Hirase, Nautilus, XVII, 1903, 44.

Part of type-lot. C. M., No. 62.15527, two specimens from Kunchan, Riukiu Island, Loo Choo Islands, Japan. Y. Hirase coll.

Eulota martensiana Pilsbry, Nautilus, XIV, 1901, 129.

Part of type-lot. C. M., No. 62.15538, six specimens from Sedake, Osumi, Japan. Y. Hirase coll.

Eulota mercatoria dæmonorum Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 545.

Part of type-lot. C. M., No. 62.15495, four specimens from Kikai, Osumi, Japan. (Fossil) Y. Hirase coll.

Eulota mercatoria perversa Pilsbry, Add. Cat. Land Shells Japan, 1908, 12. *See* **Nautilus,** XLV, 1931.

Part of type-lot. C. M., No. 62.15567, two specimens from Kumejima, Riukiu Island, Loo Choo Islands, Japan. Y. Hirase coll.

Eulota mimula mikuriyensis Pilsbry, Nautilus, XVI, 1902, 45.

Part of type-lot. C. M., No. 62.15540, four specimens from Mikuriya, Suruga, Japan. Y. Hirase coll.

Eulota nioyaka Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 627.

Part of type-lot. C. M., No. 62.15510, five specimens from Toba, Shima, Japan. Y. Hirase coll.

Eulota omiensis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 545.

Part of type-lot. C. M., No. 62.15496, six specimens from Itanami, Omi, Japan. Y. Hirase coll.

Eulota omiensis echizenensis Pilsbry and Hirase, Nautilus, XVI, 1902, 76.

Part of type-lot. C. M., No. 62.15528, four specimens from Arato, Echizen, Japan. Y. Hirase coll.

Eulota omma Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 625.

Part of type-lot. C. M., No. 62.15506, four specimens from Taramajima, Loo Choo Islands, Japan. Y. Hirase coll.

Eulota oshimæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 346.

Part of type-lot. C. M., No. 62.15492, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Eulota pannosa Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 563.

Part of type-lot. C. M., No. 62.15497, Atsumi, Uzen, Japan. Y. Hirase coll.

Eulota pannosa awashimana Pilsbry and Hirase, Nautilus, XVIII, 1904, 3.

Part of type-lot. C. M., No. 62.15530, four specimens from Awashima, Echigo, Japan. Y. Hirase coll.

Eulota peliomphala septentrionalis Ehrmann, Pilsbry and Gulick, Nautilus, XVI, 1902, 68.

Part of type-lot. C. M., No. 62.15572, four specimens from Shikonube, Ojima, Japan. Y. Hirase coll.

Eulota senckenbergiana awænsis Pilsbry = **Euhadra idzumonis awænsis** Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 31, and LXXX, 1928, 136.

Part of type-lot. C. M., No. 62.15501, four specimens from Suimura, Awa, Shikoku, Japan. Y. Hirase coll.

Eulota submandarina compacta Pilsbry, Nautilus, XVI, 1902, 46.

Part of type-lot. C. M., No. 62.15577, three specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Eulota submandarina magna Pilsbry, Nautilus, XV, 1901, 62.

Part of type-lot. C. M., No. 62.15578, three specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Eulota submandarina miyakejimana Pilsbry and Hirase, Nautilus, XVII, 1903, 53.

Part of type-lot. C. M., No. 62.15579, four specimens from Miyakejima, Izu, Japan. Y. Hirase coll.

Eulota tokunoshimana Pilsbry and Hirase, Nautilus, XVIII, 1904, 33.
Part of type-lot. C. M., No. 62.15543, three specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Eulota vulgivage lanx Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 32.
Part of type-lot. C. M., No. 62.15503, six specimens from Suimura, Awa, Shikoku, Japan. Y. Hirase coll.

Ganesella adelinæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 546.
Part of type-lot. C. M., No. 62.15593, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Ganesella jacobii Pilsbry, Nautilus, XIV, 1900, 12.
Part of type-lot. C. M., No. 62.15600, four specimens from Ibuki, Omi, Japan. Y. Hirase coll.

Ganesella japonica carinata Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 567.
Part of type-lot. C. M., No. 62.15599, six specimens from Ibuki, Omi, Japan. Y. Hirase coll.

Ganesella japonica heteroglypta Hirase, Proc. Acad. Nat. Science Phila., 1899, 529.
Part of type-lot. C. M., No. 62.15613, six specimens from Fukura, Awaji, Japan. Y. Hirase coll.

Ganesella myomphala okinoshimana Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 630.
Part of type-lot. C. M., No. 62.15602, three specimens from Okinoshima, Tosa, Japan. Y. Hirase coll.

Ganesella optima Pilsbry, Nautilus, XV, 1902, 116.
Part of type-lot. C. M., No. 62.15608, four specimens from Suimura, Awa, Japan. Y. Hirase coll.

Ganesella pagodula Ehrmann, Zoöl. Anzeiger, XXIII, 1900, 381.
Part of type-lot. C. M., No. 62.15616, six specimens from Nohara, Yamato, Japan. Y. Hirase coll.

Ganesella selasia Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 566.
Part of type-lot. C. M., No. 62.15595, five specimens from Nachi, Kii, Japan. Y. Hirase coll.

Ganesella selasia textilis Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 630.

Part of type-lot. C. M., No. 62.15603, three specimens from Arakura, Tosa, Japan. Y. Hirase coll.

Ganesella sororcula Pilsbry, Nautilus, XV, 1902, 116.

Part of type-lot. C. M., No. 62.15606, three specimens (fossil) from Kikai, Osumi, Japan. Y. Hirase coll.

Ganesella sororcula tokunoshimana Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 629.

Part of type-lot. C. M., No. 62.15607, three specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Ganesella tanegashimæ Pilsbry, Nautilus, XV, 1901, 63.

Part of type-lot. C. M., No. 62.15609, three specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Ganesella tanegashimæ dulcis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 565.

Part of type-lot. C. M., No. 62.15594, three specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Ganesella wiegmanniana Pilsbry, Nautilus, XIV, 1901, 116.

Part of type-lot. C. M., No. 62.15612, ten specimens from Kochi, Tosa, Japan. Y. Hirase coll.

Helicella barneyana (Ancey) Pilsbry, Man. Conch., (2), VIII, 1892, 183.

Part of type-lot. C. M., No. 62.9775, four specimens from Berrouaghia, Algeria. C. F. Ancey coll.

Helix pomatia lednicensis Brancsik, Nachrichtsbl. Deutsch. Mal. Ges., 1888, 117.

Part of type-lot. C. M., No. 62.18357, four specimens from Ruin Ledniez, Com. Trencsin, Hungary. Dr. C. Brancsik coll.

Helix urmiensis Kobelt, Nachrbl. der Deutschen Malak. Ges., XXI, 1889, 139.

Part of type-lot. C. M., No. 62.16741, two specimens from Urmia, Persia.

Leptaxis portosanctana evoluta Cockerell, Nature, 1921, 10.

Part of type-lot. C. M., No. 62.16666, two specimens from west side of Ilhao de Lima, Madeira. Dr. T. D. A. Cockerell coll.

Leptaxis undata grandior Cockerell, Nautilus, XXXIV, 1921, 114.

Part of type-lot. C. M., No. 62.16668, one specimen from east of Canical, Madeira. Dr. T. D. A. Cockerell coll.

Mandarina exoptata Pilsbry, Nautilus, XV, 1902, 117.

Part of type-lot. C. M., No. 62.15587, four specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Mandarina hirasei Pilsbry, Nautilus, XV, 1902, 141.

Part of type-lot. C. M., No. 62.15588, ten specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Mandarina mandarina conus Pilsbry, Nautilus, XVI, 1902, 6.

Part of type-lot. C. M., No. 62.15585, six specimens from Imotoshima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Mandarina mandarina hahajimana Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 29.

Part of type-lot. C. M., No. 62.15584, four specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Mandarina mandarina ponderosa Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 402.

Part of type-lot. C. M., No. 62.15583, ten specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Mandarina mandarina trifasciata Pilsbry, Cat. Land Shells Japan, 1903.

Part of type-lot. C. M., No. 62.15586, three specimens from Nakanoshima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Moellendorffia eucharistus Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 347.

Part of type-lot. C. M., No. 62.15711, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Papuina layardi Hartman, Proc. Acad. Nat. Science Phila., 1889, 91.
Type-lot. C. M., No. 62.2910, three specimens from Aura Island, New Hebrides. W. D. Hartman coll.

Plectopylis fimbriosa emoriens Gredler = **Helix fimbriosa** Hende (in part) not Martens., Man. Conch., (2), III, 1887, 158.
Part of type-lot. C. M., No. 62.17523, three specimens from Hunan, China. Gredler coll.

Plectopylis hirasei Pilsbry, Nautilus, XVIII, 1904, 58.
Part of type-lot. C. M., No. 62.15719, six specimens from Miyakojima, Riukiu Island, Loo Choo Islands, Japan. Y. Hirase coll.

Pleurodonte clappi Pilsbry, Nautilus, XV, 1901, 34.
Part of type-lot. Clapp, No. 4091, two specimens from Alto de Cielo, Sierra de Santa Marta, U. S. Colombia. H. H. Smith coll.

Polygyra albolabris goodrichi G. H. Clapp, Annals Carn. Mus., X, 1916.
Type-lot. Clapp, No. 7465, thirty-five specimens from Middle Sister Island, Lake Erie, Ontario, Canada. (One marked type.) Clapp, Goodrich, and Walker coll.

Polygyra albolabris maritima Pilsbry *See* **Polygyra albolabris minor** Sterki.

Polygyra albolabris minor Sterki = **Polygyra albolabris maritima** Pilsbry, Proc. Ohio Acad., IV, 1907, 376.
Type-lot. C. M., No. 62.18288, ten specimens from New Philadelphia, Tuscarawas County, Ohio. Dr. V. Sterki coll.

Polygyra barbata G. H. Clapp, Nautilus, XVIII, 1904, 85.
Type-lot. Clapp, No. 5116, eighteen specimens from near Tallapoosa River, E. of Wetumpka, Elmore County, Alabama. H. H. Smith coll.

Polygyra binneyana Pilsbry, Nautilus, XIII, 1899, 38.
Part of type-lot. Clapp, No. 2374, two specimens from Tushkahomma, Choctaw Nation, Indian Territory. J. H. Ferriss coll.

Polygyra binneyana chastatensis Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1906, 549.

Part of type-lot. Clapp, No. 3114, two specimens from Chastat Mountains, south of Mena, Polk County, Arkansas. J. H. Ferriss coll.

Polygyra blandiana Pilsbry, Proc. Acad. Nat. Science Phila., 1903, 203.

Part of type-lot. Clapp, No. 4282, six specimens from Springfield, Missouri. J. H. Ferriss coll.

Polygyra brevipila G. H. Clapp, Nautilus, XX, 1907, 110.

Type-lot. Clapp, No. 5656, ten specimens from Horseblock Mountain, Talladega County, Alabama. H. H. Smith coll.

Polygyra brevipila cherokeensis G. H. Clapp, Nautilus, XXX, 1916, 3.

Type-lot. Clapp, No. 7871, twenty-five specimens from near Pleasant Gap, Cherokee County, Alabama. H. H. Smith coll.

Polygyra cohuttensis G. H. Clapp, Nautilus, XXVIII, 1914, 78.

Type-lot. Clapp, No. 6866, fifteen specimens from Fort Mountain, Cohutta Mountains, Murray County, Georgia. (One specimen is the figured type.) H. H. Smith coll.

Polygyra decepta G. H. Clapp, Nautilus, XIX, 1905, 25.

Type-lot. Clapp, No. 5223, thirty-five specimens from Blount Springs, Blount County, Alabama. H. H. Smith coll.

Polygyra devia clappi Hemphill = **Helix devia clappi** Hemphill, Nautilus, XI, 1897, 74.

Part of type-lot. Clapp, No. 774, two specimens from Salmon River, Idaho. H. Hemphill coll.

Polygyra divesta indianorum Pilsbry, Nautilus, XIII, 1899, 39.

Part of type-lot. Clapp, No. 2414, eight specimens from Tushkahomma, Choctaw Nation, Indian Territory. J. H. Ferriss coll.

Polygyra edentata magazinensis Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1906, 545.

Part of type-lot. Clapp, No. 5151, nine specimens from Magazine Mountains, Logan County, Arkansas. J. H. Ferriss coll.

Polygyra fallax goniosoma Pilsbry, Nautilus, XXVI, 1912, 80.

Part of type-lot. Clapp, No. 7844, four specimens from Blountstown, Calhoun County, Florida. C. W. Johnson coll.

Polygyra ferrissi sericea Ferriss, Nautilus, XIX, 1905, 67.

Part of type-lot. Clapp, No. 5413, one specimen from Balsam Mountain, Swain County, North Carolina. J. H. Ferriss coll.

Polygyra indianorum lioderma Pilsbry, Proc. Acad. Nat. Science Phila., 1902, 511.

Part of type-lot. Clapp, No. 4701, two specimens from Red Fork, Indian Territory. J. H. Ferriss.

Polygyra inflecta approximans G. H. Clapp, Nautilus, XIX, 1905, 74.

Type-lot. Clapp, No. 5389, twenty-one specimens from Marion, Perry County, Alabama. H. H. Smith coll.

Polygyra inflecta mobilensis G. H. Clapp, Nautilus, XXVIII, 1915, 128.

Type-lot. Clapp, No. 7163, twenty specimens from Mobile, Mobile County, Alabama. L. H. McNeill coll.

Polygyra jacksoni deltoidea Simpson, Proc. U. S. Natl. Mus., 1888, 450.

Part of type-lot. Clapp, No. 880, fifty plus specimens from Fort Gibson, Indian Territory. J. B. Henderson coll.

Polygyra labrosa fimbriata G. H. Clapp, Nautilus, XXX, 1917, 139.

Type-lot. Clapp, No. 8112, eleven specimens from Sulphur City, Washington County, Arkansas. A. J. Brown coll.

Polygyra lawæ Lewis, Proc. Acad. Nat. Science Phila., 1874, 118.

Part of type-lot. Clapp, No. 2026, six specimens from Hayesville, North Carolina. Dr. James Lewis coll.

Polygyra loricata sonomænsis Hemphill, Trans. San Diego Soc. Nat. Hist., I, 1911, 101.

Part of type-lot. Clapp, No. 876, one specimen from Sonoma County, California. H. Hemphill coll.

Polygyra multilineata algonquinensis Nason, Nautilus, XIX, 1906, 141.

Part of type-lot. Clapp, No. 5487, four specimens from Algonquin, Illinois. Bryant Walker coll.

Polygyra obstricta occidentalis Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1906, 543.

Part of type-lot. Clapp, No. 4303, four specimens from near Benton, Saline County, Arkansas. Prof. Stewart Weller coll.

Polygyra pilsbryi Ferriss, Nautilus, XIV, 1900, 29.

Part of type-lot. Clapp, No. 4281, four specimens from Rich Mountain, Polk County, Arkansas. J. H. Ferriss coll.

Polygyra profunda strontiana G. H. Clapp, Annals Carn. Mus., X, 1916.

Type-lot. Clapp, No. 7466, seventeen specimens from Green Island, Lake Erie, Ohio. (One marked as type) Clapp, Goodrich, Walker coll.

Polygyra smithii G. H. Clapp, Nautilus, XIX, 1905, 73.

Type-lot. Clapp, No. 5388, seven specimens from Monte Sano, east of Huntsville, Madison County, Alabama. H. H. Smith coll.

Polygyra stenotrema nuda Pilsbry, Proc. Acad. Nat. Science Phila., 1900, 129.

Part of type-lot. Clapp, No. 4056, one specimen from Nashville, Tennessee. H. A. Pilsbry coll.

Polygyra stenotrema seminuda G. H. Clapp, Nautilus, XVIII, 1904, 86.

Type-lot. Clapp, No. 5117, twenty-five specimens from Bangor, north of Blount Springs, Blount County, Alabama. H. H. Smith coll.

Polygyra suprazonata Pilsbry, Proc. Acad. Nat. Science Phila., 1899, 393.

Part of type-lot. Clapp, No. 2698, two specimens from Tzintzuntian, Lake Patzcuaro, Michoacan, Mexico. S. N. Rhoades coll.

Polygyra texasensis Pilsbry, Nautilus, XVI, 1902, 31.

Part of type-lot. Clapp, No. 4703, one specimen from Colorado City, Mitchell County, Texas. J. H. Ferriss coll.

Polygyra tridentata discoidea Pilsbry, Nautilus, XVII, 1904, 142.

Part of type-lot. Clapp, No. 5016, six specimens from Charlestown Landing, Clark County, Indiana. L. E. Daniels coll.

Polygyra tridentata juxtidens Pilsbry, Proc. Acad. Nat. Science Phila., 1894, 20.

Part of type-lot. C. M., No. 62.8086, three specimens from Cave Town, Washington County, Maryland. Pilsbry and Ives coll.

Polygyra tridentata tennesseensis Pilsbry and Walker, Proc. Acad. Nat. Science Phila., 1902, 413.

Part of type-lot. Clapp, No. 4289, two specimens from Paint Rock, Roane County, Tennessee. J. H. Ferriss coll.

Polygyra wetherbyi Bland, Ann. Lyc. Nat. Hist. New York, X, 1873, 361.

Part of type-lot. (of three specimens) Clapp, No. 234, one specimen from Whitley County, Kentucky. A. G. Wetherby coll.

Polygyra wheatleyi clingmanica Pilsbry, Nautilus, XVIII, 1904, 90.

Part of type-lot. Clapp, No. 2830, six specimens from Clingman's Dome, Smoky Mountains, Tennessee. G. H. Clapp coll.

Praticolella campi Clapp and Ferriss, Nautilus, XXXII, 1919, 78.

Type-lot. Clapp, No. 9016, forty-two specimens and Part of type-lot. C. M., No. 62.13236, eleven specimens from Brownsville, Cameron County, Texas. J. H. Ferriss and R. D. Camp coll.

Praticolella strebeliana Pilsbry, Proc. Acad. Nat. Science Phila., 1899, 394.

Part of type-lot. Clapp, No. 2700, two specimens from Biente, near Monterey, Nuevo Leon, Mexico. S. N. Rhoades coll.

Thysanophora macneilli G. H. Clapp, Nautilus, XXXI, 1918, 74.

Type-lot. Clapp, No. 8572, thirty-five specimens from Shell Bank at Magazine Point, eight miles north of Mobile, Mobile County, Alabama. (One designated as, "Figured Type.")

Sonorella bicipitis Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1910, 55.

Part of type-lot. Clapp, No. 7424, three specimens from Buckeye Canyon, Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Sonorella binneyi Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1910, 68.

Part of type-lot. Clapp, No. 7427, five specimens from Horse-shoe Canyon, Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Sonorella binneyi franciscana Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1918, 318.

Part of type-lot. C. M., No. 62.19558, two specimens from San Francisco River, Graham County, Arizona. J. H. Ferriss coll.

Sonorella cæruliflumínis Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1918, 315.

Part of type-lot. C. M., No. 62.19559, four specimens from Blue River, Graham County, Arizona. J. H. Ferriss coll.

Sonorella danielsi Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1909, 501.

Part of type-lot. Clapp, No. 12062, two specimens from Head of Bear Canyon, Huachuca Mountains, Arizona. Daniels and Walker coll.

Sonorella granulatissima Pilsbry, Nautilus, XVI, 1902, 32.

Part of type-lot. Clapp, No. 4705, four specimens from Huachuca Mountains, Arizona. J. H. Ferriss coll.

Sonorella hatchitana flora Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1915, 347.

Part of type-lot. Clapp, No. 12251, three specimens from Florida Mountains, New Mexico.

Sonorella hinkleyi Pilsbry and Ferriss, Nautilus, XXXIII, 1919, 19.

Part of type-lot. C. M., No. 62.19563, five specimens from Cayetano Mountains, Pima County, Arizona. J. H. Ferriss coll.

Sonorella hinkleyi tumacacori Pilsbry and Ferriss, Nautilus, XXXIII, 1919, 19.

Part of type-lot. C. M., No. 62.19564, four specimens from Tumacacori Mountains, Pima County, Arizona. J. H. Ferriss coll.

Sonorella insignis Pilsbry and Ferriss, Nautilus, XXXIII, 1919, 21.

Part of type-lot. C. M., No. 62.19565, two specimens from Whetstone Mountains, Pima County, Arizona. J. H. Ferriss coll.

Sonorella marmoraria Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1918, 294.

Part of type-lot. C. M., No. 62.19566, three specimens from Marble Peak, Santa Catalina Mountains, Pima County, Arizona. J. H. Ferriss coll.

Sonorella micra Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1910, 74.

Part of type-lot. Clapp, No. 7422, five specimens from White Tail Canyon, Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Sonorella mustang Pilsbry and Ferriss, Nautilus, XXXIII, 1919, 20.

Part of type-lot. C. M., No. 62.19568, four specimens from Mustang Mountains, Cochise County, Arizona. J. H. Ferriss coll.

Sonorella odorata marmoris Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1918, 288.

Part of type-lot. C. M., No. 62.19570, two specimens from Marble Peak, Santa Catalina Mountains, Pima County, Arizona. J. H. Ferriss coll.

Sonorella rooseveltiana Berry, Nautilus, XXXI, 1917, 14.

Part of type-lot. Clapp, No. 8534, two specimens from rock slides, 2200 feet, Roosevelt, Gila County, Arizona. S. S. Barry coll.

Sonorella sitiens montezuma Pilsbry and Ferriss, Nautilus, XXXIII, 1919, 20.

Part of type-lot. C. M., No. 62.19575, four specimens from Montezuma Canyon, Huachuca Mountains, Cochise County, Arizona. J. H. Ferriss coll.

Sonorella tortillita Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1918, 299.

Part of type-lot. C. M., No. 62.19576, two specimens from Tortillita Mountains, Pima County, Arizona. J. H. Ferriss coll.

Sonorella tumamocensis Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1915, 401.

Part of type-lot. Clapp, No. 7793, three specimens from Tumamoc or Laboratory Hill, Tucson, Arizona. Station 35. J. H. Ferriss coll.

Sonorella wolcottiana Bartsch = **Micrarionta wolcottiana** Bartsch, Smithsonian Misc. Coll., 47, 187.

Part of type-lot. Clapp, No. 4966, one specimen from Palm Springs, San Diego County, California. U. S. Natl. Mus. coll.

Trishoplita awajiensis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 403.

Part of type-lot. C. M., No. 62.15770, six specimens from Anaga, Awaji, Japan. Y. Hirase coll.

Trishoplita collinsoni okinoshimæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 547.

Part of type-lot. C. M., No. 62.15773, four specimens from Okinoshima, Tosa, Japan. Y. Hirase coll.

Trishoplita cretacea bipartita Pilsbry, Nautilus, XIV, 1901, 107.

Part of type-lot. C. M., No. 62.15768, six specimens from Toyonishikama, Nagato, Japan. Y. Hirase coll.

Trishoplita goodwini kyotensis Pilsbry, Nautilus, XIV, 1900, 90.

Part of type-lot. C. M., No. 62.15765, six specimens from Kyoto, Yamashiro, Japan. Y. Hirase coll.

Trishoplita goodwini strigata Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 403.

Part of type-lot. C. M., No. 62.15771, six specimens from Hirado, Hizen, Japan. Y. Hirase coll.

Trishoplita hilgendorfi chikubushimæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 564.

Part of type-lot. C. M., No.62.15774, six specimens from Chikubushima, Omi, Japan. Y. Hirase coll.

Trishoplita lischkeana hizenensis Pilsbry and Hirase, Nautilus, XVI, 1903, 135.

Part of type-lot. C. M., No. 62.15775, six specimens from Ukujima, Hizen, Japan. Y. Hirase coll.

Trishoplita smithiana Pilsbry, Nautilus, XIV, 1901, 116.

Part of type-lot. C. M., No. 62.15769, six specimens from Arakura, Tosa, Japan. Y. Hirase coll.

(Note: This is also a cotype of synonym, *Trishoplita goodwini suprazonata* Pilsbry, Nautilus, XIV, 1900, 80, and Nautilus, XV, 1901, 19.)

Vallonia albula Sterki, Proc. Acad. Nat. Science Phila., XLV, 1893, 263.

Part of type-lot. C. M., No. 62.19236, one specimen from St. Joseph, (Probably St. Joseph de Beauce?), Quebec, Canada. A. W. Hanham coll.

Vallonia costata amurensis Sterki, Manual of Conchology, (2), VIII, 1892, 254.

Type-lot. C. M., No. 62.19234, nine specimens from Kassakewitsch (probably Kosakewitscha), Amur Province, Siberia. From Haas in 1892.

Vallonia costata helvetica Sterki, Manual of Conchology, (2), VIII, 1892, 254.

Type-lot. C. M., No. 62.19227, ten specimens from Geissberg, Brugg, Jura Mountains, Aargau, Switzerland. Dr. R. Häussler.

Vallonia costata pyrenaica Sterki, Manual of Conchology, (2), VIII, 1892, 254.

Part of type-lot. C. M., No. 62.19235, two specimens from the Pyrenees. A. D. Brown coll. Sterki collection from the Acad. Nat. Science Phila., collection.

Vallonia cyclophorella Ancey, Manual of Conchology, (2), VIII, 1892, 259.

Type-lot. C. M., No. 62.19285, two specimens from West Cliff, Custer County, Colorado. T. D. A. Cockerell coll. (Designated as "Types" by Dr. V. Sterki, *l.c.* 1893, 272.)

Vallonia declivis Sterki, Manual of Conchology, (2), VIII, 1892, 251.

Type-lot. C. M., No. 62.19177, three specimens from Danube-drift, Bavaria, Germany. S. Clessin coll.

Vallonia declivis altilis Sterki, Manual of Conchology, (2), VIII, 1892, 252.

Type. C. M., No. 62.19180, from Drift on Aare River, Aargau, Switzerland. Dr. V. Sterki coll.

Vallonia excentrica Sterki, Manual of Conchology, (2), VIII, 1892, 249.

Type-lot. C. M., No. 62.19132, five specimens from Pyrenees. A. D. Brown coll. (Part of this lot is in collection of the Acad. Nat. Science Phila.)

Vallonia jurassica Geyer, Unsere Land und Süsswasser Molluskan, XIX, 1909, 33.

Part of type-lot. C. M., No. 62.16728, one specimen from Urach, Württemberg, Germany. Dr. W. Blume coll.

Vallonia parvula Sterki, Manual of Conchology, (2), VIII, 1892, 254.

Type-lot. C. M., No. 62.19238, seven specimens from Joliet, Will County, Illinois. J. H. Ferriss coll.

Vallonia perspectiva Sterki, Manual of Conchology, (2), VIII, 1892, 257.

Type-lot. C. M., No. 62.19266, thirteen specimens from "The Cliffs," Knoxville, Knox County, Tennessee. Mrs. G. Andrews coll. (Note by A. E. Ortmann: "Not marked, but are ones first seen by Sterki in 1892. *See* Proc. Acad. Nat. Sci. Phila., 1893, p. 271.")

Vallonia pulchella hispanica Sterki, Proc. Acad. Nat. Science Phila., XLV, 1893, 251.

Part of type-lot. C. M., No. 62.19125, three specimens from Spain. From U. S. Natl. Mus., No. 100733.

Vallonia suevica Geyer, Unsere Land und Süsswasser Molluskan, XIX, 1909, 34.

Part of type-lot. C. M., No. 62.16727, one specimen from Neckartailfingen, Württemberg, Germany. Dr. W. Blume coll.

Family BULIMULIDÆ.

Auris aurissciuri lutea G. H. Clapp, Nautilus, XL, 1927, 131.

Part of type-lot. Clapp, No. 89700, from Belmont, Port-of-Spain, Trinidad.

Bulimulus corumbaënsis Pilsbry, Proc. Acad. Nat. Science Phila., 1897, 19.

Part of type-lot. Clapp, No. 1760, two specimens from Corumba, Brazil.

Part of type-lot. C. M., No. 62.14807, ten specimens. H. H. Smith coll.

Bulimus dealbatus ragsdalei Pilsbry, Nautilus, III, 1890, 122.

Part of type-lot. Clapp, No. 2390, one specimen from Montague County, Texas. H. A. Pilsbry coll.

Drymæus roseatus montanus Pilsbry, Manual of Conchology, (2), XIV, 1901, 161.

Type. Clapp, No. 4540, from Las Partidas, State of Santa Marta, U. S. Colombia. H. H. Smith coll.

Drymæus sanctæmarthæ Pilsbry, Manual of Conchology, (2), XIV, 1901, 161.

Type. Clapp, No. 4539, one specimen from Jiracasaca, State of Santa Marta, U. S. Colombia. H. H. Smith coll.

Drymæus stramineus fasciatus E. A. Smith, Proc. Malacol. Soc. London, I, 1895, 305.

Part of type-lot. C. M., No. 62.1060, three specimens from St. Vincent, West Indies. H. H. Smith coll.

Drymæus strigatus Sowerby *See* **Partula glaber** Hartman.

Placostylus bicolor Hartman, Proc. Acad. Nat. Science Phila., 1889, 91.

Type. C. M., No. 62.4683, from Santo Island, near Aura Island, New Hebrides. E. L. Layard coll.

Placostylus brazieri Hartman, Proc. Acad. Nat. Science Phila., 1889, 93.

Type. C. M., No. 62.4677, from Aura Island, New Hebrides.

Placostylus delatouri Hartman, Proc. Acad. Nat. Science Phila., 1886, 35.

Part of type-lot. C. M., No. 62.4680, two specimens (one might be the Type) from Aura Island, New Hebrides. De la Tour coll.

Placostylus layardi Hartman, Proc. Acad. Nat. Science Phila., 1886, 35.

Type. C. M., No. 62.4676, eleven specimens from Vate Island, New Hebrides. W. D. Hartman coll.

Family BULIMINIDÆ.

Ena callistoderma Pilsbry, Nautilus, XIV, 1900, 33.

Part of type-lot. C. M., No. 62.15836, six specimens from Hahajima, Ogasawara, Japan. Y. Hirase coll.

Ena callistoderma chichijimana Pilsbry, Nautilus, XV, 1902, 119.
Part of type-lot. C. M., No. 62.15837, ten specimens from Chichijima, Ogasawara, Japan. Y. Hirase coll.

Ena callistoderma ogasawaræ Pilsbry, Nautilus, XIV, 1901, 128.
Part of type-lot. C. M., No. 62.15838, four specimens from Hahajima, Ogasawara, Japan. Y. Hirase coll.

Ena hiraseana Pilsbry, Nautilus, XVI, 1902, 56.
Part of type-lot. C. M., No. 62.15839, three specimens from Hahajima, Ogasawara, Japan. Y. Hirase coll.

Ena hirasei Pilsbry, Nautilus, XIV, 1900, 32.
Part of type-lot. C. M., No. 62.15840, six specimens from Kikai, Osumi, Japan. Y. Hirase coll.

Ena reiniana hokkaidonis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 402.
Part of type-lot. C. M., No. 62.15846, three specimens from Shikunobe, Ojima, Japan. Y. Hirase coll.

Funiculus ortmanni Blume, Arkiv. f. Molluskenkunde 57, I, 1925, 17.
Part of type-lot. C. M., No. 62.18863, one specimen from Tentschuan, Szetchuan, China. Stötzner Expedition from Dr. W. Blume.

Liguus fasciatus lignumvitæ Pilsbry, Jour. Acad. Nat. Science Phila., XV, 1912, 461.
Paratype. Clapp, No. 6614, three specimens from Lignumvita Key, Florida. H. A. Pilsbry coll.

Family PUPILLIDÆ.

Clausilia ænea Pilsbry, Proc. Acad. Nat. Science Phila., LV, 1903, 317.
Part of type-lot. C. M., No. 62.15870, six specimens from Shimohanyama, Tosa, Japan. Y. Hirase coll.

Clausilia agna Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 371.
Part of type-lot. C. M., No. 62.15963, six specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Clausilia aratorum Pilsbry, Proc. Acad. Nat. Science Phila., LV, 1903, 316.
Part of type-lot. C. M., No. 62.15869, six specimens from Shimohanyama, Tosa, Japan. Y. Hirase coll.

Clausilia aulacophora Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 445.

Part of type-lot. C. M., No. 62.15894, six specimens from Fukura, Awaji, Japan. Y. Hirase coll.

Clausilia aurantiaca hypoptychia Pilsbry = **Clausilia aurantiaca plicilabris** A. Adams, Proc. Acad. Nat. Science Phila., LIII, 1901, 652.

Part of type-lot. C. M., No. 62.15916, six specimens from Kashima, Kii, Japan. Y. Hirase coll.

Clausilia awajiensis Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 444.

Part of type-lot. C. M., No. 62.15878, six specimens from Fukura, Awaji, Japan. Y. Hirase coll.

Clausilia bigeneris Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 656.

Part of type-lot. C. M., No. 62.15891, three specimens from Goto, Hizen, Japan. Y. Hirase coll.

Clausilia bilabrata tosænsis Pilsbry, Proc. Acad. Nat. Science Phila., LV, 1903, 318.

Part of type-lot. C. M., No. 62.15919, six specimens from Shiujomura, Tosa, Japan. Y. Hirase coll.

Clausilia callistochila Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 413.

Part of type-lot. C. M., No. 62.15928, four specimens from Kunchan, Loo Choo Islands, Japan. Y. Hirase coll.

Clausilia caloptyx Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 372.

Part of type-lot. C. M., No. 62.15962, six specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Clausilia caryostoma jayi Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 649.

Part of type-lot. C. M., No. 62.15867, six specimens from Jomura, Kii, Japan. Y. Hirase coll.

Clausilia cladoptyx Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 837.

Part of type-lot. C. M., No. 62.15977, five specimens from Tokemoshima, Osumi, Japan. Y. Hirase coll.

Clausilia comes Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 673.

Part of type-lot. C. M., No. 62.15981, six specimens from Kashima, Harima, Japan. Y. Hirase coll.

Clausilia crenilabium Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 420.

Part of type-lot. C. M., No. 62.15925, five specimens from Kunchan, Loo Choo Islands, Japan. Y. Hirase coll.

Clausilia dalli Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 656.

Part of type-lot. C. M., No. 62.15922, six specimens from Tairiuji, Awa, Shikoku Island, Japan. Y. Hirase coll.

Clausilia ducalis rex Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 809.

Part of type-lot. C. M., No. 62.15859, four specimens from Amagisan, Izu, Japan. Y. Hirase coll.

Clausilia entospira Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 501.

Part of type-lot. C. M., No. 62.15976, nine specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Clausilia euholostoma Pilsbry, Nautilus, XIV, 1901, 108.

Part of type-lot. C. M., No. 62.15985, six specimens from Mikuriya, Suruga, Japan. Y. Hirase coll.

Clausilia hachijoensis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 466.

Part of type-lot. C. M., No. 62.15972, six specimens from Hachijo, Izu, Japan. Y. Hirase coll.

Clausilia harimensis Pilsbry, Nautilus, XIV, 1901, 108.

Part of type-lot. C. M., No. 62.15879, six specimens from Kashima, Harima, Japan. Y. Hirase coll.

Clausilia hickonis saucia Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 822.

Part of type-lot. C. M., No. 62.15947, six specimens from Sodayama, Tosa, Japan. Y. Hirase coll.

Clausilia higoensis Pilsbry = **Clausilia kochiensis** Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 499.

Part of type-lot. C. M., No. 62.15882, six specimens from Minamata, Higo, Japan. Y. Hirase coll.

Clausilia hiraseana Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 648.

Part of type-lot. C. M., No. 62.15862, twelve specimens from Okinoshima, Tosa, Japan. Y. Hirase coll.

Clausilia hirasei Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 446.

Part of type-lot. C. M., No. 62.15966, six specimens from Kagoshima, Satsuma, Japan. Y. Hirase coll.

Clausilia holotrema Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 654.

Part of type-lot. C. M., No. 62.15986, four specimens from Nachi, Kii, Japan. Y. Hirase coll.

Clausilia hosayaka Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 814.

Part of type-lot. C. M., No. 62.15875, six specimens from Kamomura, Shima, Japan. Y. Hirase coll.

Clausilia hyperaptyx Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 827.

Part of type-lot. C. M., No. 62.15964, four specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Clausilia hyperoptyx Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 446.

Part of type-lot. C. M., No. 62.15969, six specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Clausilia hyperoptyx yæyamensis Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 831.

Part of type-lot. C. M., No. 62.15971, six specimens from Yaeyama, Loo Choo Islands, Japan. Y. Hirase coll.

Clausilia hyperoptyx yoronjimana Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 830.

Part of type-lot. C. M., No. 62.15970, four specimens from Yoronjima, Osumi, Japan. Y. Hirase coll.

Clausilia iotaptyx Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 674.

Part of type-lot. C. M., No. 62.15913, six specimens from Ibuki, Omi, Japan. Y. Hirase coll.

Clausilia iotaptyx clava Pilsbry, Nautilus, XIV, 1901, 108.

Part of type-lot. C. M., No. 62.15914, six specimens from Senzan, Awaji, Japan. Y. Hirase coll.

Clausilia jacobiana Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 641.

Part of type-lot. C. M., No. 62.15953, six specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Clausilia japonica interplicata Pilsbry, Nautilus, XIV, 1901, 108.

Part of type-lot. C. M., No. 62.15940, six specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Clausilia japonica okinoshimana Pilsbry, Nautilus, XVI, 1902, 6.

Part of type-lot. C. M., No. 62.15941, three specimens from Okinoshima, Tosa, Japan. Y. Hirase coll.

Clausilia japonica perobscura Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 482 and 653.

Part of type-lot. C. M., No. 62.15939, nine specimens from Shirono, Buzen, Japan. Y. Hirase coll.

Clausilia japonica perstriata Pilsbry, Proc. Acad. Nat. Science Phila., LV, 1903, 319.

Part of type-lot. C. M., No. 62.15942, six specimens from Kumanogongen, Echigo, Japan. Y. Hirase coll.

Clausilia japonica surngae Pilsbry = **Clausilia oostoma** Möllendorff, Proc. Acad. Nat. Science Phila., LII, 1900, 44.

Part of type-lot. C. M., No. 62.15943, six specimens from Mikuriya, Surnga, Japan. Y. Hirase coll.

Clausilia kikaiensis Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 446.

Part of type-lot. C. M., No. 62.15967, six specimens from Kikai, Osumi, Japan. Y. Hirase coll.

Clausilia kochiensis Pilsbry *See* **Clausilia higoensis** Pilsbry.

Clausilia koshikijimana Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 814.

Part of type-lot. C. M., No. 62.15876, six specimens from Shimokoshikijima, Satsuma, Japan. Y. Hirase coll.

Clausilia kurozuensis Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 518.

Part of type-lot. C. M., No. 62.15874, three specimens from Kurozu, Kii, Japan. Y. Hirase coll.

Clausilia martensi tinctilabris Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 648.

Part of type-lot. C. M., No. 62.15854, six specimens from Nachi, Kii, Japan. Y. Hirase coll.

Clausilia micropeas perpallida Pilsbry, Nautilus, XIV, 1901, 108.

Part of type-lot. C. M., No. 62.15872, six specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Clausilia mikado Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 676.

Part of type-lot. C. M., No. 62.15912, six specimens from Ibuki, Omi, Japan. Y. Hirase coll.

Clausilia mitsukurii Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 648.

Part of type-lot. C. M., No. 62.15856, six specimens from Tomisato, Kii, Japan. Y. Hirase coll.

Clausilia monelasmus Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 674.

Part of type-lot. C. M., No. 62.15984, six specimens from Kayabe, Ojima, Japan. Y. Hirase coll.

Clausilia munus Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 423.

Part of type-lot. C. M., No. 62.15965, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Clausilia nagashimana Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 810.

Part of type-lot. C. M., No. 62.15863, three specimens from Nagashima, Satsuma, Japan. Y. Hirase coll.

Clausilia nakadai Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 818.

Part of type-lot. C. M., No. 62.15930, six specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Clausilia nakadai degenerata Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 818.

Part of type-lot. C. M., No. 62.15931, six specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Clausilia neniopsis Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 530.

Part of type-lot. C. M., No. 62.15988, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Clausilia nesiothauma Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 414.

Part of type-lot. C. M., No. 62.15929, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Clausilia nolani Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 679.

Part of type-lot. C. M., No. 62.15865, six specimens from Fukura, Awaji, Japan. Y. Hirase coll.

Clausilia okinoerabuensis Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 816.

Part of type-lot. C. M., No. 62.15927, six specimens from Okinoerabushima, Osumi, Japan. Y. Hirase coll.

Clausilia oostoma Möllendorff *See* **Clausilia japonica surngæ** Pilsbry.

Clausilia oostoma dactylopoma Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 521.

Part of type-lot. C. M., No. 62.15945, six specimens from Kashio, Awaji, Japan. Y. Hirase coll.

Clausilia oostoma goniopoma Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 522.

Part of type-lot. C. M., No. 62.15944, six specimens from Wakayama, Kii, Japan. Y. Hirase coll.

Clausilia ophidoon Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 820.

Part of type-lot. C. M., No. 62.15933, six specimens from Shimo-Kochikijima, Satsuma, Japan. Y. Hirase coll.

Clausilia oscariana Pilsbry = **Clausilia pilsbryana** Ancey, Proc. Acad. Nat. Science Phila., LIII, 1901, 499.

Part of type-lot. C. M., No. 62.15920, four specimens from Fukuregi, Higo, Japan. Y. Hirase coll.

Clausilia oxycyma Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 634.

Part of type-lot. C. M., No. 62.15923, four specimens from Kagoshima, Satsuma, Japan. Y. Hirase coll.

Clausilia pattalus Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 832.

Part of type-lot. C. M., No. 62.15973, five specimens from Taramajima, Loo Choo Islands, Japan. Y. Hirase coll.

Clausilia pattalus miyakoensis Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 832.

Part of type-lot. C. M., No. 62.15974, six specimens from Miyakojima, Loo Choo Islands, Japan. Y. Hirase coll.

Clausilia perignobilis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 481.

Part of type-lot. C. M., No. 62.15880, six specimens from Okinoshima, Tosa, Japan. Y. Hirase coll.

Clausilia pigra Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 650.

Part of type-lot. C. M., No. 62.15896, six specimens from Kashima, Harima, Japan. Y. Hirase coll.

Clausilia pilsbryana Ancey *See* **Clausilia oscariana** Pilsbry.

Clausilia pilsbryi Sykes, Proc. Malacolog. Soc. London, IV, 1900, 222.

Part of type-lot. Clapp, No. 4248, one specimen from Callenga, Peru. E. R. Sykes coll.

Clausilia pinto Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 501.

Part of type-lot. C. M., No. 62.15959, ten specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Clausilia platydera minoensis Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 813.

Part of type-lot. C. M., No. 62.15910, four specimens from Mina Kamimura, Mino, Japan. Y. Hirase coll.

Clausilia platyderula Pilsbry, Proc. Acad. Nat. Science Phila., LV, 1903, 318.

Part of type-lot. C. M., No. 62.15911, six specimens from Aki, Tosa, Japan. Y. Hirase coll.

Clausilia ptychocyma Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 501.

Part of type-lot. C. M., No. 62.15960, four specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Clausilia ptychocyma yakushimæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 501.

Part of type-lot. C. M., No. 62.15961, six specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Clausilia sadoensis Pilsbry, Proc. Acad. Nat. Science Phila., LV, 1903, 315.

Part of type-lot. C. M., No. 62.15892, six specimens from Misakimura, Sado, Japan. Y. Hirase coll.

Clausilia sarissa Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 829.

Part of type-lot. C. M., No. 62.15968, six specimens from Okinoerabushima, Osumi, Japan. Y. Hirase coll.

Clausilia shikokuensis Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 681.

Part of type-lot. C. M., No. 62.15885, six specimens from Ushirogawa, Tosa, Japan. Y. Hirase coll.

Clausilia stereoma Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 502.

Part of type-lot. C. M., No. 62.15956, six specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Clausilia stereoma cognata Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 502.

Part of type-lot. C. M., No. 62.15957, six specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Clausilia stereoma hexaptyx Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 520.

Part of type-lot. C. M., No. 62.15958, six specimens from Yakushima. Osumi, Japan. Y. Hirase coll.

Clausilia subhickonis Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 821.

Part of type-lot. C. M., No. 62.15948, six specimens from Isobe, Shima, Japan. Y. Hirase coll.

Clausilia subignobilis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 655.

Part of type-lot. C. M., No. 62.15888, six specimens from Hirado, Hizen, Japan. Y. Hirase coll.

Clausilia surugensis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 633.

Part of type-lot. C. M., No. 62.15921, six specimens from Mikuriya, Suruga, Japan. Y. Hirase coll.

Clausilia sus Pilsbry, Proc. Acad. Nat. Science Phila., LV, 1903, 316.

Part of type-lot. C. M., No. 62.15893, six specimens from Muya, Awa, Shikoku, Japan. Y. Hirase coll.

Clausilia tantilla Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 655.

Part of type-lot. C. M., No. 62.15889, four specimens from Goto, Hizen, Japan. Y. Hirase coll.

Clausilia thaumatopoma Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 834.

Part of type-lot. C. M., No. 62.15975, six specimens from Kumejima, Loo Choo Islands, Japan. Y. Hirase coll.

Clausilia tokunoshimana Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 819.

Part of type-lot. C. M., No. 62.15932, six specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Clausilia tosana Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 680.

Part of type-lot. C. M., No. 62.15868, six specimens from Ushirogawa, Tosa, Japan. Y. Hirase coll.

Clausilia tryoni Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 467.

Part of type-lot. C. M., No. 62.15982, four specimens from Hachijo, Izu, Japan. Y. Hirase coll.

Clausilia tryoni miyakejimana Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 837.

Part of type-lot. C. M., No. 62.15983, six specimens from Miyakejima, Izu, Japan. Y. Hirase coll.

Clausilia una Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 656.

Part of type-lot. C. M., No. 62.15949, four specimens from Goto, Hizen, Japan. Y. Hirase coll.

Clausilia valida perfasciata Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 411.

Part of type-lot. C. M., No. 62.15934, six specimens from Kunchan, Loo Choo Islands, Japan. Y. Hirase coll.

Clausilia valida striatella Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 411.

Part of type-lot. C. M., No. 62.15935, six specimens from Miyakoshima, Loo Choo Islands, Japan. Y. Hirase coll.

Clausilia variegata nesiotica Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 474.

Part of type-lot. C. M., No. 62.15990, six specimens from Hachijo, Izu, Japan. Y. Hirase coll.

Clausilia ventriluna Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 811.

Part of type-lot. C. M., No. 62.15897, six specimens from Yasudamura, Tosa, Japan. Y. Hirase coll.

Gastrocopta bilamellata Sterki and Clapp, Nautilus, XXII, 1909, 126.

Type-lot. Clapp, No. 5942, one hundred plus specimens from Plumosa Range, Quartzsite, Arizona. G. S. Hutson coll.

Gastrocopta carnegiei Sterki = **Bifidaria carnegiei** Sterki, Nautilus, XXX, 1916, 84.

Part of type-lot. C. M., No. 62.20388, two specimens from woods north of Geneva, Ashtabula County, Ohio. Dr. V. Sterki coll.

Gastrocopta chichijimana Pilsbry, Manual of Conchology, (2), XXIV, 1918, 105.

Part of type-lot. C. M., No. 62.16230, three specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Gastrocopta clappi Sterki = **Bifidaria clappi** Sterki, Nautilus, XXII, 1909, 108.

Part of type-lot. Clapp, No. 5772, two specimens from "The Thickets," Knoxville, Tennessee. Mrs. Andrews coll.

Gastrocopta holzingeri Sterki = **Pupa holzingeri** Sterki, Nautilus, III, 1889, 37.

Type. C. M., No. 62.20385, from Will County, Illinois. William A. Marsh coll.

Gastrocopta pellucida parvidens Sterki = **Bifidaria hordeacella parvidens** Sterki, Nautilus, XII, 1899, 128.

Part of type-lot. C. M., No. 62.20391, ten specimens from Jerome, Arizona. E. H. Ashmun coll.

Gastrocopta pilsbryana Sterki = **Pupa pilsbryana** Sterki, Nautilus, III, 1890, 123.

Type. C. M., No. 62.20382, from Colorado River, Arizona. W. G. Mazyck coll.

Gastrocopta procera sterkiana Pilsbry = **Gastrocopta procera duplicata** Sterki, Manual of Conchology, XXIV, 1916-1918, 65.

Part of type-lot. Clapp, No. 6048, one hundred plus specimens from Paluxy Creek, Glenrose, Somerville County, Texas. B. Walker coll.

Gastrocopta prototypus Pilsbry, Proc. Acad. Nat. Science Phila., 1899, 400.

Part of type-lot. Clapp, No. 2912, three specimens from Cuitzeo, near Huingo, Michoacan, Mexico. S. N. Rhoades coll.

Gastrocopta tuba Pilsbry and Ferriss = **Bifidaria tuba** Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1906, 145.

Part of type-lot. Clapp, No. 5130, one specimen from the drift débris of the San Pedro River, Benson, Cochise County, Arizona. J. H. Ferriss coll.

Gastrocopta tuba intuscostata G. H. Clapp = **Chaenaxis tuba intuscostata** Clapp, Nautilus, XXII, 1908, 76.

Type-lot. Clapp, No. 5769, three hundred specimens from Plumosa Range, eight miles east of Quartzsite, Yuma County, Arizona. G. S. Hutson coll.

Lauria superstructa Mousson = **Pupa superstructa** Mousson, Journ. de Conchyl., XXIV, 1876, 37.

Type-lot. Clapp, No. 14950, two specimens from Lailasch, prov. Kutais, Transcaucasia, Russia. From Mousson.

Nenia smithiæ Pilsbry, Nautilus, XV, 1901, 39.

Part of type-lot. Clapp, No. 5459, ten specimens from El Libana, 6000′-7000′, south of Santa Marta, Colombia. H. H. Smith coll.

Nesopupa dedecora Pilsbry, Proc. Acad. Nat. Science Phila., LII, 1900, 432.

Part of type-lot. C. M., No. 62.15993, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Nesopupa tamagonari Pilsbry and Hirase, Nautilus, XVII, 1904, 118.

Part of type-lot. C. M., No. 62.15994, six specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Pupa superstructa Mousson. See above.

Lauria superstructa Mousson.

Pupilla insulivaga Pilsbry and Hirase, Proc. Acad. Nat. Science Phila. LVI, 1904, 631.

Part of type-lot. C. M., No. 62.15847, six specimens from Yoronjima, Osumi, Japan. Y. Hirase coll.

Pupilla sonorana Sterki, Nautilus, XII, 1899, 128.

Part of type-lot. C. M., No. 62.20395, two specimens from White Oaks, New Mexico. E. H. Ashmun coll.

Sterkia clementina Sterki = **Pupa clementina** Sterki, Nautilus, IV, 1890, 44.

Type. C. M., No. 62.20392, from San Clemente Island, California. H. Hemphill coll.

Sterkia hemphilli Sterki = **Pupa hemphilli** Sterki, Nautilus, IV, 1890, 27.

Part of type-lot. C. M., No. 62.20384, two specimens from San Diego, California. H. Hemphill coll.

Strobilops floridanus Pilsbry, Nautilus, XXIII, 1909, 90.

Part of type-lot. Clapp, No. 2475, four specimens from Miami, Florida. S. N. Rhoades coll.

Strobilops hubbardi stevensoni Pilsbry, Nautilus, XIII, 1899, 46.

Part of type-lot. Clapp, No. 2476, one specimen from Miami, Florida. S. N. Rhoades coll.

Vertigo alabamensis G. H. Clapp, Nautilus, XXVIII, 1915, 137.

Type-lot. Clapp, No. 7370, nine specimens from near the Junction of North River and Black Warrior River, Tuscaloosa County, Alabama. (One designated as "figured type.")

Vertigo alabamensis conecuhensis G. H. Clapp, Nautilus, XXVIII, 1915, 137.

Type-lot. Clapp, No. 7371, two hundred plus specimens from Evergreen, Conecuh County, Alabama. H. H. Smith coll. (One designated as "figured type.")

Vertigo dalliana Sterki = **Pupa dalliana** Sterki, Nautilus, IV, 1890, 19.

Type-lot. C. M., No. 62.20383, two specimens from near Clear Lake, Lake County, California. H. Hemphill coll.

Vertigo gouldii paradoxa Sterki, Manual of Conchology, XXV, 1919, 99.

Part of type-lot. Clapp, No. 2866, seven specimens from Woodland, Aroostook County, Maine. O. O. Nylander coll.

Vertigo morsei Sterki, Nautilus, VIII, 1894, 89.

Type-lot. C. M., No. 62.20390, two specimens from Kent County, Michigan. Bryant Walker coll.

Vertigo nylanderi Sterki, Nautilus, XXII, 1909, 107.

Type-lot. C. M., No. 62.20386, three specimens from Woodland, Aroostook County, Maine. O. O. Nylander coll.

Vertigo perryi Sterki, Nautilus, XIX, 1905, 53.

Part of type-lot. C. M., No. 62.20393, one specimen from Warwick, Rhode Island. J. F. Perry coll.

Vertigo rugosula oralis Sterki = **Vertigo rugosula ovulum** Sterki, Proc. Acad. Nat. Science Phila., 1890, 35.

Type. C. M., No. 62.20394, three specimens from Volusia County, Florida. G. W. Webster coll.

Family CERIONIDÆ.

Cerion fordi Pilsbry and Vanatta, Manual of Conchology, (2), XIV, 1902, 270.

Part of type-lot. C. M., No. 62.2507, two specimens from the Bahamas.

Cerion fordi submarmortum Pilsbry and Vanatta, Manual of Conchology, (2), XIV, 1902, 270.

Part of type-lot. C. M., No. 62.2508, two specimens from the Bahamas.

Cerion incanum saccharimeta Blanes, *See* Pilsbry, Proc. Acad. Nat. Science Phila., 1898, 477.

Part of type-lot. Clapp, No. 1112, one specimen from Sugar Loaf Key, Florida. F. E. Blanes coll.

Family UROCOPTIDÆ.

Brachypodella insulæ-cygni W. F. Clapp, Nautilus, XXVII, 1914, 99.

Part of type-lot. Clapp, No. 15266, two specimens from Swan Island, Caribbean Sea. George Nelson coll.

Holospira arizonensis mustang Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1923, 98.

Part of type-lot. C. M., No. 62.19579, six specimens from Mustang Mountains, Cochise County, Arizona. J. H. Ferriss coll.

Holespira bilamellata heliophila Pilsbry, Proc. Acad. Nat. Science Phila., 1915, 338.

Part of type-lot. Clapp, No. 14272, six specimens from Teocalli Buttes, Hachita Grande Mountains, New Mexico. Daniels and Walker coll.

Holospira bilamellata media Pilsbry, Proc. Acad. Nat. Science Phila., 1915, 339.

Part of type-lot. Clapp, No. 12163, six specimens from southwest part of Sheridan Canyon, Hachita Grande Mountains, New Mexico. Daniels and Walker coll.

Holospira chiricahuana Pilsbry, Proc. Acad. Nat. Science Phila., 1905, 219.

Part of type-lot. Clapp, No. 5128, six specimens from Cave Creek, Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Holospira cionella intermedia Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1910, 123.

Part of type-lot. Clapp, No. 12166, seven specimens from White Tail Canyon, Chiricahua Mountains, Arizona. Ferriss and Walker coll.

Holospira elizabethæ Pilsbry, Manual of Conchology, (2), XV, 1903, 99.

Part of type-lot. C. M., No. 62.2761, eleven specimens and No. 62.7193, one hundred specimens from Amula, Guerrero, Mexico. H. H. Smith coll.

Holospira ferrissi Pilsbry, Proc. Acad. Nat. Science Phila., 1905, 215.

Part of type-lot. Clapp, No. 7058, four specimens from Manilla Mines, Huachuca Mountains, Cochise County, Arizona. J. H. Ferriss coll.

Holospira mesolia Pilsbry, Nautilus, XXVI, 1912, 89.

Part of type-lot. Clapp, No. 6154, one specimen from Sanderson, Terrell County, Texas. H. A. Pilsbry coll.

Urocoptis acicularis Torre, Nautilus, XXVI, 1912, 68.

Part of type-lot. Clapp, No. 14689, four specimens from Chinchilla and the Mogotes de las Tumaguas, near Sagua la Grande, Santa Clara Province, Cuba. Dr. C. de la Torre coll.

Urocoptis bacillaris Torre, Nautilus, XXVI, 1912, 57.

Part of type-lot. Clapp, No. 14690, nine specimens from Sierra de Matahambre y Tatibonico and Veredas de Aguada y del Chorreron in Mountains, near Las Llanadas, District of Mayajigua, Santa Clara Province, Cuba. Dr. C. de la Torre coll.

Urocoptis bacillaris albicostulata Torre, Nautilus, XXVI, 1912, 66.

Part of type-lot. Clapp, No. 14691, two specimens from Cueva Bonita and Rosa Perdida, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Urocoptis bacillaris exilis Torre, Nautilus, XXVI, 1912, 58.

Part of type-lot. Clapp, No. 14692, two specimens from Vereda le los Negros, between La Legua and Tatibonico, District of Mayajigua, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Urocoptis bacillaris sordidula Torre, Nautilus, XXVI, 1912, 66.

Part of type-lot. Clapp, No. 14693, three specimens from the road east of El Bano de Mayajigua, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Urocoptis boqueronis Torre, Nautilus, XXVI, 1912, 67.

Part of type-lot. Clapp, No. 14694, four specimens from El Boqueron, Rio Tatibonico del Norte, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Urocoptis camagueyana Torre, Nautilus, XXVI, 1912, 68.

Part of type-lot. Clapp, No. 14695, two specimens from El Cercado, Cerro de Tuabaguey and Los Paredones, Sierra de Cubitas, Province of Camaguey, Cuba. Dr. C. de la Torre coll.

Urocoptis fortiuscula Torre, Nautilus, XXVI, 1912, 57.

Part of type-lot. Clapp, No. 14696, six specimens from Casimba de Buenavista, Malpaez District, near Sagua la Grande, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Urocoptis livida Torre, Nautilus, XXVI, 1912, 56.

Part of type-lot. Clapp, No. 14697, eight specimens from El Palenque de Taguayabon and La Puntilla, near Remedios, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Urocoptis livida occulta Torre, Nautilus, XXVI, 1912, 56.

Part of type-lot. Clapp, No. 14698, ten specimens from the road between Remedios and Taguayabon, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Urocoptis pallidula Torre, Nautilus, XXVI, 1912, 57.

Part of type-lot. Clapp, No. 14699, seven specimens from Mogotes de las Jumaguas, near Sagua la Grande, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Urocoptis parallela Torre, Nautilus, XXVI, 1912, 67.

Part of type-lot. Clapp, No. 14700, five specimens from El Boqueron, Rio Tatibonico del Norte, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Urocoptis stricta Torre, Nautilus, XXVI, 1912, 66.

Part of type-lot. Clapp, No. 14701, two specimens from Lomas del Purio, near Calabazar de Sagua, Province of Santa Clara, Cuba. Dr. C. de la Torre coll.

Family ACHATINIDÆ.

Leptinaria livingstonensis Pilsbry, Nautilus, XXXIII, 1920, 80.

Part of type-lot. C. M., No. 62.8441, two specimens from Livingston, Guatemala. A. A. Hinkley coll.

Opeas mauritianum obesispira Pilsbry, Proc. Acad. Nat. Science Phila., LVI, 1904, 638.

Part of type-lot. C. M., No. 62.15790, six specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Opeas mauritianum prestoni Sykes, Manual of Conchology (2), XVIII, 1906, 134.

Part of type-lot. C. M., No. 62.9729, three specimens from Uda Pussellawa, Ceylon. H. B. Preston coll.

Family PARTULIDÆ.

Partula albescens Hartman, Proc. Acad. Nat. Science Phila., 1888, 251. *See* H. H. Smith, Annals Carn. Mus., I, 1902, 467.

Type-lot. C. M., No. 62.4290, four specimens from Aura Island, New Hebrides. E. L. Layard coll.

Partula auraniana Hartman, Proc. Acad. Nat. Science Phila., 1888, 250. *See* H. H. Smith, *l.c.*, 468.

Type-lot. C. M., No. 62.4295, eleven specimens from Aura Island, New Hebrides. E. L. Layard coll.

Partula bellula Hartman, Proc. Acad. Nat. Science Phila., 1885, 203. *See* H. H. Smith, *l.c.*, 460.

Type. C. M., No. 62.4264, from Huapu Island, Marquesas Islands. Garrett coll.

Partula carnicolor Hartman, Proc. Acad. Nat. SciencePhila., 1888, 250. *See* H. H. Smith, *l.c.*, 466.

Type-lot. C. M., No. 62.4289, four specimens from Aura Island, New Hebrides. E. L. Layard coll.

Partula coxi Hartman, Proc. Acad. Nat. Science Phila., 1886, 32. *See* H. H. Smith, *l.c.*, 455.

Type-lot. C. M., No. 62.4245, seven specimens from Ysabel Island, Solomon Islands. John Brazier coll.

Partula eximia Hartman, Proc. Acad. Nat. Science Phila., 1886, 35. *See* H. H. Smith, *l.c.*, 468.

Type. C. M., No. 62.4292, from Anietum Island, New Hebrides. E. L. Layard coll.

Partula flexuosa Hartman, Proc. Acad. Nat. Science Phila., 1885, 204. *See* H. H. Smith, *l.c.*, 453.

Type-lot. C. M., No. 62.4238, three specimens from Solomon Islands. Dr. Cox coll.

Partula fraterna Hartman, Proc. Acad. Nat. Science Phila., 1888, 250. *See* H. H. Smith, *l.c.*, 468.

Type-lot. C. M., No. 62.4294, two specimens from Aura Island, New Hebrides. E. L. Layard coll.

Partula glaber Hartman = **Drymæus strigatus** Sowerby, Proc. Acad. Nat. Science Phila., 1885, 205. *See* H. H. Smith, *l.c.*, 467.

Type. C. M., No. 62.4291, Incorrectly labeled: New Hebrides. Known from Peru. W. D. Hartman coll.

Partula hastula Hartman, Proc. Acad. Nat. Science Phila., 1886, 33. *See* H. H. Smith, *l.c.*, 453.

Type-lot. C. M., No. 62.4239, five specimens from Simbo or Eddystone Island, Solomon Group. John Brazier coll.

Partula hollandiana Pilsbry, Manual of Conchology, (2), XX, 1910, 293. *See* H. H. Smith, *l.c.*, 452, **Partula lævigata.**

Type. C. M., No. 62.4237, from Solomon Islands. Geale coll.

Partula incurva Hartman, Proc. Acad. Nat. Science Phila., 1886, 31. *See* H. H. Smith, *l.c.*, 454.

Type-lot. C. M., No. 62.4240, two specimens from Rubiana Island, Solomon Islands. John Brazier coll.

Partula kubaryi Hartman, Proc. Acad. Nat. Science Phila., 1890, 284. *See* H. H. Smith, *l.c.*, 457.

Type. C. M., No. 62.4247, Karakaut, New Britain, Bismarck Archipelago. Kubary coll.

Partula magdelinæ Hartman, Proc. Acad. Nat. Science Phila., 1885, 203. *See* H. H. Smith, *l.c.*, 460.

Type-lot. C. M., No. 62.4263, four specimens from Santa Magdalina Island, Marquesas Islands. Garrett coll.

Partula martensiana Pilsbry, Manual of Conchology, (2), XX, 1910, 310. *See* H. H. Smith, *l.c.*, 469. **P. rufa.**

Type-lot. C. M., No. 62.4298, two specimens from Ualan Island, Caroline Islands. John Brazier coll.

Partula minor Hartman, Proc. Acad. Nat. Science Phila., 1886, 31. *See* H. H. Smith, *l.c.*, 455.

Type-lot. C. M., No. 62.4243, two specimens from Erromango Island, New Hebrides. Dr. Turner coll.

Partula mooreana Hartman, Proc. Acad. Nat. Science Phila., 1880, 229. *See* H. H. Smith, *l.c.*, 448.

Type-lot. C. M., No. 62.4221, nine specimens from Society Islands, Moorea. W. D. Hartman coll.

Partula nematoraphe Pilsbry, Manual of Conchology, (2), XX, 1910, 279. *See* H. H. Smith, *l.c.*, 468. **P. alabastrina.**

Part of type-lot. C. M., No. 62.4293, two specimens from Fiji Islands (Incorrect; probably New Hebrides.) W. D. Hartman coll.

Partula newcombiana Hartman, Proc. Acad. Nat. Science Phila., 1886, 34. *See* H. H. Smith, *l.c.*, 474.

Type. C. M., No. 62.4336, (Photograph of Type. The vessel was lost in which the example was returned. The Type was lost.) from Salisbaboe Island, Talaut Islands.

Partula pyramis Hartman, Proc. Acad. Nat. Science Phila., 1886, 34. *See* H. H. Smith, *l.c.*, 471.

Type-lot. C. M., No. 62.4305, two specimens from Efate Island, New Hebrides. E. L. Layard coll.

Partula regularis Hartman, Proc. Acad. Nat. Science Phila., 1886, 31. *See* H. H. Smith, *l.c.*, 454.

Type-lot. C. M., No. 62.4241, two specimens from Savu or Galeria Island, Solomon Islands. John Brazier coll.

Partula tæniata corneola Hartman, Proc. Acad. Nat. Science Phila., 1886, 32. *See* H. H. Smith, *l.c.*, 454. **P. corneola.**

Type-lot. C. M., No. 62.4242, two specimens from Moorea, Society Islands. Mr. Geale coll.

Partula tryoni Hartman = **Partula zebrina** Gould, Proc. Acad. Nat. Science Phila., 1885, 204. *See* H. H. Smith, *l.c.*, 460.

Type. C. M., No. 62.4261, (Solomon Islands, incorrect), Samoan Islands. Dr. Cox coll.

Partula zebrina Gould. *See* **Partula tryoni** Hartman.

Family FERUSSACIDÆ.

Cochlicopa lubrica hachijoensis Pilsbry, Nautilus, XVI, 1902, 57.

Part of type-lot. C. M., No. 62.15450, six specimens from Hachijojima, Izu, Japan. Y. Hirase coll.

Family TORNATELLINIDÆ.

Elasmias kitaiwojimanum Pilsbry and Hirase, Nautilus, XVII, 1903, 53.

Part of type-lot. C. M., No. 62.15761, four specimens from Kitaiwojima, Izu, Sulphur Islands, Japan. Y. Hirase coll.

Tornatellides inexpectatus Pilsbry, Nautilus, XV, 1901, 23.

Part of type-lot. C. M., No. 62.15762, four specimens from Yæyama, Loo Choo Islands, Japan. Y. Hirase coll.

Tornatellides tryoni Pilsbry and Cooke, Manual of Conchology, (2), XXIII, 1916, 197.

Part of type-lot. C. M., No. 62.15791, three specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Tornatellina biplicata Pilsbry, Nautilus, XVI, 1902, 57.

Part of type-lot. C. M., No. 62.15757, six specimens from Hachijojima, Izu, Japan. Y. Hirase coll.

Tornatellina hataiana Pilsbry and Cooke, Manual of Conchology, (2), XXIII, 1916, 171.

Part of type-lot. C. M., No. 62.15760, four specimens from Kitaiwojima, Sulphur Islands, Japan. Y. Hirase coll.

Tornatellina nakadai Pilsbry and Cooke, Manual of Conchology, (2), XXIII, 1916, 170.

Part of type-lot. C. M., No. 62.15759, six specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

SUPERFAMILY AGNATHOMORPHA.

Family OLEACINIDÆ.

Glandina dalli Pilsbry, Proc. Acad. Nat. Science Phila., 1899, 396.

Part of type-lot. Clapp, No. 2920, one specimen from Diente, near Monterey, Nuevo Leon, Mexico. S. N. Rhoades coll.

Glandina michoacanensis Pilsbry, Proc. Acad. Nat. Science Phila., 1899, 397.

Part of type-lot. Clapp, No. 2921, three specimens from Uruapam, Michoacan, Mexico. S. N. Rhoades coll.

Glandina rhoadsi Pilsbry, Proc. Acad. Nat. Science Phila., 1899, 395.

Part of type-lot. Clapp, No. 2922, one specimen from Diente, near Monterey, Nuevo Leon, Mexico. S. N. Rhoades coll.

Glandina truncata minor Pilsbry, Nautilus, XIII, 1899, 46.
Part of type-lot. Clapp, No. 2481, two specimens from Miami, Florida. S. N. Rhoades coll.

Ravenia hollandi Henderson = **Spiraxis anomalus** C. B. Adams, Nautilus, XII, 1898, 25, and Manual of Conchology (2), XIX, 1907-1908, 18.
Type-lot. C. M., No. 62.14873, two specimens from Jamaica. (Note: two specimens—one may be the Type.) Dr. W. J. Holland.

Strepostyla novoleonis Pilsbry, Proc. Acad. Nat. Science Phila., 1899, 397.
Part of type-lot. Clapp, No. 2924, two specimens from Diente, near Monterey, Nuevo Leon, Mexico. S. N. Rhoades coll.

Family STREPTAXIDÆ.

Ennea iwakawa yakushimæ Pilsbry, Nautilus, XV, 1901, 65.
Part of type-lot. C. M., No. 62.15486, ten specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Superfamily Aulacopoda.

Family ZONITIDÆ.

Euconulus fulvus alaskensis Pilsbry, Nautilus, XII, 1899, 116.
Part of type-lot. Clapp, No. 1120, thirty-two specimens from Dyea Valley, Alaska. P. B. Randolph coll.

Euconulus sterkii Dall, Proc. U. S. Natl. Museum, XI, 1888, 214.
Part of type-lot. Clapp, No. 5835, two specimens from New Philadelphia, Ohio. W. F. Webb (Sterki).

Fametesta mirabilis Pilsbry, Proc. Acad. Nat. Science Phila. LIV, 1902, 31.
Part of type-lot. C. M., No. 62.15636, four specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Gastrodonta demissa lamellata Pilsbry, Nautilus, XIII, 1900, 107.
Part of type-lot. Clapp, No. 2841, one specimen from Poteau, Choctaw Nation, Indian Territory. J. H. Ferriss coll.

Gastrodonta intertexta volusiæ Pilsbry, Nautilus, XIV, 1900, 40.
Part of type-lot. Clapp, No. 3102, thirty-two specimens from Mount Taylor, south of Volusia, Volusia County, Florida. H. A. Pilsbry coll.

Guppya miamiensis Pilsbry, Nautilus, XVII, 1903, 77.
Part of type-lot. Clapp, No. 2484, four specimens from Miami, Florida. S. N. Rhoades coll.

Helicarion thomsoni C. F. Ancey, Le Naturaliste, 1889, 19.
Part of type-lot. Clapp, No. 2974, two specimens from West Australia. A. W. Hanham coll.

Hirasea acuta Pilsbry, Nautilus, XVI, 1902, 5.
Part of type-lot. C. M., No. 62.15631, six specimens from Imotoshima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea acutissima Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 30.
Part of type-lot. C. M., No. 62.15634, three specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea biconcava Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 30.
Part of type-lot. C. M., No. 62.15635, four specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea chichijimana Pilsbry, Nautilus, XV, 1902, 119.
Part of type-lot. C. M., No. 62.15624, six specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea diplomphalus Pilsbry, Nautilus, XV, 1902, 141.
Part of type-lot. C. M., No. 62.15625, twelve specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea diplomphalus latispira Pilsbry, Nautilus, XVI, 1902, 47.
Part of type-lot. C. M., No. 62.15628, six specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea eutheca Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 30.

Part of type-lot. C. M., No. 62.15632, four specimens from Hahajima, O asawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea goniobasis Pilsbry, Nautilus, XV, 1902, 141.

Part of type-lot. C. M., No. 62.15627, twelve specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea hypolia Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 30.

Part of type-lot. C. M., No. 62.15633, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea insignis Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 636.

Part of type-lot. C. M., No. 62.15638, six specimens from Mukojima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea major Pilsbry, Nautilus, XVI, 1902, 47.

Part of type-lot. C. M., No. 62.15629, six specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea nesiotica Pilsbry, Nautilus, XV, 1902, 119.

Part of type-lot. C. M., No. 62.15623, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea nesiotica liobasis Pilsbry and Hirase, Conch. Magaz. I, 1907.

Part of type-lot. C. M., No. 62.15639, six specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea profundispira Pilsbry, Nautilus, XVI, 1902, 47.

Part of type-lot. C. M., No. 62.15630, four specimens from Chichijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Hirasea sinuosa Pilsbry, Nautilus, XV, 1902, 118.

Part of type-lot. C. M., No. 62.15622, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Kaliella bimaris Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 633.

Part of type-lot. C. M., No. 62.15675, six specimens from Naha, Riukiu Islands, Japan. Y. Hirase coll.

Kaliella borealis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 346.

Part of type-lot. C. M., No. 62.15662, six specimens from Kayabe, Ojima, Japan. Y. Hirase coll.

Kaliella gudei Pilsbry and Hirase, Nautilus, XVI, 1902, 79.

Part of type-lot. C. M., No. 62.15671, six specimens from Kayabe, Ojima, Japan. Y. Hirase coll.

Kaliella hachijoensis Pilsbry, Nautilus, XVI, 1902, 55.

Part of type-lot. C. M., No. 62.15670, six specimens from Hachijojima, Izu, Japan. Y. Hirase coll.

Kaliella harimensis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 404.

Part of type-lot. C. M., No. 62.15664, six specimens from Kashima, Harima, Japan. Y. Hirase coll.

Kaliella higashiyamana Pilsbry and Hirase, Nautilus, XVI, 1903, 129.

Part of type-lot. C. M., No. 62.15681, four specimens from Higashiyamamura, Awa, Shikoku, Japan. Y. Hirase coll.

Kaliella humiliconus Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 633.

Part of type-lot. C. M., No. 62.15673, four specimens from Gokashomura, Ise, Japan. Y. Hirase coll.

Kaliella kikaigashimæ Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 633.

Part of type-lot. C. M., No. 62.15672, six specimens from Kikai, Osumi, Japan. Y. Hirase coll.

Kaliella kyotensis Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 548.

Part of type-lot. C. M., No. 62.15665, six specimens from Kyoto, Yamashiro, Japan. Y. Hirase coll.

Kaliella multivolvis Pilsbry, Proc. Acad. Nat. Science Phila., 1900, 383.

Part of type-lot. C. M., No. 62.14679 and No. 62.15660, eighteen specimens from Kashima, Province of Harima, Japan. Y. Hirase coll.

Kaliella nahaënsis Gude, Conch. Mag., II, 1908, 44.
Part of type-lot. C. M., No. 62.14680, twelve specimens from Naha, Loo Choo Islands, Japan. Y. Hirase coll.

Kaliella nesiotica Pilsbry and Hirase, Nautilus, XVII, 1903, 54.
Part of type-lot. C. M., No. 62.15678, four specimens from Miyakejima, Izu, Japan. Y. Hirase coll.

Kaliella ogasawarana Pilsbry, Proc. Acad. Nat. Science Phila., LIV, 1902, 31.
Part of type-lot. C. M., No. 62.15668, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Kaliella okinoshimana Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 633.
Part of type-lot. C. M., No. 62.15674, four specimens from Okinoshima, Tosa, Japan. Y. Hirase coll.

Kaliella præalta izushichitoensis Pilsbry and Hirase, Nautilus, XVII, 1903, 54.
Part of type-lot. C. M., No. 62.15677, six specimens from Miyakejima, Izu, Japan. Y. Hirase coll.

Kaliella sororcula Pilsbry and Hirase, Nautilus, XVII, 1904, 107.
Part of type-lot. C. M., No. 62.15679, four specimens from Amasaki, Tosa, Japan. Y. Hirase coll.

Kaliella yæyamensis Pilsbry, Nautilus, XV, 1901, 21.
Part of type-lot. C. M., No. 62.15667, ten specimens from Yaeyama, Loo Choo Islands, Japan. Y. Hirase coll.

Macrochlamys cerasina Pilsbry, Nautilus, XV, 1902, 117.
Part of type-lot. C. M., No. 62.15690, six specimens from Tobishima, Ugo, Japan. Y. Hirase coll.

Macrochlamys cerasina awænsis Pilsbry, Nautilus, XV, 1902, 117.
Part of type-lot. C. M., No. 62.15691, six specimens from Tairiuji, Awa, Shikoku Island, Japan. Y. Hirase coll.

Macrochlamys cerasina reducta Pilsbry, Conch. Mag., I, 1907. (See Nautilus, XLV, 1931).
Part of type-lot. C. M., No. 62.15697, four specimens from Yutagawa, Uzen, Japan. Y. Hirase coll.

Macrochlamys fulgens Gude, Proc. Malacol. Soc. London, IV, 1901, 75.

Part of type-lot. C. M., No. 62.15695, six specimens from Loo Choo Islands, Japan. Y. Hirase coll.

Macrochlamys gudei inclytus Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 636.

Part of type-lot. C. M., No. 62.15693, six specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Macrochlamys tanegashimæ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 498.

Part of type-lot. C. M., No. 62.15689, six specimens from Tanegashima, Osumi, Japan. Y. Hirase coll.

Microcystina anijimana Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVII, 1905, 711.

Part of type-lot. C. M., No. 62.15709, six specimens from Anijima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Microcystina hahajimana Pilsbry, Nautilus, XV, 1902, 118.

Part of type-lot. C. M., No. 62.15704, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Microcystina lampra Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 18.

Part of type-lot. C. M., No. 62.15708, six specimens from Yakushima, Osumi, Japan. Y. Hirase coll.

Microcystina vaga Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 634.

Part of type-lot. C. M., No. 62.15707, six specimens from Muya, Awa, Shikoku Island, Japan. Y. Hirase coll.

Omphalina cuprea ozarkensis Pilsbry and Ferriss = **Omphalina fuliginosa ozarkensis** Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1906, 562.

Part of type-lot. Clapp, No. 5153, three specimens from Petit Jean Mountains, Arkansas. J. H. Ferriss coll.

Omphalina pilsbryi G. H. Clapp, Nautilus, XVIII, 1904, 30.

Type-lot. Clapp, No. 5115, twelve specimens from the ravines, near Wetumpka, Alabama. H. H. Smith coll.

Otesia hahajimana Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVII, 1905, 711.

Part of type-lot. C. M., No. 62.15718, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Pseudopartula dohertyi Aldrich = **Nanina dohertyi** Aldrich = **Ariophanta dohertyi** Aldrich, Nautilus, X, 1897, 110.

Part of type-lot. Clapp, No. 14949, one specimen from Marang, Sumatra. W. H. Doherty coll.

Sitala circumcincta elata Gude = **Kaliella elata** Gude, Ann. Mag. Nat. Hist., (7), VI, 1900, 453. *See also*, Conch. Mag., II, 1908, 45. (For Type Locality.)

Part of type-lot. C. M., No. 62.15745, six specimens from Takayama, Iyo, Japan. (Gude's locality is Kashima, Harima, Japan.) Y. Hirase coll.

Sitala latissima Pilsbry, Nautilus, XVI, 1902, 56.

Part of type-lot. C. M., No. 62.15742, six specimens from Yaeyama, Loo Choo Islands, Japan. Y. Hirase coll.

Sitala nanodes Gude = **Arnouldia nanodes** Gude, Ann. and Mag. Nat. Hist., (7), VI, 1900, 399.

Part of type-lot. C. M., No. 62.15743, six specimens from Kyoto, Yamashiro, Japan. Y. Hirase coll.

Sitala reinhardti Pilsbry, Nautilus, XIV, 1900, 81.

Part of type-lot. C. M., No. 62.15744, sixteen specimens from Kashima, Harima, Japan. Y. Hirase coll.

Trochomorpha convexa Hartman, Proc. Acad. Nat. Science Phila., 1889, 93.

Type. C. M., No. 62.4408, from Aura Island, New Hebrides. W. D. Hartman coll.

Trochomorpha cultrata Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 632.

Part of type-lot. C. M., No. 62.15782, three specimens from Tokunoshima, Osumi, Japan. Y. Hirase coll.

Trochomorpha gouldiana Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 344.

Part of type-lot. C. M., No. 62.15780, six specimens from Oshima, Osumi, Japan. Y. Hirase coll.

Trochomorpha pulcherrima Hartman, Proc. Acad. Nat. Science Phila., 1890, 228.

Type. C. M., No. 62.5825, from New Hebrides. W. D. Hartman coll.

Trochomorpha rubens Hartman, Proc. Acad. Nat. Science Phila., 1888, 251.

Part of type-lot. C. M., No. 62.4410, seven specimens from Aura Island, New Hebrides. W. D. Hartman coll.

Vitrea aldrichiana G. H. Clapp = **Paravitrea aldrichiana** G. H. Clapp, Nautilus, XX, 1907, 109.

Type. Clapp, No. 5657, from the slope of Cumberland Plateau, south-east of Anderson, Tennessee. (Close to State line in Alabama). H. H. Smith coll.

Vitrea clappi Pilsbry = **Paravitrea clappi** Pilsbry, Nautilus, XII, 1898, 86.

Part of type-lot. Clapp, No. 1114, seven specimens from Thunderhead, Great Smoky Mountains, Tennessee. G. H. Clapp coll.

Vitrea conecuhensis G. H. Clapp = **Paravitrea conecuhensis** G. H. Clapp, Nautilus, XXX, 1917, 138.

Type-lot. Clapp, No. 8111, twelve specimens from Evergreen, Conecuh County, Alabama. (One designated as "figured type"). H. H. Smith coll.

Vitrea cryptomphala G. H. Clapp = **Retinella cryptomphala cryptomphala** G. H. Clapp, Nautilus, XXIX, 1915, 25.

Type-lot. Clapp, No. 7365, one hundred plus specimens from Knox County, Tennessee. (One designated as "figured type").

Vitrea cumberlandiana G. H. Clapp = **Retinella cumberlandiana cumberlandiana** G. H. Clapp, Nautilus, XXXIII, 1919, 8.

Type-lot. Clapp, No. 9157, eight specimens from Cumberland Plateau, near Stevenson, Jackson County, Alabama. (One designated as "figured type"). H. H. Smith coll.

Vitrea lewisiana G. H. Clapp = **Retinella lewisiana** G. H. Clapp, Nautilus XXI, 1908, 129.

Type-lot. Clapp, No. 5658, five specimens from Monte Sano, near Huntsville, Madison County, Alabama. (Type designated.) H. H. Smith coll.

Vitrea pilsbryana G. H. Clapp = **Paravitrea pilsbryana** G. H. Clapp, Nautilus, XXXIII, 1919, 9.

Type-lot. Clapp, No. 9159, twenty-one specimens from the cove, three miles north of Anderson, Franklin County, Tennessee. (One shell designated as "figured type.") H. H. Smith coll.

Vitrea radiatula circumstriata Taylor = **Retinella circumstriata** ("Taylor" Walker), Man. Land and Fresh Water Mollusca of the British Isles, III, 87.

Type-lot. Clapp, No. 5268, twenty-eight specimens from one mile south of Wetumpka, Alabama. (Figured shell designated.) H. H. Smith coll.

Vitrinizonites latissimus Lewis, Phila. Acad. Nat. Sci. Proc., 1875, 336.

Type. Clapp, No. 2366, Bald Mountain, 6600′, Tennessee. Dr. James Lewis coll. (Note: "This shell appears to be Lewis' type as it agrees with measurements given in above reference, although there the locality is given as Tesquita Bald Mountain, 6600′." G. H. Clapp.)

Zonitoides chishimanus Pilsbry and Hirase, Nautilus, XVIII, 1904, 5.

Part of type-lot. C. M., No. 62.15787, six specimens from Kunajiri, Chishima, Japan. Y. Hirase coll.

Zonitoides dallianus Simpson = **Retinella dalliana** (Simpson) Pilsbry, *See* Pilsbry, Proc. Acad. Nat. Science Phila., 1889, 83.

Part of type-lot. Clapp, No. 1153, four specimens from Manatee County, Florida. J. B. Henderson coll.

Zonitoides nummus Vanatta = **Helicodiscus nummus** Vanatta, Proc. Acad. Nat. Science Phila., LI, 1899, 524.

Part of type-lot. Clapp, No. 2801, two specimens from New Braunfels, Texas. E. G. Vanatta coll.

Zonitoides subarboreus Pilsbry, Nautilus, XVI, 1902, 54.

Part of type-lot. C. M., No. 62.15786, four specimens from Hachijojima, Izu, Japan. Y. Hirase coll.

Family ENDODONTIDÆ.

Endodonta hectori Suter, Trans. New Zealand Inst., XXII, 222.

Part of type-lot. C. M., No. 62.19534, three specimens from Hastwell, North Island, New Zealand. H. Suter coll.

Endodonta pseudoleioda Suter, Trans. New Zealand Inst., XXII, 221.

Part of type-lot. C. M., No. 62.19533, two specimens from Hastwell, North Island, New Zealand. H. Suter coll.

Helicodiscus eigenmanni Pilsbry, Nautilus, XIV, 1900, 41.

Part of type-lot. Clapp, No. 2874, one specimen from Beaver Cave, near San Marcos, Texas. H. A. Pilsbry coll.

Oreohelix avalonensis Hemphill, Trans. San Diego Soc. Nat. Hist., I, 1911, 104.

Part of type-lot. Clapp, No. 6160, three specimens from Santa Catalina Island, California. H. Hemphill coll.

Oreohelix barbata Pilsbry, Proc. Acad. Nat. Science Phila., 1905, 279.

Part of type-lot. Clapp, No. 7014, seven specimens from Cave Creek Canyon, Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Oreohelix chiricahuana Pilsbry, Proc. Acad. Nat. Science Phila., 1905, 283.

Part of type-lot. Clapp, No. 7015, nine specimens from Cave Creek Canyon, Chiricahua Mountains, Arizona. J. H. Ferriss coll.

Oreohelix cooperi berryi Pilsbry, Nautilus, XXIX, 1915, 48.

Part of type-lot. Clapp, No. 8482, twelve specimens from the east slope of Swimming Woman Canyon, Big Snowy Mountains, Fergus County, Montana. S. S. Berry coll.

Oreohelix elrodi Pilsbry, Nautilus, XIV, 1900, 40.

Part of type-lot. Clapp, No. 3170, twenty-one specimens from above McDonald Lake, Mission Mountains, Montana. M. J. Elrod coll.

Oreohelix haydeni betheli Pilsbry and Cockerell, Nautilus, XXVI, 1913, 144.

Part of type-lot. C. M., No. 62.14614, three specimens from Glenwood Springs, Garfield County, Colorado. E. Bethel and T. D. A. Cockerell coll.

Oreohelix haydeni betheli Pilsbry and Cockerell forma: **alta** Pilsbry, Nautilus, XXVI, 1913, 144.

Part of type-lot. C. M., No. 62.14615, five specimens from Glenwood Springs, Garfield County, Colorado. E. Bethel and T. D. A. Cockerell coll.

Oreohelix haydeni corrugata Henderson and Daniels, Proc. Acad. Nat. Science Phila., 1916, 315.

Part of type-lot. Clapp, No. 12068, six specimens from Isolated Mountain, one mile south-east of Webster, Utah. Daniels and Walker coll.

Oreohelix hendersoni Pilsbry, Nautilus, XXVI, 1912, 29.

Part of type-lot. Clapp, No. 6546, two specimens from north-west of Longmont, Colorado. J. Henderson coll.

Oreohelix hendersoni dakani Henderson, Nautilus, XXVII, 1913, 38.

Part of type-lot. Clapp, No. 6547, two specimens from New Castle, Colorado. J. Henderson coll.

Oreohelix pygmæa Pilsbry and Cockerell, Nautilus, XXVII, 1913, 52.

Part of type-lot. Clapp, No. 6659, four specimens from Shell Creek Canyon, north-east of Shell, Wyoming. J. Henderson coll.

Oreohelix strigosa huachucana Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1902, 511.

Part of type-lot. Clapp, No. 6996, twelve specimens from Huachuca Mountains, Cochise County, Arizona. J. H. Ferriss coll.

Oreohelix strigosa meridionalis Pilsbry and Ferriss, Proc. Acad. Nat. Science Phila., 1918, 324.

Part of type-lot. C. M., No. 62.19578, two specimens from Eagle Creek, Graham County, Arizona. J. H. Ferriss coll.

Punctum amblygonum pretiosum Gude, Ann. and Mag. Nat. Hist., (7), VI, 1900, 454.

Part of type-lot. C. M., No. 62.15727, sixteen specimens from Fukura, Awaji, Japan. Y. Hirase coll.

Punctum apertum Pilsbry, Nautilus, XVIII, 1904, 5.

Part of type-lot. C. M., No. 62.15725, six specimens from Nemuro, Nemuro, Japan. Y. Hirase coll.

Punctum atomus Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 636.

Part of type-lot. C. M., No. 62.15722, six specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Punctum blandianum Pilsbry, Proc. Acad. Nat. Science Phila., 1900, 110.

Part of type-lot. Clapp, No. 1022, one specimen from "Sugar Cove," Blount County, Tennessee. G. H. Clapp coll. (Note: This is one of the two found.)

Punctum clappi Pilsbry, Nautilus, XI, 1898, 133.

Part of type-lot. Clapp, No. 950, twenty-one specimens from Seattle, King County, Washington. P. B. Randolph coll.

Punctum elachistum Pilsbry and Hirase, Nautilus, XVIII, 1904, 5.

Part of type-lot. C. M., No. 62.15724, six specimens from Yanagawa, Chikugo, Japan. Y. Hirase coll.

Punctum infans Pilsbry and Hirase, Nautilus, XVII, 1904, 107.

Part of type-lot. C. M., No. 62.15721, four specimens from Hachijo, Izu, Japan. Y. Hirase coll.

Punctum morseanum Pilsbry, Nautilus, XVI, 1902, 5.

Part of type-lot. C. M., No. 62.15720, six specimens from Hirado, Hizen, Japan. Y. Hirase coll.

Punctum rota Pilsbry and Hirase, Proc. Acad. Nat. Science Phila., LVI, 1904, 637.

Part of type-lot. C. M., No. 62.15723, six specimens from Nishigo, Uzen, Japan. Y. Hirase coll.

Pupisoma japonicum Pilsbry, Nautilus, XVI, 1902, 21.

Part of type-lot. C. M., No. 62.15735, four specimens from Hirado, Hizen, Japan. Y. Hirase coll.

Pyramidula alternata costata (Lewis) G. H. Clapp, Nautilus, XIII, 1899, 41.

Type-lot. Clapp, No. 966, twenty specimens from Cades Cove, Blount County, Tennessee. (Two designated as "types"). G. H. Clapp coll.

Pyramidula alternata eriensis G. H. Clapp, Annals of Carnegie Museum, X, 1916.

Type-lot. Clapp, No. 7464, ninety-three specimens from Middle Sister Island, Lake Erie, Ontario, Canada. (One marked "Type"). Walker, Goodrich, and Clapp coll.

Pyramidula alternata rarinotata Pilsbry, Nautilus, XIII, 1900, 114.

Part of type-lot. Clapp, No. 2348, two specimens from Winchester, Fayette County, Texas. J. A. Singley coll.

Pyramidula conica Pilsbry, Nautilus, XVI, 1902, 77.

Part of type-lot. C. M., No. 62.15739, six specimens from Suimura, Awa, Shikoku, Japan. Y. Hirase coll.

Pyramidula cumberlandiana alabama G. H. Clapp, Nautilus, XXXIV, 1920, 25.

Type-lot. Clapp, No. 7132, ten specimens from Vincent Mountain, Gurley, Madison County, Alabama. (One marked "type"). H. H. Smith coll.

Pyramidula cumberlandiana columba G. H. Clapp, Nautilus, XXXIV, 1920, 25.

Type-lot. Clapp, No. 7100, sixteen specimens from the east slope of Battle Creek Valley, Cumberland Plateau, near Dove, Marion County, Tennessee. (One shell marked "figured type"). H. H. Smith coll.

Pyramidula paupera hachijoensis Pilsbry, Nautilus, XVI, 1902, 56.

Part of type-lot. C. M., No. 62.15738, six specimens from Hachijojima, Izu, Japan. Y. Hirase coll.

Pyramidula picta G. H. Clapp, Nautilus, XXXIV, 1920, 23.

Type-lot. Clapp, No. 7101, fifteen specimens from Buck Creek Cove or No Business Cove, three miles north of Anderson, Franklin County, Tennessee. (One shell marked as "figured type"). H. H. Smith coll.

Pyramidula solitaria mynesites G. H. Clapp, Annals of Carn. Mus., X, 1916.

Type-lot. Clapp, No. 7232, thirty-five specimens from Mouse Island, Lake Erie, Ottawa County, Ohio. (One marked "type"). Calvin Goodrich coll.

Pyramidula solitaria roseo-apicata G. H. Clapp, Annals of Carn. Mus., X, 1916.

Type-lot. Clapp, No. 7463, fifty-seven specimens from North Harbor Island, Lake Erie, Ontario, Canada. (One designated as "type"). Goodrich, Walker, Clapp coll.

Pyramidula solitaria strontiana G. H. Clapp, Annals of Carn. Mus., X, 1916.

Type-lot. Clapp, No. 7462, fifty-two specimens, and Type-lot. Clapp, No. 14072, ten specimens from Green Island, Lake Erie, Ohio. (One marked "type"). Walker, Goodrich and Clapp coll.

Sphyradium edentulum alticola (Ingersoll) Pilsbry, Bull. U. S. Surv. Terr., No. 2, 1875, 128.

Part of type-lot. C. M., No. 62.18999, six specimens from Cunningham Gulch, Howardsville, San Juan County, Colorado. U. S. Geol. Surv. Terr. coll.

SUPERFAMILY ELASMOGNATHA.

Family SUCCINEIDÆ.

Succinea campestris unicolor Tryon, Amer. Jour. Conch., II, 1866, 230.

Part of type-lot. Clapp, No. 3103, one specimen from New Orleans, Orleans County, Louisiana. ("One of the original lot." Pilsbry.) Tryon coll.

Succinea hirasei Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 348.

Part of type-lot. C. M., No. 62.15751, twelve specimens from Tsuchiura, Hitachi, Japan. Y. Hirase coll.

Succinea ikiana Pilsbry and Hirase, Nautilus, XVII, 1904, 117.

Part of type-lot. C. M., No. 62.15754, six specimens from Wataramura, Iki, Japan. Y. Hirase coll.

Succinea indiana Pilsbry, Nautilus, XIX, 1905, 28.

Part of type-lot. Clapp, No. 5496, one specimen from New Harmony, Posey County, Indiana. L. E. Daniels coll.

Succinea nuttalliana Lea, Proc. Acad. Nat. Science Phila., II, 1841, 32.

Type. Clapp, No. 2262, California. Dr. James Lewis Collection. (Note: This shell is marked "type". In G. H. Clapp's handwriting is the notation: "Among some old letters left by my grandfather, Dr. E. W. Hubbard, is one from Isaac Lea to Dr. Lewis dated 1-9-68, in which he mentions sending this shell on the 8th, and says that it is 'a type specimen'.") Lea coll.

Succinea ogasawaræ Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 195.

Part of type-lot. C. M., No. 62.15748, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

Succinea ovalis chittenangoënsis Pilsbry, Proc. Acad. Nat. Science Phila., 1908, 49.

Part of type-lot. Clapp, No. 5457, fifty plus specimens, and Clapp, No. 15095, five specimens from Chittenango Falls, Madison County, New York. Pilsbry, Walker, Henderson, and Clapp coll.

Succinea puntulispira Pilsbry, Proc. Acad. Nat. Science Phila., LIII, 1901, 195.

Part of type-lot. C. M., No. 62.15749, six specimens from Hahajima, Ogasawara, Bonin Islands, Japan. Y. Hirase coll.

VIII. NOTES ON SOME AMERICAN BUTTERFLIES MAINLY RELATING TO CLASSIFICATION AND NOMENCLATURE. PART 3.

(Continued from Vol. XX, No. 1, p. 55)

By W. J. Holland.

Subfamily Nymphalinæ.

Genus Anthanassa Scudder

In the Annals, Vol. XX, p. 45, I briefly spoke of the genus *Anthanassa* Scudder. Since publishing what there appears I have critically reexamined the matter and discover to my surprise that although Scudder (Bull. Buffalo Soc. Nat. Sci., Vol. XI, 1875, p. 268), designates *Eresia cincta* Edwards as the type of his genus *Anthanassa*, he nevertheless a few lines below sinks *cincta* as a synonym of *frisia* Poey. It is evident from this fact that Scudder could not have known *cincta*, which Edwards compares with *leucodesma* Felder, it is quite different in appearance from *frisia*. As I stated, the types of *cincta* have disappeared from the Edwards collection, and, so far as I know, no specimen identified as *cincta* and agreeing with Edwards' description, is to be found in any collection in the world. Under these circumstances it appears to me to be an entirely defensible procedure to designate *Eresia frisia* Poey as the type of the genus *Anthanassa* Scudder. What he says of his genus holds good of *frisia* Poey, but certainly does not hold good of *leucodesma* Felder, with which Edwards compares *cincta*. Scudder evidently had *frisia*, which he had misidentified with *cincta*, in his mind when he set up the genus *Anthanassa*.

Genus Argynnis.

Argynnis cybele var. **krautwurmi** var. nov.

♂. *Upper side.* Ground-color not bright fulvous, as in typical *A. cybele*, but pale buff; basal and median areas of both wings dark fuscous; fore wing near the apex more or less clouded with fuscous, the subapical spots tending to fuse with each other, the marginal light spots, especially toward the costa, becoming whitish. Hind wing with the outer margin more or less fuscous; the broad light band

between the marginal and inner area light buff, punctuated about the middle by a row of five small black dots, located at the outer extremities of the second row of silvery spots of the under side, which are faintly indicated upon the upper side. *Under side.* Fore wing clouded near the apex with dark fuscous, upon which the apical and subapical small silvery spots stand out conspicuously. The inner third of the wing is not as bright pinkish red as in typical *cybele*, but obscure greyish buff. Hind wing with the basal and mesial areas dark umber, only slightly invading on the inner side the broad light submarginal band. The second row of silvery spots on this side lack the dark terminal markings, which are revealed on the upper side; the spots composing the outer row of silvery markings are relatively large and distinct, varying in form from triangular to suboval; between the outer row of silvery spots and the extreme outer margin the hind wings are broadly of the same color as the basal half of the hind wing. The thorax and abdomen on the upper side are dark, conformed in color to the adjacent wings; on the lower side they are paler. Legs pale brownish. Expanse: 2.87-3.15 inches.

Described from four female specimens, type and paratypes, from Les Cheneaux, Upper Peninsula of Michigan. I take pleasure in naming this rather striking form in honor of my associate Mr. Bernard Krautwurm, who collected the specimens a number of years ago.

Argynnis irene Boisduval

After careful study I am led to think that *Argynnis luski* Barnes & McDunnough is identical with *Argynnis irene* Bdv., and that the name *luski* sinks as a synonym of *irene*. I have compared the type of *luski* with the figure of the type of *irene* published by Oberthür and in my judgment the two are identical.

Family PIERIDÆ.

Ascia monuste var. **crameri,** var. nov.

In the Bulletin of the Brooklyn Entomological Society, Vol. XXV, No. 3, pp. 123-127, I wrote in reference to *Papilio monuste*, expressing the conviction that this insect is not the insect subsequently described and figured by Hewitson as *Pieris cynis*, as maintained in an anonymous article, which appeared in the Bulletin of the Hill Museum, Vol. III, pp. 52-56.

Since then I have been engaged in a study of the North American Pieridæ with a view to the illustration of the various species and forms in the revised edition of The Butterfly Book, which shortly

will appear. With a vast amount of material before me, I have concluded to give a varietal name to that form of *Ascia* (*Pieris*) *monuste* figured by Cramer and I designate it, therefore, as *Ascia monuste* var. *crameri*. It is larger than specimens taken in the early spring of the year in Florida and somewhat differently marked from the insect figured by Kleemann, which must be accepted as the typical form of *monuste*. *Monuste*, which ranges from the Gulf States of North America to northern Argentina, is a very variable species. The variety recently named *raza* by Klots I find represented in our collection by numerous specimens from Minas Geraes in Brazil. The Brazilian specimens agree exactly with the type and paratypes of Klots. This form ranges far to the south and is not confined to the island in the Gulf of California from which Klots originally obtained his typical material.

Genus CALLIDRYAS Boisduval

The type of the genus *Callidryas* Boisduval is *Papilio eubule* Linn. I see no reason for applying other generic names than *Callidryas* to the small group of Large Sulphurs which are found in our Gulf States. Conversion of specific into generic distinctions is being carried entirely too far. In this connection the presidential address recently delivered by Dr. Karl Jordan before the Entomological Society of London, in which he shows the variations, which exist in the genitalic armature of a well known species of hawk-moth in Europe, is most suggestive. These organs tend to vary even in the species and cannot be expected to lay foundations for generic distinctions to the extent which is being advocated by some recent writers, who, if they persevere, will presently establish a genus for every species of butterfly on the continent of North America.

Family LYCÆNIDÆ.

The following is a preprint from p. 244 of the Revised Edition of The Butterfly Book, which is passing through the press.

"SUBFAMILY SPALGINÆ Holland.
(Type *Spalgis epius* Westwood)

This subfamily of the *Lycænidæ* is proposed by me, not only upon the ground of the structural affinities of the imagines, or perfect wing-insects, but upon the structure of the larvæ, more particularly the

chrysalids, and the habits of the larvæ. The genera so far included in the group by me are the genus *Spalgis* of the eastern hemisphere, and *Feniseca* of the western hemisphere. There may be other genera, which later will be found to be properly included. The *Gerydinæ*, of the larval stages of which next to nothing is known, are, however, structurally quite different in important respects. The genus *Spalgis* ranges in Asia from Burmah to Ceylon, and in Africa is represented by several species, which occur in the tropical regions of the western coast. The genus *Feniseca*, which I include in this subfamily, has a moderately wide distribution in the eastern parts of boreal America. There is nothing really very remarkable in this in the light of what, as paleontologists, we know of the distribution of animals. Some genera, now extinct in North America, still exist in tropical Africa.

Butterfly. Both *Spalgis* and *Feniseca* agree in the structural features of the imago, and particularly in having the third to the fifth subcostal nervules of the fore wing arising from a common stalk, the third at a point about one-third of its length beyond the end of the cell.

Larva. The larvæ are oblong-oval, flattened dorsally, the segments covered with bristles or bristly hairs, arranged in dense series on the summit of each segment. The caterpillars are carnivorous, feeding upon scale-insects, with the exuviæ of which they are covered in life.

Chrysalis. All the species have chrysalids, which are peculiar in that, when viewed dorsally, they present a grotesque likeness to the features of an ape, or a human being. This is shown in the figures which I give."

Family HESPERIIDÆ.

In studying the generic nomenclature, so far as it relates to the forms which occur in the fauna of North America, and attempting to reach conclusions, which will stand the test of critical inquiry, I naturally have encountered difficulties. Some of these arise from the acceptance of the "Tentamen" of Hübner, which we now know to have been erroneously regarded as a "zoological record," whereas it was only a bit of private correspondence, as has been determined by the International Commission on Zoölogical Nomenclature, and which, moreover, as I have had occasion to point out (*Cf.* Entomological News, Vol. XXXIX, No. 2, pp. 50-59), has been thoroughly misunderstood and misinterpreted. According to Hübner himself the *Tentamen* had nothing whatever to do with generic concepts. In

consequence the so-called genus *Urbanus* and the subfamily *Urbaninæ* derived from it disappear from accredited nomenclature.

The fact just mentioned brings us to the consideration of what is the true name of the group, to which Barnes and Benjamin in their Check-List gave the subfamily name *Urbaninæ*, by previous authors known as the *Hesperiinæ*. Scudder in his "Historical Sketch of Generic Names Proposed for Butterflies," states unqualifiedly that the type of the genus *Hesperia* was fixed as *malvæ* by Cuvier in his "Tableau Élémentaire, &c." This view was generally accepted throughout the Nineteenth Century and only recently has met opposition. Barnes and Lindsey (Psyche, Vol. XXVIII, Nos. 5 and 6) treated the action of Cuvier lightly as not fixing the type of the genus, though admitting that they had not been able to examine the "Tableau Élémentaire." Careful study shows that this work should be accepted as a sincere effort to fix the species of the genera therein cited. It was an attempt by its illustrious author to bring to the knowledge of the French people the *Systema Naturæ* of Linnæus, with such changes and modifications as later investigations justified.

In the preface on pp. vii-viii, Cuvier says:

"La division générale des insectes n'est (à quelques familles près) qu'une combinaison de celles de Linnæus et de M. Fabricius; quant aux genres, pour ne point embrouiller la nomenclature, et ne point fatiguer les commençans, je n'ai mis en première ligne que ceux de *Linnæus*, et j'ai placé comme sous-genres, ou comme genres additionels ceux de M. *Fabricius*. Tout ce que j'ai dit des caractères pris de la manducation repose sur des observations exactes, auxquelles M. *Fabricius* lui-mème a pris part; et, en général, il a bièn voulu parcourir toute cette portion de l'ouvrage, et m'aider de ses conseils. On pourra mème remarquer quelques genres nouveaux qu'il m'a communiqués en manuscrit. J'aurois bien voulu profiter du grand travail de mon digne ami le citoyen Latreille; mais comme il n'a point indiqué les espèces qu'il comprend sous chacun de ses genres, je n'ai pu en adopter qu'un petit nombre."

I give a free translation of the foregoing:

'The general classification of insects (except some families) represents only a combination of those of Linnæus and of M. Fabricius. So far as genera are concerned, not to obscure the nomenclature and fatigue beginners, I have only accorded first place to those proposed by Linnæus and I have placed as subgenera, or as additional genera, those of M. Fabricius. All that I have said relating to characters founded upon methods of feeding depends upon exact observations, in which Fabricius himself has taken part, and in general he has gone over all this portion of the work and aided me by his counsel. Some new

genera which he has communicated to me in writing may be observed. I would have been glad to profit from the great labor of my worthy friend, citizen Latreille, but as he has not indicated the species, which he includes in each of his genera, I have only been able to adopt a small number of them.'

Nothing could be clearer than this statement that the author, the prince of naturalists in his day, was endeavoring to give a conspectus of the genera of animals, fixing the representative species to be accepted under the generic names he cites. He regrets that he could not use the generic names of Latreille, because that great naturalist as yet had not, except in a few cases, designated the species to be included in them, *i. e.* had not yet "fixed the types" to use a modern phrase. Cuvier tells us that he had Fabricius, the pupil of Linnæus, as his collaborator in preparing that part of his work which deals with the insects and Fabricius had read and approved the manuscript.

On p. 592 we find the following:

"LES HESPERIES (Hesperia Fabr.)

Dans lesquels le renflement des antennes est pointu, la tête grosse, et qui tiennent ordinairement les ailes horizontales, ou du moins ne les relèvent qu'à demi. Leurs chenilles ont seize jambes, et se filent un coque.

10. Le P. de la mauve (P. malvæ) Petit; ailes d'un brun foncé, parsemées de taches blanches."

From the foregoing it seems plain to me that Crotch and Scudder were perfectly correct in designating the species *malvæ* of Linnæus as the type of the genus *Hesperia*. The generic name *Hesperia* was originally given by Fabricius in 1793 to a group of three hundred and forty-nine butterflies including two hundred and thirty-one *Rurales*, most of them what we now know as *Lycænidæ*, and one hundred and eighteen *Urbicolæ*. The *Urbicolæ* are what we now know as *Hesperids*. Among these is included (No. 333) *malvæ* Linnæus. This species, as shown above, is cited by Cuvier under *Hesperia*, and, as we have seen from what Cuvier tells us in the introduction to his great work, Fabricius had read the manuscript and approved of what had been done. The placing of *malvæ* as the typical species under *Hesperia* was not merely the act of Cuvier, but had the approval of Fabricius himself, the author of the generic name *Hesperia*.

Eighteen years later Dalman, who may not even have known of the existence of Cuvier's "Tableau Élémentaire," designated *comma* as the type of *Hesperia*. There is no doubt of this; but I agree with

Crotch and Scudder that the first designation of a representative species, *i.e.* of a "type" for the genus *Hesperia* was that contained in Cuvier's work, approved by Fabricius himself.

The acceptance of *malvæ* as the type of *Hesperia* is in every way advisable, for it prevents that general upsetting of derived terms, which is involved in the contrary procedure, and is more in accord with general usage for over a century. *Urbanus* never was employed by Hübner as a generic name. As such it is erroneously credited to him. Its erroneous use as a generic term must be credited to Scudder and Barnes and Lindsey. Hübner merely suggested it in his unpublished circular letter entitled: "Tentamen, &c." as the name of a "Stirps" or family.

The **Comma**-group.

The question as to the generic name, which should be applied to the species *comma* (Linnæus) and its congeners presents difficulties. Barnes and Lindsey (Annals Entomological Society of America, Vol. XV, p. 94), designated the species *tages* as the type of the genus *Erynnis*, basing their action upon that of Scudder in 1872 in his "Systematic Revision," p. 50. Scudder in his "Historical Sketch, etc." published in 1875, p. 168, repudiates his action of 1872 and designates *comma* as the type of *Erynnis*, plainly showing that the removal by other authors of the various species included by Schrank in his genus *Erynnis* had left the species *comma* as the only species in that genus, and, according to the rules, it must stand as the type of *Erynnis* Schrank. Scudder was perfectly logical in correcting the error he made in 1872. The action of Rambur in 1858 (?) and of Scudder in 1872 in making *tages* the type of *Erynnis* must be disregarded. Scudder (Historical Sketch, p. 168) makes the case, it appears to me, perfectly clear.

Schrank's genus *Erynnis* was erected in 1801. It has chronological precedence over the name *Pamphila* erected by Fabricius in 1807. All the species recorded by Schrank under the name *Erynnis* except *comma* were transferred to other genera prior to 1833.

Malvæ was designated as the type of *Hesperia* by Cuvier, with the approval of Fabricius in 1798. The designation of *comma* as the type of *Hesperia* in 1816 by Dalman was *ultra vires* in view of the action of Cuvier and Fabricius in 1798.

Hübner in his "Verzeichniss" had transferred *alceæ* to *Carcharodus*

not later than 1819. *Thaumas* was made the type of *Adopœa* by Billberg in 1820. *Morpheus* was made the type of *Heteropterus* through the action of Dumeril in 1823. *Fritillum* is congeneric with *malvæ*, although Rambur in 1870 put it into his genus *Scelothrix*, which is a synonym for *Hesperia*. In 1832, certainly not later than 1833, *tages* was made the type of *Thanaos* by Boisduval.

It is well understood by all systematists and nomenclaterists that a genus erected by a competent authority cannot be struck down by elimination therefrom of *every* species enumerated therein. Scudder, who evidently devoted a great deal of careful attention to the matter, realized that in his somewhat hurriedly prepared paper, published in 1872, he had made an indefensible error, which he corrected in 1875. He designated the last species left in the genus *Erynnis*, to wit *comma*, as the type of the genus *Erynnis*. I cannot help believing that Scudder's process of reasoning is absolutely correct, and I am glad to know that I am sustained in this opinion by a number of the most competent European students, among them Mabille (See Seitz, Grosschmet, d. Erde, Vol. I, p. 348), Draudt (*l.c.*, Vol. V, p. 929), and many others. "To err is human," and while Dr. Scudder made errors, which he sometimes himself corrected, and some of which he did not correct, his conclusions in this case in my opinion are not open to question. I accordingly employ *Erynnis* as the generic designation of the Hesperids belonging to the "*Comma*-group," and am glad to think that in so doing I have the concurrence of eminent European investigators, who have exhaustively studied this particular question.

Genus PAMPHILA.

The genus *Pamphila* has as its type the species *palæmon*. I am in full accord with Scudder, Mabille, Draudt, and many others in this view. The generic name *Pamphilidia* Lindsey must be sunk as a synonym together with *Carterocephalus* Lederer.

SUBFAMILY MEGATHYMINÆ.

Megathymus leussleri, sp. nov.

♂. *Upper side.* The fore wing broadly black with greenish squamation at the base of the wings; fringes narrowly gray becoming wider and lighter near the outer angle, interrupted at the tips of the veins by dark gray. There is a quadrate white spot at the end of the cell near the costa; beyond it outwardly a larger squarish spot similarly colored, fusing by a narrow line with an oblong quadrate spot located

near the outer border and traversing the space between the last subcostal and the upper median nervule. Following this spot below and somewhat more inwardly is a series of three honey-yellow spots greatly decreasing in size toward the inner margin, the lowermost spot often being bifid. The hind wing is uniformly dark black with only a few greenish scales at the base; somewhat broadly banded outwardly by pale red, this red band being invaded by the black ground-color at the tips of the veins; fringes white. On the upper side of the hind wings the black bristle-like androconia characteristic of the males of the genus are well developed. *Under side.* The fore wings are deep black with the spots of the upper side reproduced but reduced in size. The hind wings on the lower side are dark gray, darker near the costa, and the region of the cell, bordered on the costa and outwardly as far as the inner angle by very pale gray. This external band of gray is composed of semi-lunate spots defined outwardly by a fine pale gray line; the fringes are whitish. There are four white spots on the hind wings: one near the costa located outwardly beyond its middle, subtriangular in form, and larger than the other spots; the second is small and circular, located some distance beyond the end of the cell; the third, which is ovate, is near the inner angle; and the fourth, which is very faint, is above the last mentioned spot and near the base. The thorax on the upper side is clothed with long greenish scales closely appressed, and extending backward over the anterior abdominal segments, the terminal being black. The palpi and the pectus below are pale gray. The thorax, the legs, and the lower side of the abdomen black.

♀. *Upper side.* The female is considerably larger than the male. The spots on the fore wing are much larger, subapical and marginal spots fusing to form an irregular outer band. Both the fore and the hind wings are more heavily clothed at their bases with long green scales than is the case with the male. The outer border of the hind wings is more broadly marked with the reddish lunules than is the case in the male. There is a submarginal row of fuscous spots running from beyond the end of the cell toward the anal angle. *Under side.* Marked as the male, but with the spots larger and the light gray band running around the wing on the costa and outer margin somewhat irrorated with minute dark dots and not broken into lunules on the outer border as in the male, but continuous. In addition to the four spots which are found on the under side of the wings of the male there are in the female here and there a few minute silvery scales suggesting spots variously located. Expanse: ♂, 60-70 mm.; ♀, 70-75 mm.

Described from nine specimens, 5 ♂♂ and 4 ♀♀, kindly sent me by my friend R. A. Leussler of Omaha, who took them on the sandhills of Nebraska. There is some variety in the specimens before me, especially on the under side, a number of them showing a tendency to white maculation on the hind wings, but by no means as strongly

developed as in the species named *streckeri* by Skinner. *Streckeri* Skinner is a smaller insect, and on the hind wings both the male and the female are profusely maculated with small silvery dots and points and lines. I have carefully studied all of the species of the genus and am convinced that the form, which I have described above, is worthy of discrimination from *M. streckeri* Skinner.

Mr. Leussler writes as follows:

"The Yucca which grows in the Nebraska sandhills is *glauca*. It has narrow, fleshy stiffly erect leaves, with needle-sharp points. It is commonly called "dagger weed" in the sandhills. When in blossom the flower stem stands three to four feet high."

Mr. Leussler kindly sends me a transcript of a paper communicated to him by Mr. J. B. Bonniwell, which apparently never has been published. At the suggestion of my friend Leussler I here give it to the world.

Notes on **Megathymus mariæ** Barnes & Benjamin.

By J. C. Bonniwell.

It was in the latter part of October 1919, that I took two specimens of *Megathymus*, a male and a female, near Ft. Bliss, El Paso, Texas. Recognizing them as a species of *Megathymus*, but being unable to place them, I sent the two specimens to Dr. Skinner. He pronounced them *polingi*, but stated it was the farthest east they had been reported. It did not take me very long to trace out the earlier stages of the species, being familiar with the habits of the *Megathymus* and having bred numbers of *cofaqui* and *yuccæ*.

Food plant. A low scrubby form of yucca (I regret that I am not able to give the exact botanical name) which is most common on the desert and mountains in the vicinity of El Paso. It has not a long upright stock like *Yucca aliofolia* (?) but is confined to clusters of plants ranging from six inches to a foot in height.

Egg. Was never able to observe ova, except what I took to be broken fragments, where attached to yucca leaves, in a similar manner to those of *Megathymus yuccæ* and *cofaqui*.

Larva. First observed very small larvæ on December 25th, feeding on the outside of leaf. On Feb. 9th found larvæ three-eighths of an inch to one-half inch long entering the fleshy stock of the leaves about one-third down from the tip. March 13, larvæ quite a bit larger, some of which I found on the outside of the leaves. Am convinced from

observation that the larva of this species does not remain in the same burrow until maturity. For one thing the yucca plant on which it is found will not provide sufficient food in one plant without destroying same (thousands are destroyed, whether from this cause or from the burrow at maturity I cannot say). It is my belief that the larvæ move from plant to plant. In the early stages the larvæ are yellow in color with numerous minute dark dots. Sparsely clothed with darkish hairs; head black with dark banded mark on top of first ring of head. The young larvæ compare favorably with the plate in Holland of young *yuccæ* larvæ.

Pupæ. Unlike *cofaqui* and *yuccæ* the larvæ of *mariæ* do not make a silk pouch. The food plant offers no amount of root or stem stock, and I was puzzled for a long time where to look. The larvæ must go into the pupal stage in August or September, for on October 8, 1920, I obtained a large number of living pupæ and some adult flies and found numerous empty fresh pupa-cases. The burrow which contains the pupa is seldom over two inches long, is made in the base of the leaf and rarely penetrates the root below the ground line. The burrow is oval rather than round, due possibly to the restrictions of the leaf in which it is made. Exit is made through a small round opening on the top surface of the leaf one-half inch to one inch above the point where leaf is joined to the plant stock. This opening is protected with a clever translucent cap, or door, circular in form and like a flap fitting flush with the top surface of the leaf. The pupæ resemble those of *cofaqui*, except that they are markedly oval or flattened (brought about by the restricted shape of the burrow I presume). Pupæ obtained October 8th began emerging the next day and continued for a matter of ten days or two weeks.

IX. AN UNDESCRIBED WATER-STRIDER FROM BRAZIL.

(Hemiptera-Gerridæ).

By C. J. Drake and H. M. Harris.

Since the publication of Notes on Some South American Gerridæ (Hemiptera) in Vol. XIX, No. 4, 1930, pp. 235-239, of these Annals, the writers have had the privilege of examining two cotypes (males) of *Tenagogonus opacus* (Champion) from the British Museum. A comparison of the specimens recorded in the afore-mentioned paper as *T. opacus* (Champ.) with the cotypes proves them to be quite distinct and to represent an undescribed species. The writers are indebted to Dr. Hugo Kahl for the privilege of restudying the five specimens of the new Gerrid from Brazil.

Genus Tenagogonus Stål, 1855.

Tenagogonus Stål, Ofv. Vet. Akad. Forh., X, 1853, p. 263, (*nomen nudum*); Stål, *ibid*, XII, 1855, p. 45.

Limnometra Mayr, Verz. Zool.-bot. Ges. Wien, XV, 1865, p. 443; Champion, Biol. Centr.-Amer., Rhynch., II, 1898, p. 150.

Tenagogonus celocis, sp. nov.

Tenagogonus opacus Drake and Harris, Ann. Carn. Mus., Vol. XIX, No. 4, 1930, p. 235 (*nec* Champion).

Winged form. Very similar to *T. opacus* (Champion) in size, color, and general appearance, but easily distinguishable by the shallower groove on the mesosternum and by the differently formed genital segments and anterior femora in the male. Markings very similar to *opacus*, the ante-coxal pieces of the meso- and metapleura each with larger and more conspicuous silvery pubescent spot. Antennæ exceedingly long and slender; proportions—(♂) 72:50:90:115, (♀) 76:57:80:115. Rostrum reaching the middle of the mesosternum, its tip black. Mesosternum distinctly but shallowly grooved down the middle in the male, in female very broadly and shallowly grooved only to the middle of the mesosternum.

Male. Anterior femora strongly curved, distinctly carinate within on the basal third, the carina becoming more strongly raised distally and terminating abruptly to form a conspicuous elevation; tibiæ

straight. Genital segments broader than in *T. opacus*, segment I truncate behind and II more strongly produced as viewed from below.

Female. Distinctly larger and stouter than male; anterior femora moderately curved, rather slender, simple. Connexivum terminating in a moderately long, blunt spine. Last venter broadly and strongly produced to form a very wide, rectilinear-like process, the length of which is about one-third of its width.

Length, ♂, ♀, 6.3—8.1 mm.; width, 1.8—2.54 mm.

Holotype, ♂, and *allotype*, ♀, Chapada, Brazil, in Carnegie Museum. *Paratypes*, 3 specimens, taken with type—♀ in Carnegie Museum and ♂ and ♀ in collection of the writers. The anterior femora (110) and tibiæ (96) are a little longer in *T. opacus* than in *T. celocis* (femora, 100; tibiæ, 85).

X. LEPTOYPHA, AN AMERICAN GENUS HITHERTO UNKNOWN AS OCCURRING IN PALEARCTIC ASIA.

(Hemiptera: Tingitidæ).

By A. Kiritshenko, Leningrad.

Many years ago Jakovlev described a species of the family *Tingitidæ* from Ussuriland in East Siberia as *Monanthia* (*Tropidochila*) *capitata* Jak., 1876, Bull. Soc. Nat. Moscou L. N3, p. 110. Owing to the fact that the placing of this insect in the genus *Monanthia* Lep. & Serv. was quite erroneous, the species has remained entirely unknown, thus resulting in many incorrect citations in hemipterous literature. As a result of a very poor description, Dr. G. Horvath in his excellent revision of Palearctic Tingitidae transferred the species to the genus *Monosteira* Costa. Recently, Mr. H. Lindberg has described and figured this species as *Tingis* (*Birgitta*) *tenuimarginata* Lindb.

In 1913 the author pointed out that "*Monanthia*" *capitata* Jak. had nothing at all to do with the genus *Monosteira* but was unable to indicate its true systematic position because the species did not fall in any palearctic genus. Through the kindness of Dr. Carl J. Drake of Iowa State College, Ames, Iowa, the author has received many specimens of North American Tingitidae and can easily recognize in *Monanthia capitata* Jak. a representative of the heretofore purely North American genus *Leptoypha* Stål.

The synonymy of the species is as follows:

Genus Leptoypha Stål, 1873.

capitata Jak., 1876, Bull. Soc. Nat. Moscou L. N3, p. 110 (*Monanthia* subgen. *Tropidochila*).

capitata Horv., 1906, Ann. Mus. Nat. Hung., IV, p. 105 (*Monosteira*).

capitata Kir., 1914, Rev. Russ. d'Entom. XIII, p. 482 (ad *Monosteiram* haud pertinet).

tenuimarginata Lind., 1927, Acta Soc. Fauna et Flora Fenn., LVI, N9, p. 19, Tab. I, fig. (*Tingis* subgen. *Birgitta*).

In 1929 the author collected this species in the upper course of the Ussuri River. It is usually found feeding on the leaves of the apple

(*Malus manshurica* Maxim.) and pear (*Pirus ussuriensis* Maxim.) trees.

The geographical distribution of *Leptoypha capitata* (Jak.) embraces the Ussuri-Land in Eastern Siberia to 48° N. lat.; the Bay of St. Vladimir, the villages Vinogradovka and Yakovlevka on the river Daubee-he and its upper course; and also Vladivostok, river Liancheehe, station of the railway Kangaus in the Sutchan-rayon.

XI. A NEW SUBSPECIES OF THE ARIZONA GRAY SQUIRREL (*SCIURUS ARIZONENSIS* COUES).

By J. Kenneth Doutt.

Recent study of a collection of mammals made for the Carnegie Museum in Arizona in the year 1927, reveals that the Gray Squirrels inhabiting the Santa Catalina and Santa Rita Mountains represent a race, which I here name and describe.

Sciurus arizonensis catalinæ, subsp. nov.

Type. Adult female (skin and skull) No. 5612, Carnegie Museum Catalog of Mammals. Taken near Soldier Camp, altitude 8000 feet, Santa Catalina Mountains, Pima County, Arizona, August 30, 1927. Collected by J. Kenneth Doutt (original No. 130).

Diagnosis. Anterior half of upper parts pale mouse-gray; posterior half of upper parts, russet. (Color terminology according to Ridgway, 1912). Rostrum narrow; interorbital breadth great; brain-case shallow (See measurements)

Range. At present only known from the Santa Catalina and Santa Rita Mountains of southern Arizona.

Material. Five specimens from the type-locality; one specimen from Old Baldie Peak, 9400 feet, Santa Rita Mountains, Santa Cruz County, Arizona; all taken between July 14th and August 30, 1927.

For comparison eleven specimens from the California Museum of Vertebrate Zoology as follows: four specimens from the type-locality of *Sciurus arizonensis huachuca* taken during May, June, and July; seven specimens of *Sciurus arizonensis arizonensis* from Carr's Ranch, Sierra Ancha, Gila County, Arizona, taken in June and November.

Comparisons. This new race comes from a region, which lies between the range of *S. a. arizonensis*, which occurs northward, and that of *S. a. huachuca*, which occurs southward; and, as might be expected, it shows characters which are intermediate between the two subspecies. The intermediate character of specimens from this region was noted by Mearns (1907, p. 280) and by Nelson (1899, p. 97). As compared with *huachuca*, *catalinæ* is russet instead of deep

mouse-gray over the rump; rostrum relatively, as well as actually, narrower and shallower; interorbital breadth greater; height of brain-case less. As compared with *arizonensis*, *catalinæ* has the brown markings confined to the rump, and not extending continuously from the head to the base of the tail; rump russet, rather than tawny olive; interorbital breadth tending to be greater, and height of brain-case less.

Measurements. In the following table the measurements of the three subspecies of *Sciurus arizonensis* are in millimeters. In each case the average is followed by the maximum and minimum in parenthesis.

TABLE OF MEASUREMENTS

Species and Subspecies	Number of specimens	Width of rostrum over anterior palatine foramina.	Least intercostal breadth	Height of brain-case at bullæ*
S. a. arizonensis	7	10.7 (11.2-10.4)	21.0 (22.0-20.0)	20.5 (21.0-19.8)
S. a. catalinæ	6	10.9 (11.3-10.5)	21.8 (22.8-20.7)	19.7 (20.0-19.5)
S. a huachuca	4	11.9 (12.4-11.2)	20.6 (21.0-19.6)	20.3 (20.5-20.2)

Remarks. The series of *S. a. arizonensis* clearly shows that there is a decided seasonal variation in color, similar to that mentioned by Mearns (1907, p. 279) in the case of *S. a. huachuca*; similar variation may be also expected in *S. a. catalinæ*.

The specimen from the Santa Rita Mountains, although most similar to *S. a. catalinæ*, can be separated readily from any of the other five specimens by its more rufous crown patch. In the series of seventeen skins of the species here assembled, it is interesting to note that specimens to the south are grayest, and that northward there is a gradual increase of rufous or tawny olive.

At the time the author was in the Santa Catalina Mountains these squirrels were feeding on the seeds of the White Pine cones, and in this connection the following digest from the field journal may be of interest. On the morning of August 24, I was hunting along the ridge south of Soldier Camp, and having previously seen signs of squirrels working along the ridge, was on the lookout for them. About five hundred yards from camp I shot one out of a White Pine tree, and just a little later saw two others in another White Pine tree. I watched one of these go out to the end of the branch and gnaw off a cone.

*Measurement taken from lowest point of auditory bullæ to lowest point in interparietal, that is, to the depression just anterior to the slight lambdoidal ridge.

Instead of letting the cone fall to the ground and going there to eat it, he carried it part way back along the branch and there, balancing himself on his hind feet, he held the cone between his front feet and the branch. As he ate the seeds he turned the cone around on the branch with much dexterity. The cones at this time were covered with soft resin and the squirrels became smeared with this, especially on the paws and about the mouth, thus causing the fur there to become badly matted.

Carnegie Museum,
Pittsburgh,
Pennsylvania.
May, 1931.

Please paste into Vol. XX, on p.273.

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1899 Revision of the Squirrels of Mexico and Central America. Proc. Wash. Acad. Sci., 1, pp. 15-110.

RIDGWAY, R.
1912 Color Standards and Color-nomenclature.

ADDENDA ET CORRIGENDA

ANNALS OF THE CARNEGIE MUSEUM VOL. XX, No. 11, 1931

p. 272. fifth line from top, *after* "rump russet, rather than tawny olive" *insert* 'shoulders pale mouse-gray rather than tawny olive.'

p. 272. In the table of measurements column four *change* "intercostal breadth" to read 'interorbital breadth.'

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ANNALS

OF THE

CARNEGIE MUSEUM

Vol. XX, No. 3–4.

June, 1931

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ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME XX, NOS. 3 AND 4.

Editorial Notes.

Since the last number of this volume of the Annals was sent to the press, many things, some sad, some glad, have happened.

The collections made in Angola by Mr. Ralph Pulitzer and Mr. and Mrs. Boulton during the earlier part of their stay in Angola have arrived in safety at the Museum. Among the notable things is a fine specimen of the Giant Sable Antelope. Mr. Boulton did not come home with Mr. and Mrs. Pulitzer, but remained at Mr. Pulitzer's request to make further collections. The Boultons will arrive in Pittsburgh about the end of the month of May.

We greatly mourn the sudden death on February 18, 1931, of Mr. Fred Marloff. His large and truly wonderful collection of the micro-lepidoptera of western Pennsylvania was acquired not very long ago through the generosity of Mr. George H. Clapp. Now Mr. Marloff by his last will and testament has bequeathed to the Carnegie Museum the entire remainder of his collection, consisting of over twenty-six thousand lepidoptera, principally Heterocera, or moths. The collection is one of the most perfect of its kind ever made in this region, and the Museum has been greatly enriched by its acquisition.

Through the generosity of Mr. John B. Semple all of the collections made by Mr. George M. Sutton on Southampton Island, Hudson Bay, from the autumn of 1929 to the autumn of 1930 have been acquired by the Carnegie Museum.

At the end of May, 1931, Mr. Semple, accompanied by Mr. Sutton, Mr. Seward Pettingill, and Mr. B. C. Lloyd will start on another expedition to the region of Hudson Bay. On the present journey they will explore the northwestern border of that great inland sea.

The habitat group kindly presented by Dr. Thomas S. Arbuthnot showing a Cheetah about to spring upon a pair of Grant's Gazelles, has been completed and has been placed in the Gallery of Mammals, where it attracts much attention.

A family of Ruffed Grouse and a group showing the common Skunk has been prepared and is on display in the Children's Museum, where there are a number of smaller groups illustrating the commoner mammals and birds. The work of preparing these two groups was done by Mr. R. L. Fricke.

Mr. LeRoy Kay accompanied by Mr. J. J. Burke and Mr. John Clark have gone to Scenic, South Dakota, to investigate a deposit of fossils, which it seemed worth while for us to examine. From this point they will repair to Vernal, Utah, to carry on further paleontological work during the summer in the upper Uinta Beds, where for the last two years they have been engaged in work.

From April 29th to May 13th an exhibition containing a representation of art work produced by pupils in the High Schools of the United States was held at the Carnegie Institute, as in former years under the auspices of "The Scholastic." This annual exhibition of art work in the high schools of the United States has revealed an extraordinary amount of talent among the pupils in these schools throughout the country. Almost every state in the union was represented by exhibits. The exhibition contained a number of striking examples of the adaptation of forms in nature for decorative purposes under what we know as "the Carnegie Museum Scheme." Some of this work attained a very high standard and might well have been accomplished by professional decorators. Upon the whole this exhibition of the work of the pupils in the schools of America is one of the most striking and interesting displays occurring on the continent.

The American Association of Museums held its Twenty-fifth Annual Meeting at the Carnegie Museum, the sessions lasting from May 21st to the evening of May 23d. There was a very large attendance, representing all the leading museums of America. Throughout our sessions we were honored by the presence of M. Jean Capart, Director of the Musées Royaux d'Art et d'Histoire of Brusselles. M. Capart is a member of the Royal Academy of Belgium and a Corresponding Fellow of the British Academy, and is furthermore Honorary Professor in the University of Liège.

The meetings were held in the Music Hall of the Carnegie Institute, the Lecture Hall of the Carnegie Museum, and sections met in different parts of the Museum, which had been assigned to them for purposes of conference. Luncheon was daily served in the Foyer of the Institute.

The meeting was concluded by the Annual Banquet, which was held in the dining hall of the Hotel Schenley. Several hundred delegates and their friends were present. The toastmaster called upon Dr. Holland as the first speaker. Dr. Holland claims the American Association of Museums as one of his "children." He related the circumstances leading to its organization and the steps which he took to bring about the first meeting, which was held at the American Museum of Natural History in New York on May 15, 1906. At that time Dr. Holland called the meeting to order and moved that Dr. Hermon C. Bumpus take the chair. A committee upon organization was appointed, consisting of Dr. W. J. Holland, Chairman, Mr. W. M. R. French of the Art Institute of Chicago, Mr. P. M. Rea Curator of the Charleston Museum, Professor James E. Talmadge of the Deseret Museum, Salt Lake City, and Dr. W. P. Wilson of the Philadelphia Commercial Museum. Dr. Holland had a draft of a Constitution and By-Laws in his pocket. The committee presently reported recommending the adoption of this constitution and by-laws, which were adopted, and still govern the Association, having been in later years modified in only one or two small particulars.

At the conclusion of the banquet M. Capart was unanimously chosen an Honorary member of the American Association of Museums and graciously responded in recognition of the singular honor which had been conferred upon him. He is the first and only honorary member of the Association.

The important and interesting discussions which took place during

the twenty-fifth meeting of the Association will be reported in the publications of the Museums Association.

Mrs. Herbert DuPuy has made important additions to the collection of miniatures, snuff-boxes, Limoges enamels, and other art objects to the DuPuy Collection, and has also generously presented two beautiful exhibition cases, to which have been transferred various miniatures and art objects to the great advantage of the general appearance of the gallery.

At a meeting of the American Society of Ichthyologists and Herpetologists held in Philadelphia, from May 8th to May 14th, Mr. A. W. Henn of this Museum was elected Treasurer and Mr. M. Graham Netting, also of this Museum, was elected Secretary. Both of these gentlemen have taken an active part in bringing about the formation of the American Society of Ichthyologists and Herpetologists.

The following item has just been received by the Editor:

"A telegram containing happy news was received from Mr. John B. Semple as follows:

'Churchill, Manitoba,
June 16, 1931

DR. ANDREY AVINOFF,
Director Carnegie Museum.

It is with extreme satisfaction that our expedition reports the collection at 8:35 this morning of the first set known to science of the eggs of the rare Harris Sparrow. Will the Museum please record it?

(Signed) JOHN B. SEMPLE FOR THE EXPEDITION'

Congratulations were wired to the lucky explorers in the name of Mr. Todd and myself.

A. AVINOFF"

Earl Douglass.

Photograph taken at the time he entered the service of the Carnegie Museum.

XII. EARL DOUGLASS.

A SKETCH IN APPRECIATION OF HIS LIFE AND WORK

By W. J. Holland.

The news of the death in Salt Lake City on Tuesday, January 13, 1931, of Earl Douglass, came some days later as a distinct shock to his many friends at the Carnegie Museum.

Earl Douglass was born at Medford, Minnesota, on October 28, 1862. His parents were the late Fernando and Abigail Louisa (Carpenter) Douglass. His father, who survived his mother, is buried on the banks of the Green River, Utah, near the spot where Earl Douglass had built for himself a house on land, which he acquired while making collections for the Carnegie Museum at the "National Dinosaur Monument."

After pursuing elementary studies in the common schools of his native village he matriculated in 1888 at the University of South Dakota, and later entered the South Dakota Agricultural College, where he took his degree as Bachelor in Science in 1892. He studied further at Iowa State College during the year 1893. For some years he taught school in Montana, part of the time at Virginia City. During the years 1899-1900 he studied in the University of Montana, serving part of the time as instructor in physics, physical geography, and geology. From the summer of 1900 to the autumn of 1901 he was an assistant to Dr. William Trelease at the Missouri Botanical Gardens in St. Louis. He then was granted a fellowship in geology at Princeton University, where under the direction of Prof. William B. Scott he studied tertiary vertebrates. In 1902 he became a member of the staff of the Carnegie Museum in the Section of Paleontology. This relationship lasted for twenty-two years until shortly after the accession of the late Mr. Douglas Stewart to the Directorship, when Earl Douglass sundered his connection with the Carnegie Museum to become a consulting geologist for certain companies engaged in developing the oil-fields of Utah. He also devoted some time to work at the State Museum in Salt Lake City.

On October 20, 1905, Mr. Douglass married Miss Pearl C. Goetschius of Alder, Montana. One son, Gawin Earl Douglass, was born to them

in the early years of their married life. He makes his home in East Salt Lake City with his widowed mother at 130 South 18th Street, and is at present engaged as draftsman and assistant engineer for a local railway company.

At the time Mr. Douglass became a member of the staff of the Carnegie Museum he brought with him to Pittsburgh quite an extensive collection of fossils, which he had collected during previous years in various parts of Montana and the Dakotas. This was purchased from him by the Museum. In the summer of 1902 he was sent to Montana to continue collecting. He was very successful. On his return to the Museum in the fall of the year he began under the direction of the late J. B. Hatcher, and subsequently under the direction of the writer of these lines, the study of the fossil remains from Montana, which had been assembled by him, and to which additions in subsequent years were made. The results of his investigations are embodied in a series of papers published in the Annals and Memoirs of the Carnegie Museum from the year 1903 to the year 1910, after which period, although carrying on most remarkable work in the field for the Museum, he ceased to produce descriptive papers, finally bending all his energies to the exploitation of the great quarry in northeastern Utah, which came later to be known as "The National Dinosaur Monument."

In 1905 the writer sent Mr. Percy E. Raymond and Mr. Douglass to collect vertebrate and invertebrate fossils in Minnesota, North Dakota, Montana, and Idaho, and to obtain, if possible, data for the settlement of certain geological problems, which had arisen in the study of that region. One or the other of these two gentlemen explored the Ordovician rocks near St. Paul and westward; the Badlands of the Little Missouri River in North Dakota and on the Yellowstone River in eastern Montana; various Paleozoic and Mesozoic formations in western Montana, and certain Tertiary beds extending from Montana into Idaho. The summer and fall of 1905 were occupied in this survey. The result was the ascertainment of the relative position of various strata and the acquisition of quite a considerable body of material, some of which was new to science.

During the year 1906 Mr. Douglass was mainly occupied in work in the laboratory at the Carnegie Museum and in writing upon material acquired by him, as already stated.

In 1907 the Director of the Carnegie Museum decided to send Mr.

Douglass to northeastern Utah to make a thorough exploration of the fossiliferous strata of the Uinta Basin. But little was as yet known about the geology and paleontology of this area, though many years before the late Professor O. C. Marsh had made some collections in the Uinta Basin on the occasion of a hurried visit, and as early as 1893 Mr. O. A. Peterson had, while collecting for the American Museum of Natural History, touched the western borders of the Basin and had collected valuable material.

The region in 1907 was included in the Uinta and Uncompahgre Indian Reservations. Accordingly I repaired to Washington and had a pleasant interview with Mr. J. Rudolph Garfield, at that time the Secretary of the Interior, who expressed approval and interest in the proposed undertaking. He referred me to Mr. Leupp, the Indian Commissioner, who provided me with the necessary papers authorizing me, or my representatives, to enter these Indian reservations for the purpose of collecting fossils. The only condition suggested was that neither I nor my representatives were to provide the Indians on the reservations with whiskey. This proviso was not in the least degree embarrassing.

Mr. Douglass on his way to Utah made hurried investigations near Grand Junction, Colorado, and at Dragon, Utah, which were interesting. He, however, did not delay, but went forward, and finally located himself at an abandoned stone house at "Well No. 2" on the stage route from Dragon to Vernal, Utah. This house had been erected by a company engaged in mining gilsonite in that region, but had been abandoned by them. The officers of the company accorded the use of the house to Mr. Douglass without charge. Making this spot his headquarters, he explored the fossil-bearing exposures in this desolate land from the crossing of the White River in the east to the banks of the Green River in the west, and north and south of the trail to Vernal. He collected a large number of fossils, mostly vertebrates, among them numerous species new to science. One tract known as "The Devil's Play-ground," where extensive erosion had gone on was particularly rich at that time in fossil remains. Here he discovered a number of fossil turtles, which later were named and described by the late O. P. Hay. One of the most remarkable of his discoveries was that of a complete skeleton of *Dolichorhinus longiceps*, which has for a long time been one of the striking displays in the gallery of fossil mammals in the Carnegie Museum, and is the most

perfect specimen representing this genus in existence. It was found not far from the White River in a high bluff. It is an early eocene forerunner of the Titanotheres.

In the spring of 1908, Mr. Douglass returned to the Uinta Basin and with great success continued his work. In September of that year the writer visited him and carefully went over the field. One evening my admiration was excited by a brilliant sunset in which the lofty peaks of the Uinta Range to the northwest loomed up grandly. I remarked to him that a study of Hayden's Survey disclosed the fact that in those mountains there were extensive exposures of Jurassic strata, and I said to him that we ought to find the remains of dinosaurs in that region. We decided that we would set forth early the next day with our team of mules and visit the foot-hills, where Hayden had indicated the presence of Jurassic exposures. We started shortly after dawn and spent a long day on the cactus-covered ridge of Dead Man's Bench, and in making our way through the gullies and ravines to the north. At nightfall we found ourselves after descending a wild declivity by the edge of a small brooklet, where we slept under our blankets, while the mules grazed upon the scanty pasturage which was found at that spot. The next day we went forward through the broken foot-hills which lie east and south of the great gorge through which the Green River emerges from the Uinta Mountains on its course toward the Grand Canyon of Arizona. As we slowly made our way though stunted groves of pine we realized that we were upon Jurassic beds. We tethered our mules in the forest. Douglass went to the right and I to the left, scrambling up and down through the gullies in search of Jurassic fossils, with the understanding, that, if he found anything he was to discharge the shot gun which he carried, and, if I found anything, I would fire the rifle, which I carried. His shotgun was presently heard and after a somewhat toilsome walk in the direction of the sound I heard him shout. I came up to him standing beside the weathered-out femur of a Diplodocus, lying at the bottom of a very narrow ravine into which it was difficult to descend. Whence this perfectly preserved bone had fallen, from what stratum of the many above us it had been washed, we failed to ascertain. But there it was, as clean and perfect as if it had been worked out from the matrix in a laboratory. It was too heavy for us to shoulder and carry away, and possibly even too heavy for the light-wheeled vehicle, in which we were traveling. So we left it there, proof

positive that in that general region search for dinosaurian remains would probably be successful. This specimen, if my memory serves me correctly, was later taken to a Lutheran college somewhere in the middle west, some of the graduates of which we found dredging for gold in the Green River below the gorge, and to whom at their campfire we spoke of our discovery.

I shall not take time to here relate the adventures of the following days in which we carefully investigated the Jurassic beds upon which we found ourselves, except to state that after crossing the Green River, we found that these beds continued as an extensive uplift on the right bank of that great stream, below the deep gorge of the Green River, into which we peeped from below, and into which we peered after climbing half a mile into the air along its western flank. At points this chasm, which is very narrow, is more than a mile deep.

In the spring of the year 1909 the writer instructed Mr. Douglass to repair to the region which we had visited the previous September and to minutely and carefully explore the exposures of Jurassic rock on the right bank of the Green River above Vernal, for the purpose of ascertaining whether he could find some locality rich in dinosaurian remains. He carried out his instructions. Letter after letter was received from him stating that, aside from fragments, occurring here and there, he had found no prospect apparently worth more than passing examination. However, I was finally delighted to receive from him a letter in which he told me that at the very summit of a rough jagged peak he had discovered the remains of a huge dinosaur, the caudal vertebræ of which were apparently all in place and as far as he had uncovered them the indication was that an entire skeleton was there buried in the rock. I was not long in going out to the spot to investigate and encourage my associate. I was more than pleased with what I found had already been accomplished and realized that future work was full of promise. The skeleton Douglass had found on the mountaintop was that of the huge animal which subsequently I named *Apatosaurus louisæ* in honor of Mrs. Andrew Carnegie, and which has long stood mounted in the Gallery of Fossil Reptiles in the Carnegie Museum, alongside of the skeleton of *Diplodocus carnegiei*. Mr. Carnegie, when I reported to him the results of our work in Utah, expressed himself as greatly delighted, and as the work was destined to be expensive added $5,000 to his annual contribution of $10,000,

which he had previously entrusted to me for use in carrying on paleontological researches.

The mountain, on which was the quarry, which had been opened by Mr. Douglass, I ventured to call "Dinosaur Peak." The opening was long known as the "Carnegie Quarry."

Anticipating for the moment, I may here say that our work went on for some years without interruption and with great success; and then the Uncompahgre Indian Reservation was thrown open to settlement. We realized that at any moment, desolate though the land was, some wandering speculator might file a claim to the land upon which we were working. Accordingly Mr. Douglass, acting for the Carnegie Museum, was instructed to file a mining claim to the land on which the quarry was located. A learned official in the office at Washington, D. C., decided that fossil bones cannot be regarded as "minerals," and the claim was rejected. In this extremity I repaired to Washington and talked the matter over with my good friend, Dr. Charles D. Walcott of the Smithsonian Institution. He pointed out to me that the land might be exempted from occupation by others under the provisions of a law, which had shortly before been enacted, under the provisions of which the President of the United States has authority to withdraw from settlement lands, upon which are located archeological and scientific remains which it may be important to preserve. With Dr. Walcott's able assistance we secured the designation of the eighty acres, upon which we had filed our claim, as "The National Dinosaur Monument," President Wilson smilingly acceding to the request, which Dr. Walcott and I laid before him in prescribed form. So the quarry opened by Mr. Douglass on Dinosaur Peak came to be, and remains to this day "The National Dinosaur Monument," under the general care and oversight of those officers of the government, who are in charge of the National Parks and Forests.

The fossiliferous strata at the point where Mr. Douglass was working lie inclined to the horizon at an angle of approximately sixty degrees. The deposit is apparently a sand-bar of an ancient river, once laid down at sea-level, now tilted up at a sharp angle and raised over seven thousand feet above the sea. This is proved by the presence just below it of marine beds full of sea-shells. The fossil-bearing bed has considerable thickness, and is overlaid by very heavy beds of sandstones and shales. In operating it was necessary to remove the overlying shales and rock and thus expose the bone-bearing strata.

This involved much labor and consequent expense. Men from the neighborhood were employed. A track of rails, such as are used in coal-mines, was laid down and a dumping-car was placed upon them. We tore away the rock covering the remains imbedded in the lower layer of sandstone. We went down from month to month and year to year, and finally, at the time when we ceased operations, we had made an excavation nearly six hundred feet long and eighty feet deep from the point where we had begun the process of uncovering. It probably was the largest undertaking of its kind in the history of paleontology.

From year to year we were rewarded by great and sometimes most unexpected discoveries. Dinosaurs representing many families, genera, and species were recovered. Several of the skeletons are almost perfect. One of these mounted in the Carnegie Museum on a slab is probably the most perfect skeleton of a small dinosaur ever discovered. Of course a great deal consisted of fragments. From year to year the boxes containing the specimens taken out were shipped to Pittsburgh. Each box contained material, the location of which was exactly fixed upon a map of the quarry, which from month to month and year to year grew ever larger. Minutely accurate records were kept. Some of these skeletons still remain in the basement of the Carnegie Institute not freed from the matrix or prepared for study; others have been carefully worked out, some of them described, and others still await description. This work, which was carried on continuously from the year 1909 until the spring of 1923 resulted in the shipment to the Carnegie Museum of many carloads of stone containing fossil bones in the aggregate weighing over three hundred tons. Much still remains to be cleared from the matrix, described, figured, and reported upon in our publications. Mr. Carnegie's death and the cessation of his annual contributions to this phase of the work of the Carnegie Museum has reduced and held back the progress of the work, which was enthusiastically carried on during his lifetime.

To all of this great undertaking Mr. Earl Douglass devoted himself continuously with the greatest enthusiasm and energy. In 1910 he purchased a considerable tract of land on the banks of the Green River below the peak on which the quarry was located and there erected for himself a house. His wife and son, later his father, joined him there and he made his home at the spot, the work in the quarry going on continuously. He labored the year long, even in

the cold of winter, when it was possible to work in the quarry. Occasionally he made excursions at the request of the Director of the Museum to other fossiliferous localities not far away; but for the greater part of twelve years his time was spent uninterruptedly in extracting from the great opening, which was gradually made, the treasures which it contained, mapping the work from day to day, numbering the specimens, bone by bone, and keeping an accurate account of every fragment which was found. Probably no quarry ever opened by collectors has as minutely exact and carefully prepared a record of the relative position of every bone or block of stone which was taken therefrom.

At the invitation of people near by he occasionally lectured, illustrating his lectures by lantern-slides. He found interested audiences at Jensen, Vernal, and other towns, which were accessible to him by the modes of conveyance which he had at his command. He wrote constantly for the newspapers in Utah upon geological themes. It is a matter of regret that the writer of these lines has no file of these papers, which were published in various journals.

The quarry, as its existence became known, was frequently visited not only by scientists, but by the curious living near by, and even coming from great distances. The task of receiving and explaining to visitors what was being done took up some of his time, but he was always kind and gracious. His agricultural and pastoral adventure unfortunately did not flourish well, although he built a reservoir upon the land which he had acquired, hoping through it to be able to irrigate at least a portion of the tract which he had acquired. He depended for the filling of his reservoir upon the melting snows which in the springtime sent a brooklet full of water from the nearby eminences. Unfortunately although his reservoir was generally filled in the spring it only furnished moisture enough to make productive a few acres immediately adjacent to his bungalow. Here he was able to grow vegetables. He had live stock which furnished him with milk and to a certain extent with meat. Poultry thrived well.

He consistently refused the urgent entreaties of the writer of these lines to return to the Museum in the winter months, preferring as he expressed it, the life of the wilderness, with which he had become entranced.

He kept faithfully in touch with the administration of the Carnegie Museum, and the writer has before him a number of volumes of his

letters giving an account of his work and embodying a great deal of information which is interesting. It is hoped that the time may come when it will be possible to publish at least some portions of this large file of correspondence, which relates not only to his work in the quarry, but to his observations upon the geology of the region around about.

As already stated, Mr. Douglass ceased, after he began his work in Utah, to write systematically upon paleontological themes. His principal contributions to the literature of paleontology and geology are here listed.

1. The Neocene Lake Beds of Western Montana and Descriptions of Some New Vertebrates from the Loup Fork, a Thesis for the degree of M.S. in the University of Montana, presented June, 1899, published by the University July, 1900, pp. 1-27; Pls. I-IV.

In this paper he described and figured the following new species: *Gomphotherium serus; Protolabis montanus; Procamelus madisonius* and *lacustris: Palæomeryx americanus* and *madisonius; Cosoryx agilis; Anchitherium minimus.*

2. New Species of Merycochœrus in Montana, Pt. I, American Journal of Science, (4), Vol. X, 1900, pp. 428-438; 3 figures in text.

In this paper he described *Merycochœrus laticeps*, subsequently by him made the type of his genus *Pronomotherium.*

3. Part II of the foregoing paper, American Journal of Science, (4) Vol. XI, Jan. 1901, pp. 73-83.

In this paper he described the following new species: *Merycochœrus altiramus* (Subsequently referred by him to the genus *Pronomotherium*); *M. madisonius*; *M. elrodi*; *M. compressidens*; and contributed to our knowledge of an allied species, which he called *Merycochœrus* (?) *obliquidens* Cope. Whether the last species is identical with that named by Cope is open to question.

4. Fossil Mammalia of the White River Beds of Montana. Transactions American Philosophical Society, (2), XX, 1901, pp. 237-239; 1 map; Pl. LX.

In this paper he describes as new to science the following genera: *Cylindrodon, Bathygenys, Limnenetes,* and *Arretotherium;* and the species: *Ictops acutidens; Steneofiber hesperis,* and *complexus; Palæoolagus temnodon; Cylindrodon fontis; Sciurus jeffersoni; Eumys minor;*

Hyænodon montanus, and *minutus; Cotodon cingulatus; Bathygenys alpha; Limnenetes platyceps*, and *anceps; Oreodon robustum; Eucrotaphus helenæ; Agriochærus maximus*, and *minimus: Arretotherium acutidens.*

5. Dinosaurs in the Ft. Pierre Shales and Underlying Beds in Montana. Science (n.s.) XV, 1902, pp. 31-32.
6. The Discovery of Torrejon Mammals in Montana. Science (n.s.) XV, 1902, pp. 272-273.
7. A Cretaceous and Lower Tertiary Section in South Central Montana. Proc. Amer. Philos. Soc., XLI, 1902, pp. 207-234, Pl. XXIX.

This paper was an amplification of what he had previously published in "Science" in relation to the discovery of early mammalian remains which before that time had only been known from Torrejon in New Mexico. The plate accompanying the article shows fragments referable to the genera *Pantolambda*, *Anisonchus*, *Euprotogonia*, and *Myoclænus*, but no new species are described.

8. Astropecten (?) montanus—A New Star-fish from the Fort Benton; and some Geological Notes. Annals Carn. Mus., Vol. II, Pt. I, 1903, pp. 5-8.
9. New Vertebrates from the Montana Tertiary. Annals Carn. Mus., Vol. II, Pt. 2, 1903, pp. 145-200; 37 figs. in text; Pl. II.

In this paper he described and illustrated the following:

REPTILIA: *Helodermoides* gen. nov.; *tuberculatus* sp. nov.; *Ogmophus arenarum* sp. nov.

MAMMALIA: *Insectivora*: *Talpa* ? *platybrachys* sp. nov.

Carnivora: Mesocyon (?) *drummondanus* sp. nov.; *Ælurodon* (?) *brachygnathys* sp. nov.; *Mustela* (?) *minor* sp. nov.; *Dynocyon ossifragus* sp. nov.

Perissodactyla: Heptodon (?) sp.; *Hyrachyus* (?) *priscus* sp. nov.; *Mesohippus latidens* sp. nov.; *Aphelops* (?) *ceratorhinus* sp. nov.

Artiodactyla: Trigenicus gen. nov., *socialis* sp. nov.; *Oreodon macrorhinus* sp. nov., *Promerycochærus minor* sp. nov.; *Hesperhys* gen. nov.; *vagrans* sp. nov.; *Poatrephes* gen. nov., *paludicus* sp. nov.; *Merychyus smithi* sp. nov.

Rodentia: Sciurus arctymyoides sp. nov.; *Palæarctomys* gen. nov., *montanus, macrorhinus* spp. nov.; *Mylagaulus pristinus, proximus* spp. nov.

10. Some Notes on the Geology of Southwestern Montana. Annals Carn. Mus., Vol. III, Pt. 2, 1905, pp. 407-428, Pl. XV.

A stratigraphical paper largely based upon original observations made by the author.

11. Tertiary of Montana. Memoirs Carn. Mus., Vol. II, 1905, pp. 203-225, Pl. XXII.

This paper describes and gives figures of the following: *Xenotherium* gen. nov., *unicum* sp. nov.; *Ictops montanus*, *intermedius*, *tenuis*, *major* spp. nov.

12. Generic Names of Merycoidodonts. Science (n.s.), XXIV, 1906, pp. 565-567.

The article deals wholly with questions of taxonomy and nomenclature.

13. Merycochœrus and a New Genus of Merycoidodonts, with Some Notes on other Agriochœridæ. Annals Carn. Mus., Vol. IV, 1907, pp. 84-98, Pl. XXII.

In this paper the author erects the genus *Pronomotherium* specifying as its type the species originally described by him as *Merycochœrus laticeps*.

14. Some New Merycoidodonts. Annals Carn. Mus., Vol. IV, 1907, pp. 99-109, Pls. XXIII-XXX.

The author describes and figures the following: *Eucrotaphus dickinsonensis*, *montanus*, spp. nov.; *Merycoides* gen. nov., *cursor* sp. nov.; *Mesoreodon* (?) *latidens* sp. nov.; *Promerycochœrus hatcheri*, *grandis*, *hollandi*, spp. nov.; *Ticholeptus breviceps*, *bannackensis*, spp. nov.

15. New Merycoidodonts from the Miocene of Montana. Bull. Amer. Mus. Nat. Hist., XXIII, 1907, pp. 809-822, with 9 text-figures.

In this paper he describes and figures *Mesoreodon longiceps* sp. nov., *Ticholeptus brachymelis*, sp. nov. and in the light of the new material before him places *Merycochœrus altiramus* Douglass in the genus *Pronomotherium*, to which it plainly belongs.

16. Rhinoceroses from the Oligocene and Miocene Deposits of North Dakota and Montana. Annals Carn. Mus., IV, 1908, pp. 256-266; 7 figs. in text, Pls. LXIII-LXIV.

Aphelops montanus sp. nov. is described and fuller information in the light of new material is supplied as to *Aphelops ceratorhinus* Douglass and *Aceratherium tridactylum* Osborn.

17. Fossil Horses from North Dakota and Montana. Annals Carn. Mus., 1908, pp. 267-277, Pls. LXV-LXVIII.

In this paper he erects the new genus *Altippus*, and names the following: *Mesohippus portentus* sp. nov., *Altippus taxus* sp. nov.; *Merychippus* (?) *missouriensis* sp. nov. He also describes much material representing species previously named and partially described by other authors.

18. Some Oligocene Lizards. Annals Carn. Mus., IV, 1908, pp. 278-285; 8 figs. in text.

The skull of *Glyptosaurus* (?) *montanus* sp. nov. is described and figured. Descriptions and some figures are given of material representing species previously named and partially described by Marsh, Baur, and Cope.

19. Vertebrate Fossils from the Fort Union Beds. Annals Carn. Mus., V, 1908, pp. 11-26; Pls. I-II.

This paper deals with the fauna of the very early Tertiary discovered by Douglass in Montana. The following are the new things named and described: *Ptilodus montanus* sp. nov.; *Picrodus* gen. nov. *silberlingi* sp. nov.; *Coriphagus* gen. nov. *montanus* sp. nov.; *Megopterus* gen. nov. *minuta* sp. nov.

20. A Hunt for Extinct Animals. Guide to Nature, Vol. I, 1908, pp. 1-8, 8 half-tone cuts of photographs taken in western Montana.

The article, the first in the new magazine undertaken by Edward P. Bigelow, gives a popular account of one of his last collecting trips into western Montana.

21. Description of a New Species of *Procamelus* from the Upper Miocene of Montana, with Notes upon *Procamelus madisonius* Douglass. Annals Carn. Mus., V, 1909, pp. 159-165, 2 figs. in text, Pls. IX-XI.

The type of *Procamelus elrodi* sp. nov., is figured and described as well as other cameloid material.

22. A Geological Reconnaissance in North Dakota, Montana, and Idaho, with notes on Mesozoic and Cenozoic Geology. Annals Carn. Mus., V, 1909, pp. 211-288, Pls. XVI-XXI.

Photograph of Earl Douglass taken not long before his death.

This is an important paper dealing with the geology of the regions visited.

23. Dromomeryx, a New Genus of American Ruminants. Annals Carn. Mus., V, 1909, pp. 457-479, Pls. LIX-LXIII, 3 figs. in text.

In this paper Douglass erected the new genus *Dromomeryx* using *Blastomeryx borealis* Cope as the type of the genus. He effects a restoration of the skeleton of *borealis* from material in the Carnegie Museum; and to the new genus he transferred the species *Palæomeryx madisonius* Douglass and with doubt *Palæomeryx americanus* Douglass. Later authors have agreed that the last species should remain in the genus, where Douglass had originally placed it.

24. Preliminary Description of Some New Titanotheres from the Uinta Deposits. Annals Carn. Mus., VI, 1910, pp. 304-313, 8 figs. in text.

In this paper he describes and figures *Telmatherium* (?) *incisivum* sp. nov., *Manteoceras uintensis* sp. nov., *Dolichorhinus longiceps* sp. nov.

A study of the foregoing papers reveals that he added seventeen genera and eighty-three species to the ever growing list of fossil vertebrates. A great deal of his work related to the Merycoidodonts. He had mastered the entire literature relating to this interesting group. His collection, which was acquired by the Carnegie Museum, was rich in the remains of these animals. Important additions were made to it during his connection with the Museum not only by himself, but by other members of the staff, and the Museum in consequence possesses one of the best assemblages in existence of material representing this long extinct group. Other additions which he made to our knowledge of the extinct mammals of North America were important. His careful observations upon the geology of the regions where he collected are most valuable.

Mr. Douglass although not robust in form possessed much physical vigor and great endurance. He, as I have already intimated elsewhere, loved the outdoor life, much preferring it to the confinement of the laboratory and the study. To a certain extent he appeared to be indifferent to what many regard as the essentials of comfort and happiness. He felt most at home in the wilderness. He was very quiet in his manner. His speech was always gentle. He had a fine sense of

humor and not only relished, but told many a witty tale. He was a good companion whether in the home or the camp. He was devoted to his parents, for whom he provided in their old age. He was a kind husband, and a loving father. His death is greatly mourned by all who knew him, but his name will last forever as one of those who did great work as a pioneer in geological and paleontological research in the regions where he labored.

XIII. THE UPPER UINTA FORMATION OF NORTHEASTERN UTAH.

By O. A. Peterson and J. LeRoy Kay.

(Plates IX-XI.)

Since the publication of the geological notes on the Uinta Basin by the senior author (Memoirs of the Carnegie Museum, Vol. XI, No. 2, 1928, pp. 94-96) much additional field work in the Uinta Basin has been done by the Carnegie Museum. The junior author has spent considerable time in verifying previous work, as well as in discovering and collecting data, geological and paleontological. Director Avinoff authorized the senior author to make short visits to the Uinta Basin in the early part of the season of 1929 and in the fall of 1930. Many localities examined in previous years, as well as others not before explored, were visited and new data were obtained. As a preliminary paper, to be followed by more detailed publications, it is thought that the new data obtained may be of immediate value to students.

While a cross-section from south to north through the Uinta sediments, from the Green River shales at Willow Creek upward to the top of the Upper Uinta at Little Mountain has been carefully made, see pp. 301–6, the chief points of inquiry in the present paper are:

1. The ascertainment by correlation of the geological position of the upper red beds of the Uinta sediments;
2. The fixation of the contact between these upper red beds and the underlying Uinta horizon (horizon C1 of Osborn) to the south;
3. A study of the contacts between the Upper Uinta and the underlying formations along the northern border of the Uinta Basin;
4. The relation between the upper Uinta and the so-called "Bishop Conglomerate" along the Uinta Mountain range.

We have been spurred to the study of the first and last subjects of inquiry by a letter of criticism from Dr. Julian D. Sears of the United States Geological Survey, referred to in the supplementary note in the article on the "Brown's Park Formation," Memoirs Carnegie Museum, Vol. XI, No. 2, 1928, p. 12. It is quite obvious that the final determination of the geological relation of the uppermost

Uinta sediments to the beds underlying them cannot be satisfactorily disposed of without the assistance of more complete fossil remains than have heretofore been available from these upper beds. The fortunate discovery of additional material, by the Carnegie Museum field-party of 1929, and especially the discovery of a quarry of Titanotheres and other remains well up in the Upper Uinta has clearly demonstrated that Peterson was in error in referring these beds to the Brown's Park Miocene in northwestern Colorado.[1]

The formation under discussion is a long and rather narrow belt along the southern base of the Uinta range. It has an extent of approximately eighty miles from east to west, reaching the foothills of the Wasatch range westward; while to the east it extends close to the Colorado-Utah state-line. In a north-south direction the formation seldom exceeds twelve to fifteen miles.

In looking at the eroded faces of the stratigraphic mass the panorama appears as of a pale brick-red. There are many other colors, but the red predominates. Along the southern borders of these upper red beds the strata have a northward and slightly westward dip of from two to four degrees. In proceeding northward through the Basin this dip constantly decreases, especially in the region where the section was made. At a point some three to four miles north of White River the strata become horizontal and very soon there is a noticeable southward dip, thus forming a syncline in this region of the Basin. The extreme southward dip observed along the northern contacts with the base of the Uinta range is seldom over twelve to fifteen degrees.

Lithologically the strata in the region, through which the geological section was taken, are made up, for the most part, of soft and hard sandstones, often enclosing lenses of clay. These sandstones alternate with soft and indurated layers of strongly arenaceous clays. Along the northern border of the Basin are numerous intercalations of masses of conglomerates of finer and coarser texture.[2] These layers of conglomerates are sometimes twenty to thirty feet thick and of considerable geographic extent.[3]

[1]Memoirs, Car. Mus., Vol. XI, 1928, pp. 94-95. This error was chiefly due to inadequate paleontological evidence, upon which the previous determination was based.

[2]The closer to the northern border of the formation, the coarser the conglomerate.

[3]For more details in lithology see pp. 305-6.

The most intensive search by Peterson (1893-95, 1912, 1929-30), Douglass (1907-29), Riggs (1910), and Kay (1928-30), revealed no clear stratigraphic break between the upper red beds of the Uinta and horizon C (=C1 of Osborn.). Furthermore the lithological gradation, color, and other conditions, along the course of the cross-section made through the Basin, are so gradual from the lower to the higher strata that it becomes extremely difficult to separate the two horizons. The exposures of the lower red beds (top of horizon C), to the west of where the section was made, or in the Duchesne Valley, are, however, capped by a decided hard banding of sandstone, which is quite persistent in the middle region and western end of the Basin. At Point Randlette about three miles above the junction of the Duchesne and the Uinta rivers, on the north bank of the Uinta, the upper part of horizon C is capped with a brown sandstone some ten to twenty feet thick. To the east of this point (Point Randlette) it is possible to trace this horizon to the north of "Pelican Lake" or the northern rim of "Leota Basin," thence crossing the region where the cross-section is taken (See map, Pl. IX) on Green River between the Baser and Leota bends of Green River, thence eastward along the south rim of "Dead Man's Bench" to the Colorado-Utah state-line.

From Point Randlette westward, the sandstones overlying horizon C are clearly distinct and more easily traced. They weather out to characteristic reddish brown cliffs along the streams and on the divides between Lake Fork, "Dry Gulch," Duchesne, and the course of other rivers. In places the sandstones are fine-grained; in other places coarse, with a tendency to become conglomerates. Cross-bedding is often shown, indicating stream action. In a lithological sense these Upper Uinta sandstones are distinctly different from the lower formations in the middle and western part of the Basin. There is more sandstone, less clay, and the sedimentary mass, as a whole, has less vertical thickness. There was, however, no distinct break found between horizon C and the Upper Uinta sediments along the water-courses and divides here mentioned. In the study and measurements of the strata from south to north further east in the Basin, where the section was taken, we are in fact forced to temporarily conclude that the entire tertiary sedimentation of the Uinta Basin including the uppermost beds, went on continuously.

In dealing with these uppermost beds from a faunistic standpoint we observe a sharp break. Well toward the top of the series, in the

Titanothere quarry (See section on p. 306 and Pl. XI) worked by the Carnegie Museum during 1929-30, we have secured an abundance of material pertaining to a typical Oligocene form (*Teleodus*). In the same quarry were found a portion of the lower jaw of a Cameloid (Poëbrotherium) and remains of Hyænodonts. With these was also discovered material representing a small rhinoceros provisionally referred to *Amynodon* and a fragment of a mandibular ramus, with M_2 in place, of a mesonychid comparable in size with *Mesonyx ossifragus*. Outside of the two latter genera the fauna, so far found in this new quarry, is certainly representative of a post-Eocene or basal Oligocene deposit.

Osborn (pp. 99-103, "Titanotheres of Ancient Wyoming, Dakota and Nebraska") has correlated the Uinta represented in the section at Beaver Divide, Wyoming, with horizon C ($=C_1$ of Osborn of the Uinta Basin, see p. 100). This correlation seems to rest chiefly on *Amynodon antiquus*, *Protoreodon parvus* and the evidence of a Titanothere discovered in the Wyoming section. The cameloid (*Camelodon arapahovius* Granger[4]) appears too far advanced for a form from the horizon C of the Uinta according to the artiodactyl fauna, as at present known from that horizon. The deposit in Wyoming, according to Osborn equivalent to the Uinta, may possibly represent a slightly later deposit than that of horizon C in the Uinta Basin. In other words the Uinta section of the Beaver Divide probably represents some portion of the one thousand feet of strata from the top of horizon C to the Titanothere Quarry opened by us in the Uinta Basin. According to the faunistic evidence now in our possession we must regard the uppermost red series of the Uinta sediments as pertaining to the basal Oligocene, which has been more or less anticipated, though not hitherto proven, by paleontologists who have visited and worked in the Tertiary sediments of the Uinta Basin.

The lower members of the Uinta sediments are apparently entirely absent along the northern border of the Uinta Basin. Horizons A, B, and C_1 ($= C_1$ of Osborn) so characteristic of the southern and middle part of the Uinta Basin, together with the rich fauna of horizons B and C, are entirely lacking along the northern borders. This apparent unconformity, observed by Peterson in the years 1893-1912[5], by

[4]Bull. Amer. Mus. Nat. Hist. Vol. XXVIII, 1910, p. 248.

[5]Bull. Amer. Mus. Nat. Hist., Vol. VII, 1895, pp. 72-74.

Douglass in 1908-09[6], by Kay 1928-29, led to the fruitless search by these parties for a distinct break between the Upper and Lower Uinta sediments along the southern, or rather the middle exposures, in the Uinta Basin. As has already been stated in this article, the sedimentation from the south northward in the Uinta Basin appears to have been continuous from the lower tertiary measures to the top of the Upper Uinta. So far as the Wasatch, Green River, and the lower part of the Uinta series are concerned, the deposits to the south and east are laid down in a similar order to those in the Bridger and Washakie Basins. To the north, on the other hand, the lower tertiary members of the Uinta are reduced vertically to comparatively thin fingerings or entirely absent. It is questionable whether the Wasatch is at all represented along the northern border west of Green River (see map, Pl. IX). If represented, its characteristic lithological structure, as in other places, is here entirely changed.[7]

The absence or presence of a representation of the Green River Formation in Vernal Valley was one of the studies undertaken during the early part of the season of 1929. Before ending this work Mr. Kay, the junior author, made an especial effort to trace the formation from the eastern end of the basin (near the Colorado-Utah state-line) to the vicinity of Mosby Mountain. In proceeding westward from the vicinity of "Powder Springs," Utah (see map, Pl. IX), the lithological condition and stratigraphic structure of the Green River Formation gradually changes from the typical shales to a fine-grained sandstone in many places heavily impregnated with asphaltum.[7a] The series west of the Green River Valley to Mosby Mountain we now know pertains to the same sedimentation east, south, and west in the Uinta Basin, but is here so changed that it is altogether unrecognizable as typical Green River. Furthermore, the formation in Vernal Valley thins vertically and its thickness is far less than that of the eastern, southern, and western exposures, as they appear in the Uinta Basin.

[6]"Geology of the Uinta Formation," Bull. of the Geological Soc., of Amer., Sept. 15, 1914, Vol. XXV, pp. 417-420.

[7]Numerous features in connection with the tertiary strata in the Uinta Basin, especially along the northern border, are at the present time under study.

[7a]In Bulletin 822, U. S. Geol. Survey, 1930, p. 77, Dr. E. M. Spieker informs us that, according to the analysis by the chemical laboratory of the United States Geological Survey and his personal investigations, this asphalt impregnation "may more properly be designated as bituminous."

Resting in apparent conformity on top of this Green River series along the northern border of the basin is the Upper Uinta Formation. This conformity is more apparent than real, because there is a break in sedimentation between the Upper Uinta and the Green River shales, consisting of horizons A, B, and C of the Upper Eocene, characteristic of the southern and middle parts of the Basin. Nowhere has this fossiliferous section (A, B, and C) been recognized as resting on the Green River series to the north, between Mosby Mountain and the Utah-Colorado state-line. As before stated, on the other hand, the Upper Uinta or basal Oligocene rests directly on horizon C to the south.

It is a well known fact that the tertiary sedimentary mass of the Uinta Basin, especially the upper series, is of a decided reddish color. The derivation of its color as well as a great part of its sediments are undoubtedly to be regarded as derived from the red quartzite and other formations along the dissected Uinta plateau. In the Upper Uinta sediments, especially along the northern borders, are intercalated many layers of conglomerates which are composed, for the most part, of quartzite from the Uinta range. An eroded surface of the Green River strata along the base of the Uinta Mountains is therefore expected to be found upon which rests the Upper Uinta Formation.[8]

The southward dip of the tertiary strata which now amounts to twelve or more degrees in places along the base of the Uinta Mountains most likely took place in a greater or less extent since the deposition of the Upper Uinta sediments. It seems that there is still a movement going on in the Uinta Range. During the field investigations of 1928, Mr. Kay found on the east side of Currant Creek (locally known as the "Red Narrows") that the mountain has faulted several hundred feet in recent years. In August of 1928 Kay visited this section and found that the mountain had sunk to the extent of admitting in the course of the fault, quaking asp (*Populus tremuloides*) in full leaf of that season. Trees fifteen to twenty feet high were almost totally buried in the fissure. In many places the fissure was still open and from two to three feet wide for a distance of a mile or more.

The "Bishop Conglomerates." The top of the Upper Uinta sediments along the southern base of the Uinta Mountain Range, has

[8]On White River above the Wagonbound Canyon is found evidence of unconformity between the Green River formation and horizon A of the Uinta.

not been found in actual contact with the so-called Bishop Conglomerates. The talus from this conglomerate along the base of Little and Mosby Mountains (see map, Pl. X and geological section p. 306) is, however, covering the Green River sediments; not underlying the Uinta as was erroneously stated by Peterson.[9] At the present time we are unable to definitely place the extensive deposits of coarse conglomerates along the flanks of the Uinta with regard to its geologic age. The final determination now reached, that the Upper Uinta tertiary beds are not of Miocene age and do not form true contacts with the conglomerates along the mountain, again raises the question as to whether or not the "Bishop Conglomerates" should be referred to the base of the Miocene section in Brown's Park, Colorado, to the north and east of the Uinta Mountain Range as was done by Peterson.[10] We feel rather doubtful that this series of the conglomerates are of Miocene age. In the Uinta Mountain Range generally these beds rest on elevations sometimes varying fifteen hundred or more feet. In the Uinta Basin there are found on eroded surfaces of different formations and in the Upper Uinta strata, layers of a conglomerate similar to that on the dissected plateaus of the elevated Uinta Mountain. "Leland Bench," to the east of Myton, Utah, is covered with a coarse conglomerate of ten to fifteen feet vertical depth and rests on the upper B and lower C of the Uinta sediments. The table of "benchland" between Lake Fork River and Ioka Post Office is well covered with this conglomerate, which rests on the eroded surface of the Upper Uinta sediments. Again this conglomerate is seen on different elevations along the Utah State Highway between Randlette and Vernal. It is possible that these sediments may pertain to those in the Brown's Park Miocene which have been regarded as of Pleistocene time.[11] Whether the "Bishop Conglomerates" found in many localities in the Uinta Range and vicinity[12] should be regarded as Pliocene, where

[9]Memoirs, Carnegie Museum, Vol. XI, p. 95.

[10] *Loc. cit.* p. 92.

[11]Near Lay Post Office in Colorado was discovered in soft sandy deposits a tooth of a proboscidean described and figured by Peterson as *Parelephas washingtoni* Osborn, Mem. Car. Mus. Vol. XI, 1928, p. 118-119.

[12]The type locality for this formation is the Bishop Mountains in Colorado. Hayden in his Preliminary Report on Wyoming and Contiguous Territory, 1871, chapters four and five, often speaks of these drifts and conglomerates, and seems to regard them as of comparatively late geologic origin.

they were referred by earlier geologists,[13] or to Pleistocene as suggested by Dr. Sinclair,[14] or, whether they should be regarded as the base of the Brown's Park as suggested by Sears[15] and Peterson,[16] does not now appear to admit of a satisfactory solution.[17] If determinable fossil remains ever should be discovered in the so-called Bishop Conglomerates (=Wyoming Conglomerate) it will help very much to settle the question.

During the latter part of the season 1929, while making the cross-section (Pl. XI), Mr. Kay, assisted by Mr. R. C. Thorne, discovered in the Green River Valley, some six miles north and east of Ouray, a fossiliferous locality, of considerable promise, in what is now regarded as the upper part of horizon C. This new horizon is from two to four hundred feet higher than any, in which collecting has heretofore been done in horizon C of the Upper Eocene. This general locality is of a number of square miles in extent and offers great promise in extending our paleontological investigations. Remains of large and small mammalia are already discovered in this latter horizon together with no less than three or four quarry-prospects by the Carnegie Museum party and Mr. R. C. Thorne and his party. It is hoped that these collections may ultimately be worked up as one unit in order to more correctly ascertain the vertical range and other features of many of the genera and species already known in the upper parts of horizon B and lower C of the Uinta sediments. In the Upper Uinta (now regarded as the basal Oligocene) on the other hand, fossil remains are extremely rare. Outside of a few scattered fragments found, and not capable of proper identification and fossil plants found at the base of the formation to the west of Lake Fork River, the Titanothere Quarry operated by the Carnegie Museum (see p. 306) is the only spot where recognizable remains have been found. All this material is now being cleared from the matrix for scientific investigation and exhibition.

[13]On pages 113 and 133, F. M. Endlich speaks of the Wyoming Conglomerate as of Pliocene origin. Eleventh Annual Report, U. S. Geol. and Geographic Survey, Idaho and Wyoming.

[14]Bull. Amer. Mus. Nat. Hist., Vol. XXII, 1906, p. 278.

[15]Bull. 751-G, U. S. Geol. Survey, 1924, p. 296.

[16]Mem. Car. Mus. Vol. XI, 1928, p. 92.

[17]Hayden (Preliminary Report of the United States Geol. Survey of Wyoming and Contiguous Territories, pp. 64-65) speaks of the conglomerates resting on the Brown's Park.

Lithological section of the Uinta Formation above the Green River Shales, Uinta County, Utah, made by J. LeRoy Kay, 1929.

BASE. GREEN RIVER SHALES.

	ft.	in.
Sandstone, heavily bedded	20	
Sandstone and shale, alternating bands reddish-brown on surface	111	
Sandstone, greenish gray	4	
Clay, reddish brown	7	
Sandstone, greenish	3	6
Sandstone, gray	6	
Clay, brownish	4	6
Shale, sandy, blue-gray	6	
Sandstone, coarse, with blue clay nodules	6	
Shale, sandy, greenish yellow	4	
Sandstone, coarse, gray	11	
Shale, sandy, reddish	7	
Clay, bluish white	10	
Shale, sandy, brown	10	
Sandstone, very hard, brownish gray	6	
Shale, sandy, brownish red	13	
Clay, light blue	3	
Sandstone, coarse, streaked with greenish bands	16	6
Sandstone, brownish gray	13	
Shale, sandy, blue	22	
Sandstone, greenish yellow	17	
Sandstone, reddish brown	21	
Shale, greenish	12	
Sandstone, coarse, yellow	12	
Shale, sandy, gray	4	
Clay, sandy	6	
Sandstone, fine grained, reddish brown, weathers into blocks	4	
Sandstone, coarse, gray, weathers into greenish gray on surface	18	
Sandstone, blue-gray	6	
Sandstone, greenish gray	36	
Clay, green		6
Sandstone, partly laminated, upper part copper stained	20	
Clay, brownish red	4	
Sandstone, hard, brown	6	
Shale, sandy, green	7	6
Shale, sandy, gray	17	
Sandstone, hard, gray	1	6
Shale, gray	10	
Sandstone, coarse, light gray	10	
Shale, sandy, greenish and brown	5	
Sandstone, reddish brown	3	

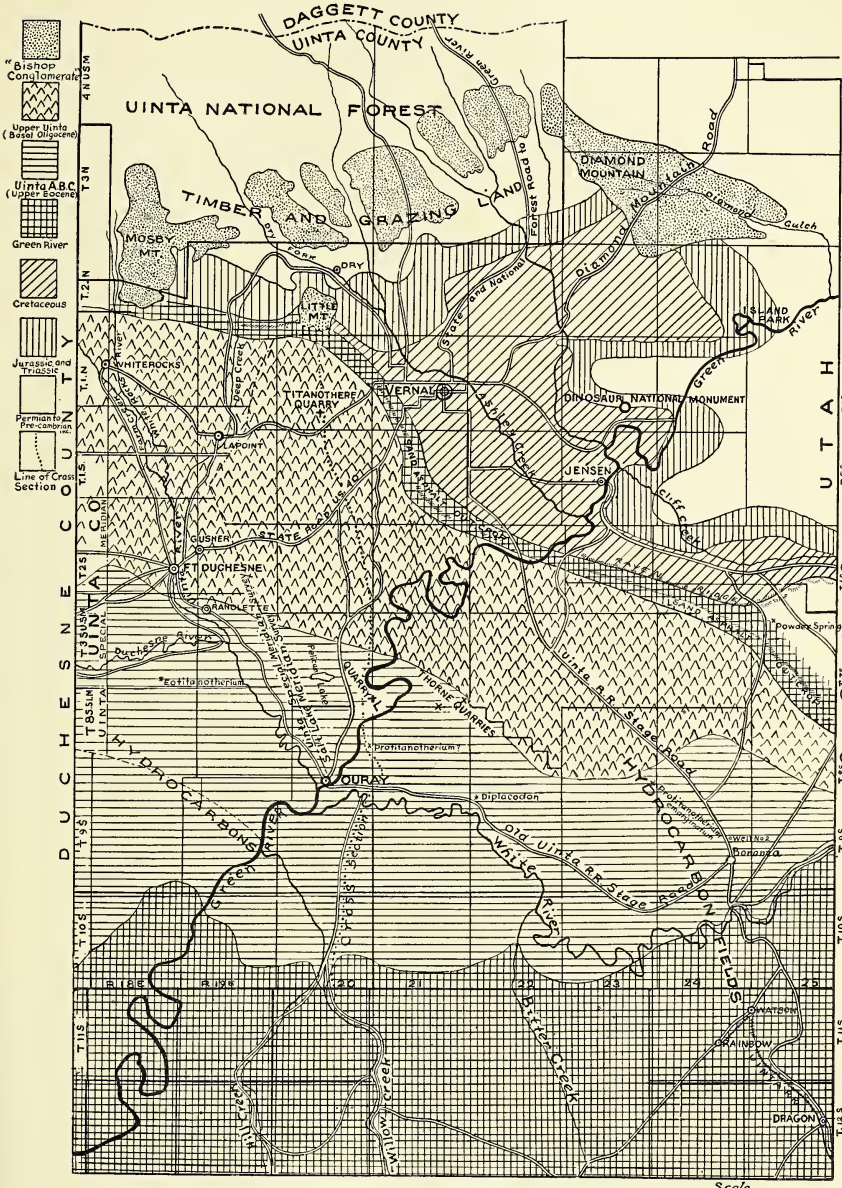
	ft.	in.
Shale, sandy, brownish and green	10	6
Sandstone, light gray	2	
Shale, green	5	
Sandstone, dark gray, weathering into blocks on the surface	2	
Shale, greenish	5	
Sandstone, fine grained, gray	2	
Shale, variegated, green and brown	10	
Sandstone, light gray	6	
Shale, variegated, with sandstone nodules	14	
Sandstone, light gray	8	
Shale, red, green and purple	15	
Sandstone, fine grained	5	
Shale, green and gray	7	
Sandstone, heavy, gray	6	
Shale, greenish gray	5	
Sandstone, gray	3	
Shale, sandy, greenish	3	
Sandstone, gray	13	
Shale, sandy	2	
Sandstone, light gray	5	
Clay, greenish	4	
Sandstone, nodular, gray	3	
Shale, sandy, greenish	6	
Shale, sandy, reddish and green with sandstone nodules	14	
Sandstone, gray	22	
Shale, variegated	7	
Sandstone, fine grained nodules	1	
Sandstone, fine grained, weathering brown on surface	3	
Shale, sandy, variegated with sandstone nodules	3	
Sandstone, fine grained, gray	4	
Shale, red and green	5	
Sandstone, gray	3	
Shale, red, green, and purple	7	
Sandstone, coarse, gray	8	
Sandstone, very hard, nodular	1	3
Shale, with sandstone nodules, reddish, purple, and green	8	
Sandstone, hard, gray	5	
Shale, variegated	16	
Sandstone, nodular, light gray	4	
Shale, reddish brown	15	
Shale, reddish gray and green	12	
Sandstone, nodular, gray	6	
Shale, reddish brown and green	17	
Sandstone, soft, light gray	2	
Shale, sandy, brown and gray	12	
Shale, gray and reddish	5	

	ft.	in.
Sandstone, nodular, gray	1	
Shale, purple, gray, and green	12	
Sandstone, nodular, light gray	4	
Shale, sandy, brownish	4	
Shale, blue	1	
Shale, reddish brown	4	
Sandstone, nodular, light gray	2	
Shale, variegated	36	
Shale, and sandstone, alternating bands brown and blue-white	80	
Sandstone, nodular, gray	8	
Shale, variegated	14	
Sandstone, nodular, light colored	6	
Shale, variegated, reddish, green, and brown	65	
Sandstone, coarse, light colored	6	
Clay, reddish and white	15	
Sandstone, coarse	6	
Shale, sandy, reddish brown	23	
Clay, bluish gray, with two small bands of nodular sandstone	26	
Sandstone, nodular, gray	8	
Shale, variegated	12	
Sandstone, nodular, light colored	5	
Shale, variegated	15	
Sandstone, blue-white	6	
Shale, reddish and yellow	22	
Sandstone, light gray weathering dark on surface	4	
Shale, reddish and blue, with two small bands of nodular sandstone	15	
Sandstone, coarse, light gray	3	
Sandstone and shale, alternating bands	26	
Shale and nodular sandstone, reddish brown	30	
Sandstone, gray, weathering brown on surface	14	
Shale, sandy, variegated	6	
Sandstone	5	
Shale, dark reddish brown	6	
Sandstone, gray	4	
Sandstone, with lenses of shale	15	
Sandstone, fine grained, gray	3	
Shale, reddish brown, with lenses of sandstone	26	
Sandstone, yellow and gray	10	
Sandstone and shale, alternating bands, shales variegated	12	
Sandstone	5	
Shale, red, gray, and purple	40	
Sandstone, coarse, light gray	5	
Shale, reddish green, and purple	40	
Sandstone, coarse, loosely cemented	16	
Shale, variegated	10	
Sandstone, coarse, light gray	3	

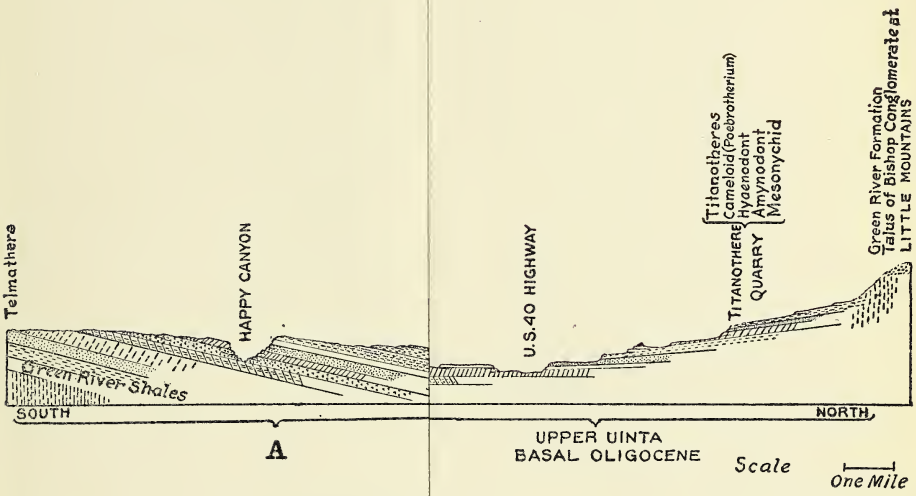
	ft.	in.
Shale, reddish brown	4	
Shale, sandy, light gray	5	
Shale, sandy, blue and yellowish	20	
Sandstone, yellowish	10	
Clay, brownish red	26	
Sandstone, yellowish gray	12	
Sandstone, very loosely cemented, bluish white, appears on surface as sandy shale	16	
Clay, dark reddish brown	10	
Sandstone, light gray	4	
Shale, reddish brown and blue	5	
Sandstone, light gray	4	
Shale, sandy, brown, red, and blue-white, with lenses of sandstone	18	
Sandstone, nodular, gray	4	
Shale, sandy, purple, blue, and red	8	
Sandstone, soft	2	
Shale, variegated	9	
Sandstone	3	
Shale, reddish brown	16	
Sandstone, coarse, light gray, weathers dark on surface	4	
Shale, variegated, capped by 18 inches of sandstone	6	
Clay, variegated	3	
Sandstone, light gray	4	
Clays, variegated, small lenses of sandstone	17	
Sandstone, fine grained, bluish white	4	
Clay, sandy, brownish red	5	
Sandstone, light gray	2	
Clay, brownish red	5	
Sandstone, light gray	1	6
Clay, brownish red	2	6
Sandstone, coarse	3	
Shale, brownish red	5	
Sandstone, fine grained, gray	2	
Clay, reddish brown	3	
Sandstone, coarse, light gray	11	
Sandstone and shale, alternating bands	20	
Sandstone, coarse, yellowish	15	
Clay, red, capped by green band	20	
Sandstone, coarse, heavy bedded	8	
Clay, brownish red	8	
Sandstone, light gray, weathering into irregular blocks on surface	2	
Clay, brownish red	6	
Sandstone, nodular	7	
Sandstone and shale, brownish red	10	
Sandstone, yellowish gray	9	
Sandstone and clay, alternating	20	

	ft.	in.
Clay, brown, red, and blue-gray	2	6
Sandstone and variegated clays alternating	62	
Sandstone, massive, light gray	28	
Clay, red	30	
Sandstone, light gray	12	
Sandstone and reddish clay, alternating	8	
Sandstone, soft, light colored	26	
Sandstone, nodular, light gray	38	
Clay, brownish red, and purple	16	
Sandstone, light colored	11	
Sandstone and shale, alternating	42	
Sandstone, with two small strata of red shale	37	
Sandstone and shale, alternating strata, shale brownish red	30	
Conglomerate	10	
Clay, brownish red and blue-gray	47	
Sandstone, laminated	10	
Sandstone and shale, variegated	9	
Sandstone, light gray	8	
Clay, brownish red and blue-white	14	
Sandstone, soft, light gray	2	
Shale, alternating brownish red and purple, with thin lenses of sandstone	41	
Conglomerate	6	
Sandstone and reddish brown sandy shale	23	
Conglomerate	4	
Sandstone, light gray	5	
Shale, sandy, brownish red with lenses of gray sandstone	26	
Shale, sandy, brownish red	12	
Sandstone, coarse, with lenses of brownish red clay	33	
Shale, brownish red, with lenses of nodular sandstone	15	
Sandstone, light gray	20	
Clay, yellow, brown, and red, with lenses of nodular sandstone	26	
Sandstone, coarse, gray	16	
Shale, reddish brown	7	
Shale, variegated with lenses of laminated sandstone	25	
Sandstone, soft, light gray	2	
Sandstone, nodular	5	
Sandstone and clay, reddish brown	19	
Sandstone, coarse, gray	16	
Clay, brownish red	8	
Sandstone and clay, light brownish red	49	
Clay, bluish white	22	
Sandstone, coarse, brownish, and gray	14	
Clay, reddish brown	22	
Sandstone, coarse, light gray	3	
Sandstone and brownish red clay	38	
Conglomerate and coarse sandstone	7	

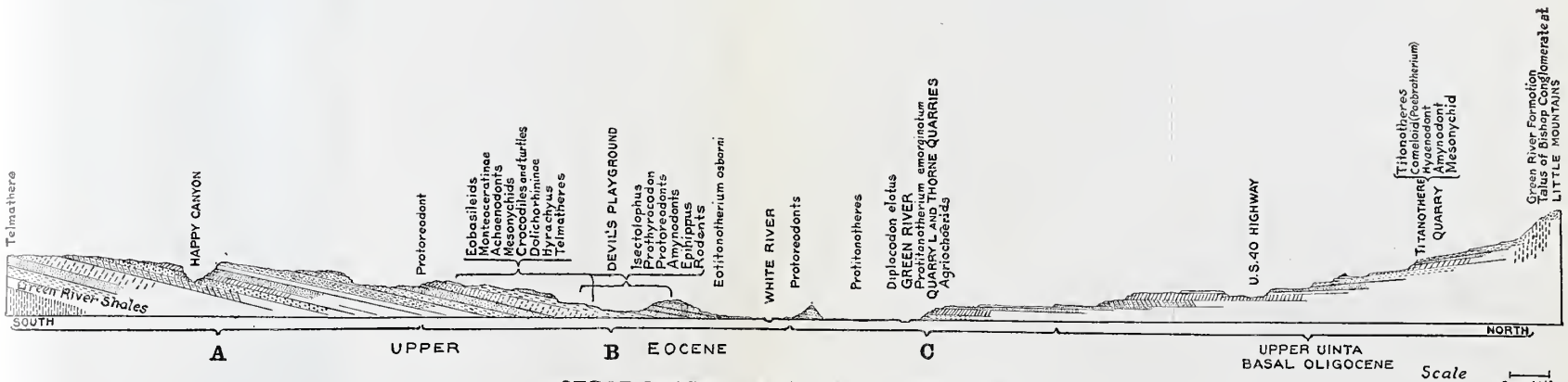
	ft.	in.
Clay, sandy, variegated	16	
Fossiliferous conglomerate and sandstone, fine grained, alternately soft and hard, (*Carnegie Titanothere Quarry*)	3	
Conglomerate	4	
Sandstone, reddish gray and light brown	23	
Clay, brownish red and variegated with lenses of sandstone	93	
Sandstone, conglomerate and brownish red clay; the clays are mostly sandy	91	
Top of Section	3020 ft.	3 in.



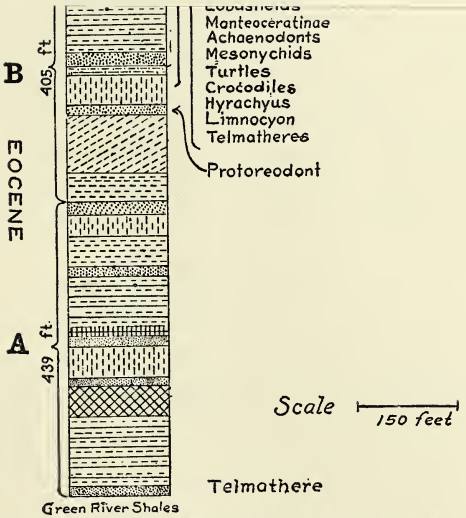
GEOLOGICAL MAP OF EASTERN UINTA BASIN


Telmathere
HAPPY CANYON
U.S.40 HIGHWAY
TITANOTHERE QUARRY
Titanotheres
Cameloid (Poebrotherium)
Hyaenodont
Amynodont
Mesonychid
Green River Formation
Talus of Bishop Conglomerate
LITTLE MOUNTAINS
Green River Shales
SOUTH
NORTH
UPPER UINTA
BASAL OLIGOCENE
Scale
One Mile

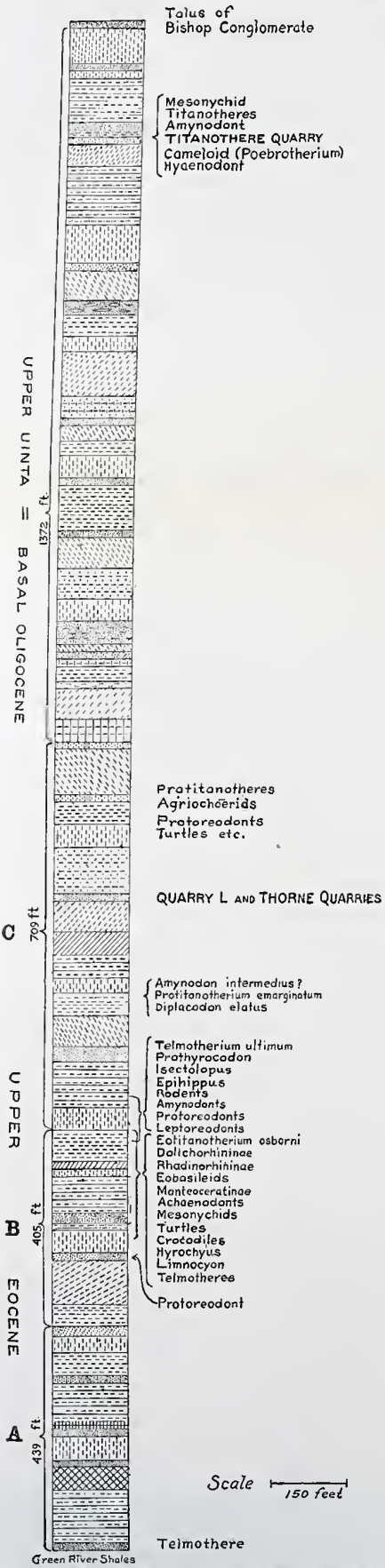
A



STRATIGRAPHIC SECTION OF UINTA BASIN



COLUMNAR SECTION OF HORIZONS A,B,C, AND UPPER UINTA



COLUMNAR SECTION OF HORIZONS A,B,C, AND UPPER UINTA

XIV. NEW SPECIES OF THE GENUS TELEODUS FROM THE UPPER UINTA OF NORTHEASTERN UTAH.

By O. A. Peterson.

(Plates XII-XV).

In the American Journal of Science, Vol. XXXIX, June, 1890, p. 524, Professor O. C. Marsh proposed the genus *Teleodus*, basing his description upon the greater part of the lower jaws of a specimen found near the base of the Oligocene in Dakota. In Professor Henry F. Osborn's valuable monograph on the "Titanotheres of Ancient Wyoming, Dakota, and Nebraska," Vol. I, pp. 227, 228, 481, 482, the genus is tentatively accepted. Osborn closes his discussion of *Teleodus* (p. 482) by stating that the characters available from the type suggest affinity to *Brontops* (an Oligocene genus) "and for the present we may regard the genus *Teleodus* as of subgeneric rank."

A fortunate discovery in 1929-1930 by the field-party of the Carnegie Museum in northeastern Utah (Mr. J. LeRoy Kay in charge) furnishes us with important additional knowledge of the anatomical structure of this little known genus.

In his recent monograph, referred to above, pp. 235-238, and 482, Osborn recognizes the Canadian Oligocene titanothere "*Megacerops*" *primitivus*, also based on the greater part of the lower jaws by Lambe,* as a distinct species of *Teleodus*. From what we have in hand we now are in a position to place the genus *Teleodus* on a more secure foundation and to considerably add to the knowledge of the osteological structure and individual variation of these forms during the known cycle of their existence. When our material is all cleared from the matrix, the present paper will be followed by a more complete description of the osteology of this new species of *Teleodus*.

TELEODUS Marsh.

Generic Characters. $\frac{\text{I.2}}{3}$, $\frac{\text{C.1}}{1}$, $\frac{\text{P.4-?3}}{4\text{-}3}$,† $\frac{\text{M.3}}{3}$.

Canines with short crowns, especially in the females. Skull brachycephalic. Bases of horns elongate oval in transverse section.

*Contrib. Canad. Pal., Vol. III, p. 49, pl. VI, figs. 4, 5.

Teleodus avus Marsh (No. 10,321, Yale Museum), is based upon the greater part of the lower jaws, and was found near the base of the Oligocene of Dakota. This specimen, the type of the genus, clearly pertains to a later form, the chief features of which are: (a) the crowded condition of the lower incisors, I_3 with an extremely short root and almost crowded out of its original position in the alveolar border; (b) the alveolar border of the incisors occupies a straight transverse line between the lower canines and does not extend in front of the canine teeth; (c) the cheek-teeth are relatively more developed than in other species, being broader, with more inwardly slanting external faces, especially in case of the molars.

Teleodus primitivus (Lambe) from the Cypress Hills of Canada is an earlier or more retardant species. In this species the alveolar border of the incisors extends well in front of the canines with a more liberal space for the incisors. Whether or not the presence of P_1 in *T. primitivus* is due to the young, though adolescent, stage of the type specimen is hard to determine; but the relatively long, narrow cheek-teeth with vertical external faces, especially in the case of the molars, are characters of strong specific value. The longer diastema between the canine and P_1 and the relatively long and slender mandible are additional distinctive features of *T. primitivus*. The delicately constructed canines in the type specimen may well be due to sex.

Teleodus uintensis sp. nov.

Type: Lower jaws, practically complete, but crushed in the symphysial region, No. 11,809, female, Carnegie Museum.

Paratypes: Skull, complete, slightly depressed by crushing, No. 11,759, female, Carnegie Museum; lower jaws complete, but crushed in the region of the angle. No. 11,761, female, Carnegie Museum. In addition there are over twenty individuals from the same quarry typical of the species, which will be consulted in connection with publications of the Carnegie Museum in the near future.

Locality: Titanothere Quarry, eleven miles west of Vernal, Utah.

Horizon: Upper Uinta (Basal Oligocene).

†In the collection from the Titanothere Quarry of the Upper Uinta, northeastern Utah, there is one skull, No. 11,760, which I associate with the new species. This old individual has lost P^1 and P^2 in both jaws, the alveoli are entirely closed giving the impression that the animal never had these teeth.

In the lower jaws under study, from the same quarry, P_1 is absent in both jaws, with alveoli closed in the type specimen, No. 11,809, while in the paratype, No. 11,761 this tooth is represented by the root on one side and an alveolus on the other.

Specific Characters: Smallest known titanothere of the Oligocene. In anatomical structure the species is intermediate between *Teleodus avus* and *Teleodus primitivus*. Incisors as in *T. avus*, but less crowded and alveolar border slightly further advanced in front of the canines.

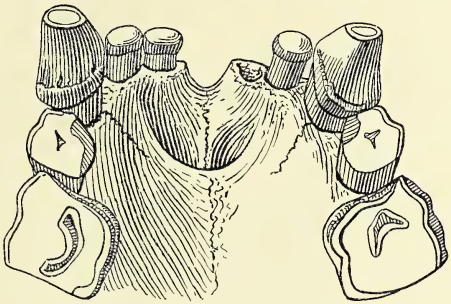


FIG. 1. Anterior dentition of skull of *Teleodus uintensis* Peterson. Carn. Mus. No. 11,759. One-half natural size.

P_1 present or absent. Diastema between canine and cheek-teeth present or absent. Molar-premolar dentition relatively broad and external faces of molars less vertical than in *T. primitivus* of the Canadian Oligocene.

As already stated, the female skull, No. 11,759, one of the paratypes of *Teleodus uintensis*, is perhaps less crushed and the most perfect specimen in the entire series of skulls under study. Its contour is less brachycephalic than those of the males. The small round-topped, button-like crowns of the two upper incisors of the left side are of nearly subequal size, separated from those on the right by a deep median invagination of the alveolar border. Incisor three is crowded close to the inner side of the canine. The latter is of small size (clearly a sexual character), with short and blunt crown, and a prominent posterior cingulum. Following the canine, without diastema, P^1 appears nearly as broad as long and well worn, so that its detailed structure is practically obliterated. Other individuals show the structure of P^1 perfectly. P^2 has tetartocone indistinctly separated from deuterocone. P^3, in one or two cases, is seen to have the tetartocone poorly indicated, but in the great majority of the skulls and upper dentitions under study the deutero- and tetartocones are distinctly marked. The tetartocone on P^4 is small, though distinctly separated from the deuterocone by a well marked constriction of the inner lobe. The inner cingula of the premolars are usually well indicated, while externally they vary in different individuals. In the

paratype, No. 11,759, the hypocone of M^3 is distinct and of large size, but in most cases this element is small and has no diagnostic value, due to variation in the different specimens. The parietals, in all the skulls from the new quarry in the Upper Uinta, present a prominent convexity, which is especially well developed on male skulls. This convexity is observed in the crania of other Oligocene titanotheres, *e.g. Brontops*, *Megacerops*, *Brontotherium*, but not so general or proportionately as large as in the species from the Upper Uinta.

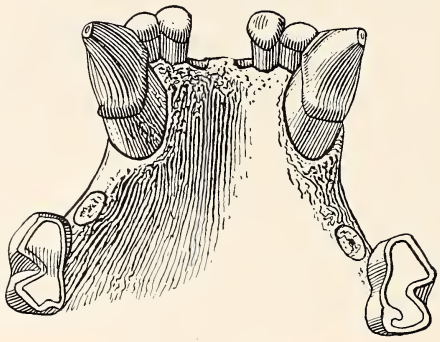


FIG. 2. Anterior dentition of lower jaw of *Teleodus uintensis* Peterson. Carn. Mus. No. 11,761, paratype. One-half natural size.

In the type No. 11, 809, the mental foramen is located below P_4 while in the paratype No. 11,761, this foramen is below P_3. This discrepancy is in part due to crushing of both specimens. The anterior part of the symphysis in the paratype is much depressed by crushing. The incisor alveolar border of the type is imperfect, while in the paratype it is complete, and there is a space between the median incisors of about five millimeters. I_1 and I_3 are subequal in size. The canine is small, with a postero-internal basal cingulum projecting at the base of the crown. In the type the diastema between the canine and premolars is much shortened by crushing, while in the paratype it is equally clear that the diastema is lengthened and the symphysis in general has a procumbent and unnatural appearance due to crushing from above downward. This crushing is also observed in the region of the condyle and the coronoid process, see Pl. XV. In the type P_1 is absent in both jaws, while in the paratype this tooth is represented by the root on the left and by an alveole on the right side. The rest of the cheek-teeth are much worn in both specimens. The

cingula are rather weak, while the teeth are relatively broad, when compared with *T. primitivus* of Canada, and relatively less broad than in *T. avus*.

MEASUREMENTS

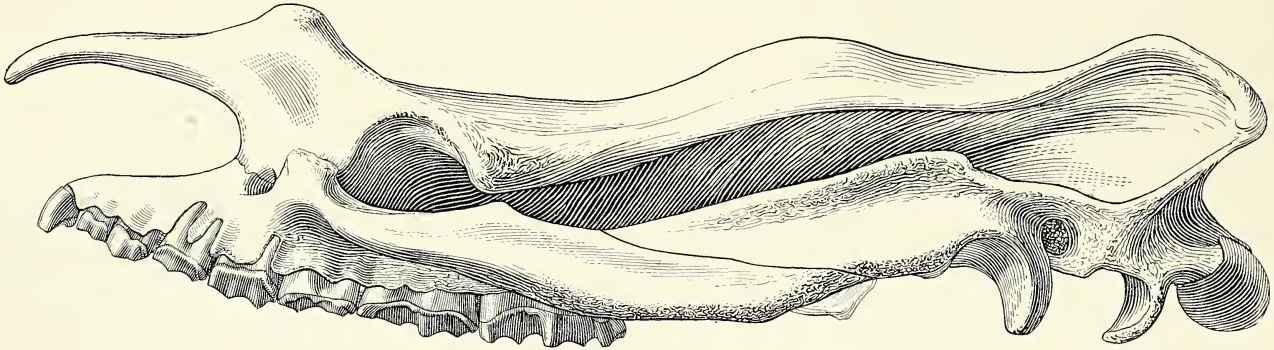
	Paratype No. 11,759
Greatest length of skull, condyle to incisive alveolar border	515 mm.
Length of skull, anterior margin of orbit to incisive alveolar border	132 mm.
Length of skull, occipital condyle to anterior border of orbit	390 mm.
Transverse diameter of skull at base of horn-cores	160 mm.
Transverse diameter of skull opposite postorbital processes	204 mm.
Transverse diameter of skull in front of occiput	100 mm.
Transverse diameter of occiput	168 mm.
Greatest transverse expanse at zygomatic arches	300 mm.
Length of molar-premolar series	230 mm.
" " premolar series	88 mm.
" " molar series	140 mm.
" " P^1	14 mm.
" " P^2	20 mm.
" " P^3	27 mm.
" " P^4	30 mm.
" " M^1	36 mm.
" " M^2	50 mm.
" " M^3	55 mm.
Breadth of P^1	14 mm.
" " P^2	24 mm.
" " P^3	29 mm.
" " P^4	32 mm.
" " M^1	39 mm.
" " M^2	49 mm.
" " M^3	53 mm.

Due to the crushing of the specimens the following measurements are only approximate.

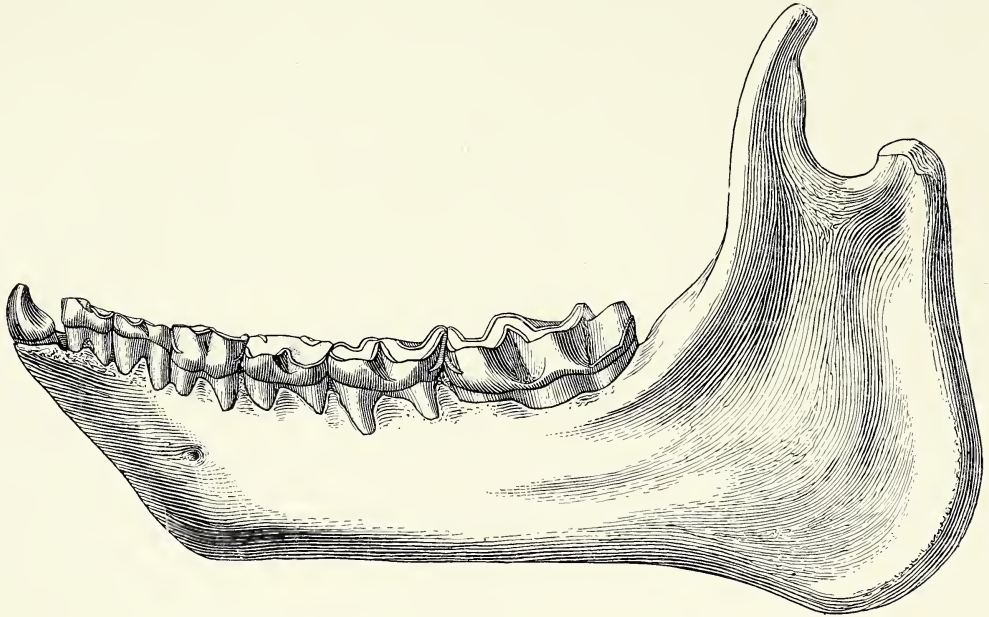
	Type 11,809	Paratype 11,761
Greatest length of mandible from the angle to incisors	425 mm.	422* mm.
Height of mandible at coronoid process	236 mm.	
Height of mandible at M_3	73 mm.	67* mm.
Height of mandible at P_4	66 mm.	53* mm.
Length of molar-premolar series	237 mm.	212 mm.
" " premolar series P_2-P_4	78 mm.	67 mm.
" " the molar series	163 mm.	145 mm.
" " P_2	22 mm.	20 mm.
" " P_3	24 mm.	22 mm.

*Measurement unreliable due to crushing.

	Type 11.809	Paratype 11.761
Length of P_4	31 mm.	26 mm.
" " M_1	35 mm.	34 mm.
" " M_2	50 mm.	47 mm.
" " M_3	78 mm.	65 mm.
Breadth of P_2	15 mm.	11 mm.
" " P_3	19 mm.	15 mm.
" " P_4	22 mm.	19 mm.
" " M_1	24 mm.	23 mm.
" " M_2	32 mm.	27 mm.
" " M_3	32 mm.	28 mm.



Skull of *Teleodus uintensis* Peterson (paratype) C. M. No. 11,759.
Twelve mm. less than one-third natural size.



Teleodus uintensis Peterson (type) C. M. No. 11,809.
About one-third natural size.

Teleodus uintensis Peterson (paratype) C. M. No. 11,761.
Slightly less than one-third natural size.

Teleodus uintensis Peterson.
Lateral view of paratype, C. M. No. 11,761.
Ten mm. less than one-third natural size.

XV. A LIST OF THE LAND-SNAILS OF PENNSYLVANIA WITH A SUMMARY OF THEIR DISTRIBUTION.

By Stanley T. Brooks, Ph.D.

(Plate XVI, Map).

There is only one excuse for a list of species occurring within certain political boundaries and that is, that it is a part of a whole, and, without the gaps filled, we will still be far from a complete knowledge of our fauna and its affinities. For this reason the writer presents this list, which he deems accurate to 1929, and in available literature until January, 1931. The major portion of the inaccuracies will undoubtedly be eliminated by further collections and, with this in mind, sufficient space has been left after each species for the addition of new localities. The lack of records from so many of our counties does not indicate any certain distributional phenomena, but the great lack of collections and necessarily of collectors. Students of Nature and others, who in their rambles could add to this list, would not only give themselves pleasure, but would greatly advance the study of the fauna of this state. It is hoped that any new records and ecological data on the land-snails of Pennsylvania, if not in a published form, will be transmitted to the author.

In compiling this list the collections of the Academy of Natural Sciences of Philadelphia and the Carnegie Museum of Pittsburgh were utilized. The writer wishes to thank Dr. H. A. Pilsbry and his staff for their coöperation and helpful criticism. The collection of the Carnegie Museum has been greatly amplified by the addition of the George H. Clapp Collection of North American Land-snails, which Dr. Clapp has so kindly presented to this institution.

LIST OF GENERA AND SPECIES

Family HELICINIDÆ.

1. *Hendersonia occulta* (Say), Western Pennsylvania. Counties: Allegheny.

Family HELICIDÆ.[1]

2. *Helix aspersa* Müller, Introduced. Greenhouses in Allegheny County.

3. *Polygyra tridentata* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Butler, Lawrence, Venango, Crawford, Forest, Clarion, Armstrong, Indiana, Westmoreland, Washington, Greene, Fayette, Somerset, Cambria, Blair, McKean, Potter, Clinton, Tioga, Sullivan, Wyoming, Susquehanna, Luzerne, Schuylkill, Lehigh, Northampton, Bucks, Berks, Montgomery, Monroe, Philadelphia, Delaware, Chester, Lancaster, York, Cumberland, Fulton.

4. *Polygyra tridentata juxtidens* Pilsbry, Western and Eastern Pennsylvania. Counties: Allegheny, Lawrence (?), Cambria, Blair, Fulton, Center, Adams, York, Lancaster, Chester, Delaware, Philadelphia, Montgomery, Bucks, Monroe, Pike, Northampton (?).

5. *Polygyra fraudulenta* Pilsbry, Western Pennsylvania. Counties: Allegheny, Greene, Warren, Beaver, Washington. Chester County is recorded as a locality, which I believe to be a mistake.

6. *Polygyra fallax* (Say) Eastern Pennsylvania. Counties: Philadelphia, Susquehanna, Chester, Berks, Adams, Lancaster, Montgomery, Delaware, Northampton (?).

7. *Polygyra inflecta* (Say), Western Pennsylvania. Counties: Washington. Other records, which I believe to be mistakes, are Philadelphia and Chester Counties.

[1]In this printed list some counties are marked with a (?). These represent localities marked in Dr. Ortmann's notes and not corroborated before his death. In the main they are logical localities and will undoubtedly be verified by future findings.

8. *Polygyra profunda* (Say), Western Pennsylvania. Counties: Allegheny, Beaver, Greene, Fayette, Somerset, Cambria, Clinton, Indiana, Westmoreland, Butler, Lawrence, Venango, Chester (?).

9. *Polygyra profunda alba*[2] Walker, Western Pennsylvania. Counties: Lawrence.

10. *Polygyra profunda unicolor*[2] Walker. Not in the collections of this laboratory but many approach this color-variety.

11. *Polygyra sayana* Pilsbry, Western Pennsylvania. Counties: Allegheny, Lawrence, Mercer, Potter, Westmoreland, Cambria, Fayette, Somerset, Indiana, Clinton.

12. *Polygyra albolabris* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Lawrence, Butler, Venango, Crawford, Erie, Forest, Clarion, McKean, Warren, Potter, Clinton, Indiana, Cambria, Blair, Huntingdon, Fulton, Bedford, Somerset, Fayette, Greene, Washington, Westmoreland, Franklin, Juniata, Perry, Cumberland, Adams, York, Lancaster, Chester, Delaware, Philadelphia, Montgomery, Bucks, Lehigh, Berks, Northampton, Carbon, Monroe, Pike, Susquehanna, Bradford, Lycoming, Luzerne, Schuylkill.

13. *Polygyra zaleta* (Binney), Western Pennsylvania. Counties: Allegheny, Indiana, Lawrence, McKean, Potter, Blair, Cambria, Somerset, Fayette, Westmoreland, Washington, Beaver, Butler, Venango.

[2]These are undoubtedly color varieties and not true subspecies, as almost all variations are found in a large collection from any of the western localities.

14. *Polygyra multilineata* (Say), Western Pennsylvania. Counties: Beaver.

15. *Polygyra dentifera* (Binney), Western and Eastern Pennsylvania. Counties: Allegheny, Lawrence, Beaver, Butler, Westmoreland, Fayette, Somerset, Cambria, Blair, Potter, Northumberland, Wayne, Indiana, Clinton, McKean, Sullivan, Wyoming, Monroe(?), Lancaster(?).

16. *Polygyra denotata* (Ferussac), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Greene, Somerset, Indiana, Cambria, Huntingdon, Clinton, Potter, McKean, Sullivan, Monroe, Bucks, Westmoreland, Washington, Armstrong, Venango, Forest, Lawrence, York, Lancaster(?).

17. *Polygyra appressa* (Say). Introduced by Amos Binney into Burlington, New Jersey and has made its way into Philadelphia County.

18. *Polygyra pennsylvanica* Green, Western Pennsylvania. Counties: Allegheny, Beaver, Greene, Indiana, Butler, Washington, Westmoreland, Lawrence, Fayette.

19. *Polygyra thyroidus* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Crawford, Erie, McKean, Forest, Venango, Lawrence, Butler, Indiana, Westmoreland, Cambria, Blair, Somerset, Fayette, Greene, Washington, Clinton, Adams, York, Lancaster, Chester, Delaware, Montgomery, Philadelphia, Bucks, Northampton, Monroe, Pike.

20. *Polygyra thyroidus bucculenta* Gould, Eastern Pennsylvania. Counties: Lancaster, Philadelphia, Luzerne.

21. *Polygyra clausa* (Say), Eastern Pennsylvania. Counties: Chester.

22. *Polygyra mitchelliana* (Lea), Western Pennsylvania. Counties: Allegheny.

23. *Polygyra hirsuta* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Greene, Fayette, Beaver, Washington, Westmoreland, Venango, Forest, Clinton, Fulton, Franklin, York, Lancaster, Chester, Philadelphia, Montgomery, Bucks, Berks, Lehigh, Northampton, Monroe, Susquehanna, Schuylkill, Lackawanna.

24. *Polygyra fraterna* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Westmoreland, Washington, Fayette, Greene, Somerset, Indiana, Forest, McKean, Potter, Clinton, Cambria, Tioga, Sullivan, Wyoming, Lackawanna, Pike, Monroe, Northampton, Lehigh, Bucks, Montgomery, Philadelphia, Schuylkill, Lycoming, Franklin, Adams, York(?), Lancaster(?), Chester(?).

Family ACHATINIDÆ.

25. *Subulina octona* Brugiere, Introduced. In greenhouses in Philadelphia.

26. *Opeas pumilum* (Pfeiffer), Introduced. In greenhouses in Philadelphia and Pittsburgh.

27. *Opeas johannina* (Morelet), Introduced. Phipps Conservatory, Pittsburgh.

28. *Opeas clavulinum kyotoënse* (Pilsbry), Introduced. Phipps Conservatory, Pittsburgh.

Family HAPLOTREMATIDÆ.

29. *Haplotrema concavum* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Lawrence, Butler, Venango, Armstrong, Westmoreland, Washington, Greene, Fayette, Somerset, Cambria, Blair, Indiana, Elk, McKean, Potter, Fulton, York, Lancaster, Chester, Philadelphia, Montgomery, Bucks.

Family TESTACELLIDÆ.

30. *Testacella haliotidea* (Draparnaud), Western and Eastern Pennsylvania. Introduced. Reported from Philadelphia, Chicago, and found in Pittsburgh in 1927. Pittsburgh, according to Dr. H. A. Pilsbry, is the third record for the United States.

Family ZONITIDÆ.

31. *Gastrodonta interna* (Say), Western Pennsylvania. Counties: Westmoreland.

32. *Ventridens intertexta* (Binney), Western and Eastern Pennsylvania. Counties: Allegheny, Washington, Westmoreland, Fayette, Somerset, Cambria, Crawford, Indiana, McKean, Potter, Clinton, Wyoming, Monroe, Luzerne.

33. *Ventridens demissa* (Binney), Described from "Western Pennsylvania" but not contained in any of the collections studied.

34. *Ventridens ligera* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Butler, Crawford, Washington, Greene, Fayette, Westmoreland, Cambria, Somerset, Juniata, Fulton, Clinton, McKean, Sullivan, Adams, York, Lancaster, Chester, Delaware, Philadelphia, Montgomery, Berks, Potter.

35. *Ventridens suppressa* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Indiana, Fulton, Franklin, Adams, York, Lancaster, Chester, Delaware, Philadelphia, Montgomery, Bucks, Berks, Lehigh, Northampton, Monroe.

36. *Ventridens gularis* (Say), Western Pennsylvania. Counties: Allegheny.

37. *Zonitoides nitidus* (Müller), Western and Eastern Pennsylvania. Counties: Allegheny, Erie, Philadelphia, Northampton, McKean.

38. *Zonitoides arboreus* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Butler, Venango, Erie, Forest, Indiana, Washington, Westmoreland, Fayette, Greene, Somerset, Cambria, Clinton, McKean, Potter, Fulton, Franklin, Adams, York, Lancaster, Chester, Delaware, Philadelphia, Montgomery, Bucks, Berks, Northampton, Monroe, Pike, Susquehanna, Wyoming, Sullivan, Lackawanna, Schuylkill.

39. *Striatura ferrea* Morse, Western and Eastern Pennsylvania. Counties: Allegheny, McKean, Pike, Monroe, Northampton.

40. *Striatura milium* (Morse), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, McKean, Lawrence(?), Adams, Chester, Delaware, Philadelphia, Montgomery, Bucks, Berks, Northampton, Monroe.

41. *Striatura exigua* (Stimpson), Western Pennsylvania. Counties: Allegheny.

42. *Paravitrea multidentata* (Binney), Western Pennsylvania. Counties: Allegheny, Beaver, Indiana, Washington.

43. *Hawaiia minuscula* (Binney), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Lawrence(?), Lancaster, Chester, Philadelphia, Montgomery, Bucks, Berks, Northampton, Monroe.

44. *Mesomphix lævigata* "Rafinesque" Beck, Western Pennsylvania. Counties: Allegheny, Washington, Westmoreland, Butler, Northumberland(?).

45. *Mesomphix inornata* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Butler, Lawrence, Venango, Forest, Crawford, Westmoreland, Washington, Greene, Fayette, Cambria, Blair, Potter, Warren, McKean, Cameron, Clinton, Huntingdon, Mifflin, Sullivan, Wayne, Lycoming(?), Lancaster(?).

46. *Omphalina cuprea* Rafinesque, Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Venango, Crawford, Potter, Blair, Cambria, Westmoreland, Fayette, Greene, Washington, Lawrence, McKean, Elk, Cameron, Indiana, Clinton, Lycoming, Somerset, Sullivan, Susquehanna, Monroe, Lehigh, Bucks, Montgomery, York, Lancaster(?).

47. *Retinella electrina* (Gould), Western and Eastern Pennsylvania. Counties: Allegheny, Washington, Westmoreland, Beaver, Butler, Forest, Erie, McKean, Lawrence(?), Cumberland, Chester, Delaware, Philadelphia, Montgomery, Berks, Bucks, Northampton, Monroe, Susquehanna, Lancaster(?).

48. *Retinella indentata* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Washington, Westmoreland, Greene, Beaver, Butler, Indiana, Forest, Lawrence(?), Franklin(?), Adams, York(?), Lancaster(?), Chester, Delaware, Philadelphia, Montgomery, Bucks, Berks, Northampton, Monroe, Pike, Susquehanna.

49. *Retinella rhoadsi* (Pilsbry), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Fulton, Adams, Franklin(?), Chester, Delaware, Philadelphia, Montgomery, Bucks, Berks, Northampton, Monroe, Pike.

50. *Oxychilus lucidus* Draparnaud, Introduced. Western and Eastern Pennsylvania. Counties: Allegheny, Philadelphia.

51. *Oxychilus cellarius* (Müller), Introduced. Western and Eastern Pennsylvania. Counties: Allegheny, Philadelphia, Montgomery, Northampton, Chester(?).

52. *Vitrina limpida* Gould, Western Pennsylvania. Counties: Allegheny.

53. *Euconulus chersinus polygyratus* Pilsbry, Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, McKean, Monroe, Bucks.

54. *Euconulus fulvus* (Müller), Eastern Pennsylvania. Counties: Montgomery, Northampton, Monroe, (Allegheny (?), Stupakoff Collection).

55. *Guppya sterkii* (Dall), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Lawrence(?), Chester, Montgomery, Bucks, Northampton.

Family LIMACIDÆ.

56. *Limax maximus* (Linnæus), Introduced. Western and Eastern Pennsylvania. Counties: Allegheny, Philadelphia, Chester, Delaware, Northampton. Records incomplete.

57. *Limax flavus* (Linnæus), Introduced. Western and Eastern Pennsylvania. Counties: Allegheny, York, Chester, Philadelphia. Records incomplete.

58. *Deroceras agrestris* (Linnæus), Western and Eastern Pennsylvania. Counties: Allegheny, Greene, Westmoreland, Mercer, Forest, Delaware, Philadelphia, Bucks, Chester(?), Northampton(?). Records incomplete.

59. *Deroceras laeve* (Müller) var. *gracile* (Rafinesque), Western and Eastern Pennsylvania. Counties: Allegheny, Washington, Greene, Armstrong, Butler, Beaver, Lawrence, Venango, Forest, Crawford, Erie, McKean, Potter, Schuylkill, York, Chester, Philadelphia, Montgomery, Bucks, Berks, Northampton(?). Records incomplete.

60. *Milax gagates* (Moquin-Tandon), Introduced. Western Pennsylvania. Counties: Allegheny. Records incomplete.

Family ENDODONTIDÆ.

61. *Anguispira alternata* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Westmoreland, Washington, Greene, Fayette, Somerset, Bedford, Cambria, Blair, Indiana, Huntingdon, Clinton, Butler, Beaver, Lawrence, Venango, Crawford, McKean, Potter, York, Lancaster, Chester, Philadelphia, Montgomery, Bucks, Berks, Lehigh, Northampton, Monroe, Pike.

62. *Anguispira alternata* mut. *alba* (Tryon), Eastern Pennsylvania. Counties: Philadelphia.

63. *Anguispira alternata fergusonii* (Bland), Eastern Pennsylvania. Counties: Philadelphia, Montgomery, Chester, Delaware.

64. *Anguispira kochi* (Pfeiffer), Western Pennsylvania. Counties: Allegheny, Beaver, Greene, Washington, Westmoreland.

65. *Gonyodiscus patula* (Deshayes), Western and Eastern Pennsylania. Counties: Allegheny, Beaver, Lawrence, Westmoreland, Washington, Greene, Fayette, Cambria, Clinton, Potter, McKean, Tioga, Dauphin, Lancaster, Susquehanna.

66. *Gonyodiscus cronkhitei anthonyi* (Pilsbry), Western and Eastern Pennsylvania. Counties: Allegheny, Washington, Beaver, Butler, Erie, Lawrence, Sullivan, York, Lancaster, Chester, Delaware, Philadelphia, Montgomery, Bucks, Northampton.

67. *Gonyodiscus cronkhitei catskillensis* (Pilsbry), Western and Eastern Pennsylvania. Counties: Forest, Chester, Montgomery, Berks, Monroe.

68. *Helicodiscus parallelus* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Washington, Westmoreland, Indiana, Beaver, Butler, Forest, Franklin, Adams, York, Chester, Lancaster(?), Delaware, Philadelphia, Montgomery, Berks, Northampton, Luzerne, Pike, Monroe(?).

69. *Helicodiscus singleyanus inermis* H. B. Baker, Eastern Pennsylvania. Counties: Philadelphia, Montgomery.

70. *Punctum pygmaeum minutissimum* (Lea), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Lawrence(?), Chester, Delaware, Philadelphia, Montgomery, Bucks, Berks, Northampton, Monroe, Pike.

Family ARIONIDÆ.

71. *Arion hortensis* Férussac, Introduced. Western and Eastern Pennsylvania. Counties: Allegheny, Erie, Philadelphia. Records incomplete.

Family PHILOMYCIDÆ.

72. *Philomycus carolinianus* (Bosc), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Butler, Lawrence, Venango, Clarion, McKean, Potter, Clinton, Indiana, Cambria, Blair, Washington, Westmoreland, Somerset, Fayette, Fulton, Perry, Sullivan, Wyoming, Susquehanna, Pike, Monroe, Luzerne, Franklin(?), York, Lancaster, Chester, Delaware, Philadelphia, Northampton(?). Records incomplete.

73. *Pallifera dorsalis* (Binney), Western and Eastern Pennsylvania. Counties: Allegheny, Delaware. Records incomplete.

74. *Pallifera pennsylvanica* Pilsbry, Eastern Pennsylvania. Counties: York. Records incomplete.

Family SUCCINEIDÆ.

75. *Succinea avara* Say, Western and Eastern Pennsylvania. Counties: Allegheny, Greene, Franklin, Chester, Delaware, Philadelphia, Montgomery, Bucks, Northampton.

76. *Succinea avara major* "Binney" Cockerell, Western and Eastern Pennsylvania. Counties: Fayette, McKean, Potter, Sullivan, Susquehanna, Pike, Monroe, Bucks, Montgomery, Philadelphia, Chester, Lancaster.

77. *Succinea ovalis* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Westmoreland, Fayette, Venango, Forest, Crawford, Erie, McKean, Indiana, Luzerne, Delaware, Lehigh, Northampton, Monroe(?), Philadelphia(?), Chester(?), Lancaster(?).

78. *Succinea retusa* (Lea), Western and Eastern Pennsylvania. Counties: Beaver, Lawrence(?), Mercer, Crawford, McKean, Bucks, Delaware, Lancaster, Chester(?), York(?).

Family COCHLICOPIDÆ.

79. *Cochlicopa lubrica* (Müller), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Washington, Lawrence(?), McKean, Monroe, Northampton, Lehigh, Bucks, Montgomery, Philadelphia, Chester, Lancaster(?).

80. *Cochlicopa lubrica morseana* (Doherty), Western Pennsylvania. Counties: Allegheny.

Family PUPILLIDÆ.

81. *Pupoides marginatus* (Say), Western and Eastern Pennsylvania. Counties: Washington, York, Lancaster, Chester(?), Delaware, Philadelphia, Montgomery, Berks, Northampton(?).

82. *Gastrocopta armifera* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Adams, York, Lancaster, Chester, Philadelphia, Montgomery, Bucks, Berks, Lehigh, Northampton.

83. *Gastrocopta contracta* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Washington, Beaver, Lawrence(?), York, Lancaster, Chester, Philadelphia, Montgomery, Bucks, Berks, Northampton, Monroe.

84. *Gastrocopta pentodon* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Washington, Beaver, Lancaster, Chester, Philadelphia, Montgomery, Bucks, Berks, Northampton, Monroe, Pike.

85. *Gastrocopta tappaniana* (C. B. Adams), Western and Eastern Pennsylvania. Counties: Allegheny, Indiana, Chester, Philadelphia, Montgomery, Northampton.

86. *Gastrocopta corticaria* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, York, Chester, Delaware, Philadelphia, Northampton.

87. *Vertigo ovata* Say, Western and Eastern Pennsylvania. Counties: Allegheny, Lancaster, Chester, Philadelphia(?), Berks, Northampton(?), Lehigh, Monroe.

88. *Vertigo gouldi* (Binney), Western and Eastern Pennsylvania. Counties: Allegheny, Philadelphia, York, Potter, Bucks, Monroe, Chester, Northampton(?).

89. *Vertigo ventricosa* (Morse), Western and Eastern Pennsylvania. Counties: Allegheny, Chester, Delaware, Philadelphia.

90. *Vertigo pygmaea* (Drapranaud), Eastern Pennsylvania. Counties: Bucks, Montgomery, Philadelphia, Chester.

91. *Vertigo tridentata* Wolf, Eastern Pennsylvania. Counties: York, Lancaster, Philadelphia, Montgomery, Northampton.

92. *Vertigo milium* (Gould), Western and Eastern Pennsylvania. Counties: Allegheny, Chester, Northampton(?).

93. *Vertigo bollesiana* (Morse), Western and Eastern Pennsylvania. Counties: Allegheny, Lancaster.

94. *Columella edentula* (Draparnaud), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, McKean, Monroe, Northampton.

Family STROBILOPSIDÆ.

95. *Strobilops œnea* (Pilsbry), Western and Eastern Pennsylvania. Counties: Allegheny, York, Chester, Berks, Philadelphia.

96. *Strobilops labyrinthica* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Westmoreland, York, Lancaster(?), Chester, Philadelphia, Berks, Montgomery, Northampton.

97. *Strobilops labyrinthica parietalis* Pilsbry, Eastern Pennsylvania. Counties: Montgomery.

Family VALLONIIDÆ.

98. *Vallonia costata* (Müller), Eastern Pennsylvania. Counties: Monroe, Northampton, Montgomery, Philadelphia, Chester, Lancaster.

99. *Vallonia pulchella* (Müller), Western and Eastern Pennsylvania. Counties: Allegheny, Washington, Fayette, Schuylkill, Chester, Philadelphia, Montgomery, Berks, Northampton, Lackawanna.

100. *Vallonia excentrica* (Sterki), Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, York, Lancaster, Chester, Delaware, Philadelphia, Montgomery, Berks, Bucks, Northampton, Monroe.

Family CARYCHIIDÆ.

101. *Carychium exiguum* (Say), Western and Eastern Pennsylvania. Counties: Allegheny, Chester, Philadelphia, Montgomery, Lehigh, Northampton, Lancaster(?).

102. *Carychium exile* H. C. Lea, Western and Eastern Pennsylvania. Counties: Allegheny, Beaver, Lawrence, Adams, Chester, Philadelphia, Montgomery, Bucks, Northampton, Monroe.

DISCUSSION OF MIGRATION

A. Pennsylvania is the meeting place of three great routes of migration, according to the principles set forth by Adams,[3] and Ortmann,[4] and is the recipient of species from the north or boreal regions. Ortmann (*l.c.*) indicates two routes, the Mississippi Valley and the Eastern Coastal Plain. The third route indicated by Adams (*l.c.*), the southern Appalachians and the adjacent plateaus, is, as the distribution of the land-snails tends to prove, an inter-relationship of the two routes mentioned above.

The forms which have advanced up the Mississippi Valley are of two groups, viz., those that are represented on both sides of the Alleghenian Divide, *in Pennsylvania*, and those which occur only[5] in the western part of Pennsylvania. This statement is the keynote, so to speak, of the explanation of Adams' third route.

B. The third route suggested by Adams is, according to my translation of the material at hand, a condition which has been the result of *distribution by watercourses.*[6]

[3]Adams, Chas. C. "Southeastern United States as a Center of Geographical Distribution of Flora and Fauna," Biological Bulletin, III, 1903, 115-131.

[4]Ortmann, A. E. "The Alleghenian Divide and its Influence upon the Fresh-Water Fauna," Proc. Amer. Philos. Soc., LII, 1913, 288-390.

[5]Those represented in the western part of Pennsylvania are all represented in the collections from North Carolina and Virginia on the Coastal Plain. This is taken up later as an example of migrational "lag."

[6]The fauna of the Mississippi Valley, migrating north and following the rivers, would naturally ascend every possible tributary and would progress in this new direction just as far as the proper conditions and lack of barriers would permit. It is understood that in this migration by water courses we mean *a tendency for animals to follow a path of the least resistance and the path affording them the maximum protection and food.* These two conditions are more likely to exist along streams than any other places.

Evidence that the third route is a combination of the eastern and western routes, aside from the evidence derived from land-snails is strikingly shown in the distribution of the genus *Anculosa*, which, having its birth in the southeast or south-central region, as the case may be, has attained a distribution to the headwaters of many of the streams of the Mississippi Drainage. In the mountain streams, which are ultimate tributaries of the Mississippi River, they have passed, by stream capture, to the headwaters of the eastern drainage; thus ascending and conquering the Appalachian Barrier.

It is obvious that the land-snails are not aquatic and for this reason are better able to migrate at their "own free will" into the best environments. Granted that this is so, then, the land-snails, if from the Mississippi Valley or intermediate[7] in origin, would go towards the west and towards the eastern path of dispersal because of the prevailing direction of the river valleys (Pl. XVI). Starting in these directions simultaneously the ones proceeding by the western route would spread faster than those going by the eastern route, as explained in a later paragraph.

C. The genera of land-snails and their representative species which have followed the Mississippi Valley to this state and which are common only to the western portion are:

Hendersonia occulta
Polygyra mitchelliana
Polygyra pennsylvanica
Polygyra multilineata
Polygyra sayana
Polygyra zaleta
Polygyra profunda
Polygyra fraudulenta
Polygyra inflecta
Polygyra appressa
Mesomphix laevigata

All of these are represented on the eastern coastal plain as far north as North Carolina and Virginia. This indicates a slower migration on the eastern slope of the Alleghenies.

D. The genera of land-snails and their representative species which are represented in both the eastern and western parts of Pennsylvania

[7]Adams (*l.c.*), The majority of the species (not especially snails) have been derived from between the delta of the Mississippi River and the west coast of Florida.

and which have arrived by way of the Mississippi Valley *and* the Coastal Plain and adjacent highlands are:

Polygyra tridentata
Polygyra tridentata juxtidens
Polygyra albolabris
Polygyra dentifera
Polygyra denotata
Polygyra thyroida
Polygyra hirsuta
Polygyra fraterna
Omphalina cuprea
Mesomphix inornata
Philomycus carolinianus

E. The apparent slowness of the migration of forms by the Coastal Plain route can be explained by the fact that in the Mississippi Valley all of the streams are tributaries of the one great stream, the Mississippi River. This forms a direct and continuous path from the Gulf of Mexico to Western New York and to the head-waters of the Columbia River in the West.

The coastal drainage, on the other hand, is abrupt and of a relatively short length. The streams of this region are not all dependent upon one great stream but almost all have their separate drainage, only approximating at the headwaters of their tributaries.

Is it not an obvious statement that animals are able to migrate faster along a continuous route than along a discontinuous one? So, for this reason, the migration of the coastal route is slower and lags behind the migration in the Mississippi Valley.

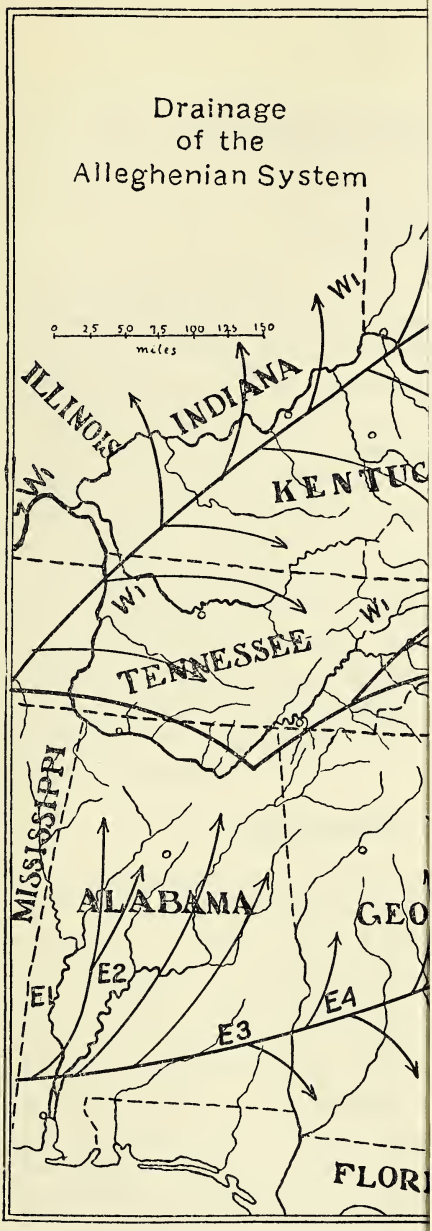
F. Distribution by means of water has for a long time been made the explanation of the distributions of many of the wide-spread forms of land-snails. Instead of this being a point of major importance, it is likely, as the writer thinks, one of very minor import. We have very few accurate records of land-snails being carried in this manner. One account that has a bearing upon the distribution in this state is reported in a series of notes from Dr. George H. Clapp to the Nautilus.[8]

[8]Clapp, George H. "Vitrina limpida in Pennsylvania," Nautilus, VII, 1893, 47.
"Vitrina limpida Gould in Pennsylvania," Nautilus, VII, 1893, 94.
"Dispersal of Shells," Nautilus, IX, 1895, 35.
"Vitrina limpida in Western Pennsylvania," Nautilus, IX, 1895, 94.

Dr. Clapp discovered a colony of *Vitrina limpida* inhabiting some drift on the banks of the Ohio River near Sewickley, Pennsylvania. He determined by records of past water-levels that this drift was deposited by a flood, which arose in the headwaters of the Allegheny River. *V. limpida*, being distributed throughout New England to Western New York, had not been reported up to that time from any locality in Pennsylvania. Hence the deduction, that this species was brought into this state by water. Further proof of such method of distribution would be the finding of this species at other stations along the Allegheny River. Hemphill[9] mentions a distribution by water of the general forms of the west coast into the interior. To the writer this should be modified to a distribution by water courses without the constant intervention of water as a distributing agent. In this part of the United States, in preglacial times, according to various authorities, the prevalent watershed was toward the northeast. This alone would discount the general idea of water-borne species (post-pleistocene) as does the present direction of flow of the Mississippi River. In the latter we well know that many of the species migrating into this region have necessarily come in, since the recession of the ice and since the formation of the present drainage. *Distribution by water courses is in no way affected by the direction of the flow of a stream.* This is a fundamental fact of distribution and explains the present situation.

G. Pennsylvania has been the recipient of many forms from more northern parts of America. The genera are as follows: *Vallonia*, *Zonitoides*, *Retinella*, *Euconuus*, *Punctum*, *Pupilla*, *Columella*, *Carychium*, *Vertigo*, *Vitrina*, *Cochlicopa*, and *Gastrocopta*. All of these genera have representatives in either Europe, or Asia, or both. Some of the species of the above genera are common to three continents, some to two, and some only to one. The dispersal of these forms was perhaps across the eastern and western land bridges, or, theoretically and indicated by their distribution, they originated in the more boreal regions and migrated southward into the respective continents obviously before the formation of the Pleistocene Ice-cap.

[9]Hemphill, Henry, "Descriptions of Some Varieties of Shells, with Short Notes on the Geographical Range and Means of Distribution of Land Shells." Trans. San Diego Society of Natural History, I, 1911, 99-108.



Map showi

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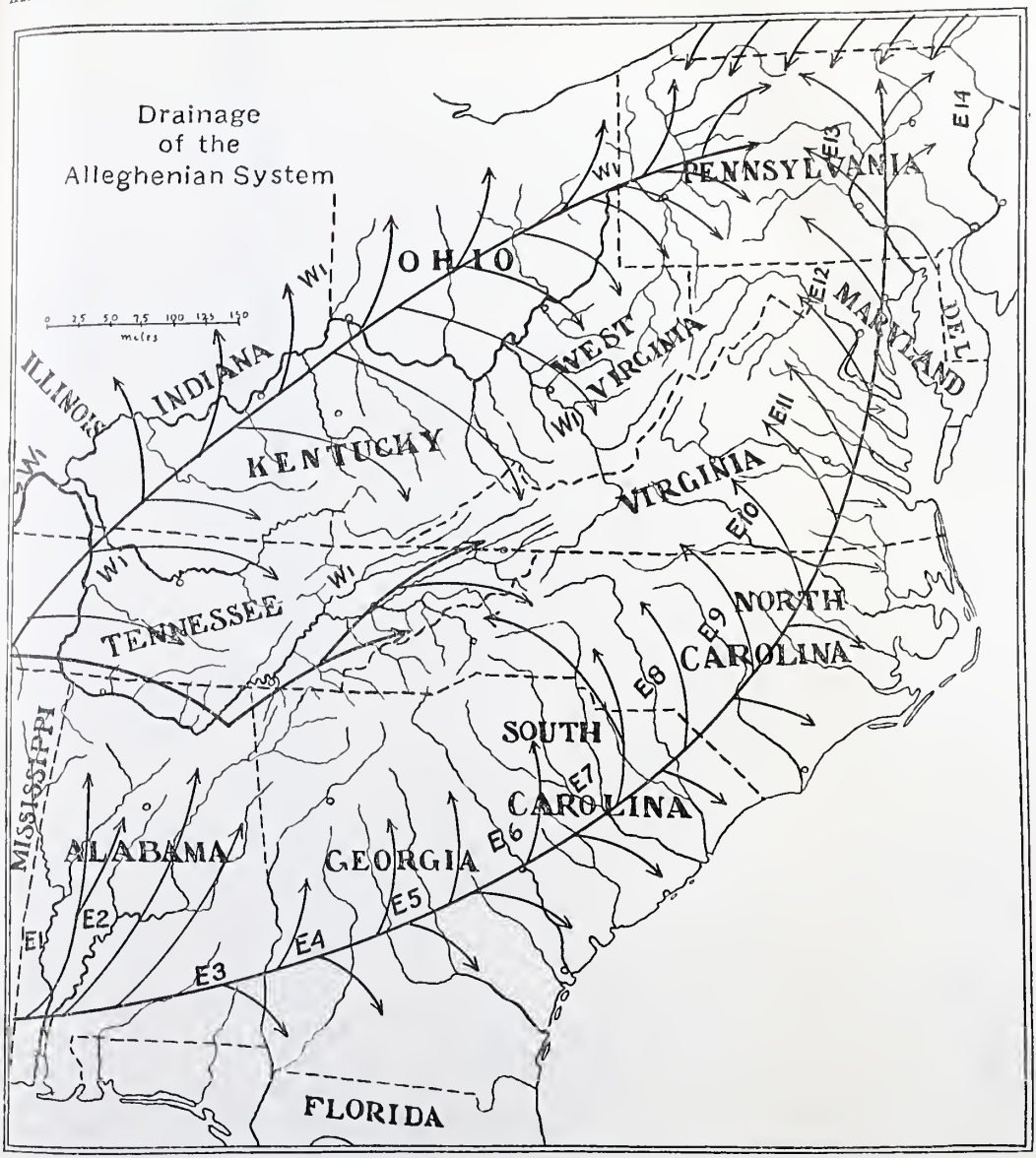


Map showing Routes of migration of Land-snails.

The two routes (plus the third of Adams), the Mississippi Valley and the Coastal Plain are shown on the map. The western route W-1 shows a continuous migrational path; while the eastern route, E-1 to E-14, shows approximately fourteen different deviations in the migrational path. This indicates the obvious cause for the eastern migrational "lag" and the manner in which the various species made their way along the river-courses and into the highlands adjacent to the migrational path. Dr. H. A. Pilsbry, in criticism, states that the lines of migration start too far west. This should be kept in mind in referring to the map.

XVI. NEW MESONYCHIDS FROM THE UINTA.

By O. A. Peterson.

(Plates XVII-XVIII.)

During the collecting seasons of 1929-30, the field-party of the Carnegie Museum recovered in the Uinta sediments of northeastern Utah two or three specimens of *Mesonychids*, which occur in these sediments, but of which comparatively little hitherto has been known. One of these specimens was found in the Uinta Quarry of the Upper Uinta now known to be in the basal Oligocene, some twelve to fourteen hundred feet above the horizons in which the known Uinta fauna is usually found, and belongs to a distinct genus. The other specimen was found in a horizon about two hundred feet higher than that in which the type of *Harpagolestes uintensis* (Scott) was found, and pertains to a distinct species of that genus.

Comparisons were carefully made between the newly discovered specimens in the Carnegie Museum and the type of *Harpagolestes uintensis* at Princeton, *H. immanis* Matthew at the American Museum, and *H. macrocephalus* Wortman and *H. breviceps* Thorpe at the Yale Museum.

1. **Harpagolestes uintensis** (Scott).

In this connection it is important to restudy the specimen No. 2,961, in the Carnegie Museum, which was referred to *Harpagolestes uintensis* by Peterson in the Annals of the Carnegie Museum, Vol. XII, 1919, p. 41. The left mandibular ramus of this specimen is very nearly complete, showing premolars two, three, four, and the molar series. As Peterson already observed P_2 and M_3 have greater antero-posterior diameters than the corresponding teeth designated by Scott in his description and illustration.[1] In comparing P_3 of the lower jaw, No. 2,961 of the Carnegie Museum, with the tooth, which Scott designated as P_4 of *H. uintensis* in his work it is very evident that the tooth in the specimen in Princeton should be referred to P_3.

[1]Jour. Acad. Nat. Sci. Philad. (2), IX, 1888, p. 168; Trans. Amer. Philos. Soc. XVI, 1890, pp. 471-473, plate X, fig. 9.

In the first place P_4 and M_1 of *Harpagolestes* appear practically to have an equal antero-posterior diameter. Secondly P_3 in the specimen of the Carnegie Museum has a minute anterior basal tubercle, while that on the tooth referred to P_4 by Scott is represented by a slight wear from the upper tooth. With the exception of this slight difference, the teeth here compared are very similar. P_4 has an anterior tubercle of subequal size to that on M_1 in the specimen of the Carnegie Museum. The anterior tubercles on the cheek-teeth in the type of *H. uintensis* are on the whole smaller[2] than those in the specimen in Pittsburgh. The latter feature I judge to be purely individual. But whether or not the longer P_2 and M_3 should be likewise regarded as individual characters must rest in abeyance until future discoveries. The type of *Harpagolestes uintensis* at Princeton consists of loose teeth, which may or may not belong together. Peterson refrained from erecting a distinct species upon the specimen in the

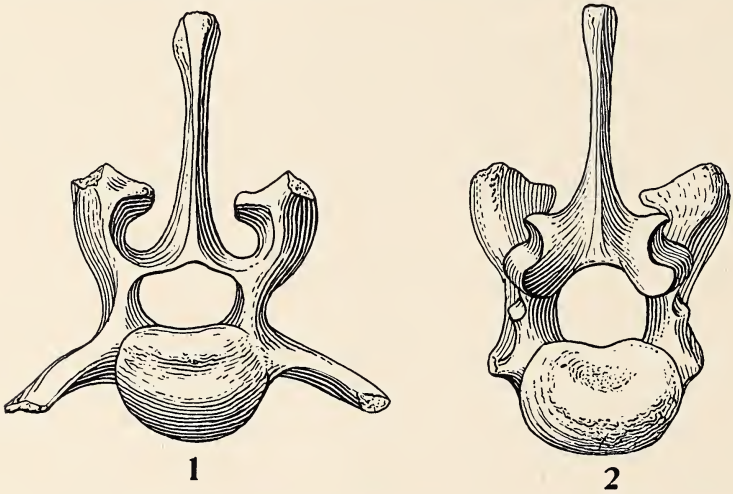


FIG. 1. Lumbar vertebra of *H. uintensis*. 1, Posterior view; 2, anterior view. No. 2961, C. M. Coll. ½ nat. size.

Carnegie Museum in his earlier publication. For the present the specimen in question is still regarded as *H. uintensis* and is here used for purposes of comparison.

[2]In Scott's illustration here referred to, M_1 is represented without anterior basal tubercle, which is an error, since the tooth actually possesses such an element though small.

As in *Mesonyx obtusidens* described by Scott[3] the cervical centrum preserved in No. 2,961 is opisthocœlous. The neural spine, arch, and zygapophyses are stout. The centrum has a distinct ventral keel, on either side of which are noticeable excavations. The transverse process is quite heavy, judging from the broken area at its base. Altogether the cervical present indicates a muscular neck.

The two lumbar vertebræ present with the specimen are from the middle region of the lumbar series. As in *M. obtusidens* the centra are large, contracted in the middle antero-posterior region, but not depressed. The spines are similarly high, broad, thin, and inclined forward. The transverse processes are perhaps shorter and relatively of smaller size than those in *M. obtusidens*. The complex development of the zygapophyses is extraordinary for a carnivore, having the convex-concave articulations very similar to the condition found in some of the recent bovines.

FIG. 2. Anterior caudal vertebræ of *Harpagolestes uintensis*. ⅓ nat. size; No. 2961, C. M. Coll.

Seven caudals from the proximal end of the tail are represented. The first and second have depressed centra, prominent transverse processes directed forward and outward, and robust zygapophyseal processes; those further back have the centra longer, more symmetrical, transverse processes lighter and zygapophyseal processes less robust. There were probably chevrons on some of the anterior caudals. The tail as a whole is long and robust, which is characteristic of the family.

The fragments of ribs indicate that the anterior ribs are flat and thin (rather an advanced condition for an early carnivore), while the posterior ribs are more rod-like.

The appendicular skeleton of this specimen is represented by only the second metatarsal and two phalanges of the second row. The upper portion of the shaft of the metatarsal has a trihedral section, while distally it is more nearly subcylindrical. The facet for the mesocuneiform is narrow and deep, due to backward extension on the plantar process. On the fibular face of the plantar process is a large

[3]Jour. Acad. Nat. Sci. Philadelphia Vol. IX, 1888, p. 159.

facet for articulation with the posterior facet of the ectocuneiform, while anteriorly there is a second interlocking facet for the same bone, situated back of an outward flaring portion of the head. This outward projection on the head of Mt. II apparently does not extend over on the dorsal face of Mt. III. Whether or not the hallux is present in this form cannot be determined from this specimen, since the tibial face of Mt. II is not entirely perfect. The distal articulation resembles more that of an ungulate than a carnivore. While the dorsal face is slightly rounded, it has not the hemispherical feature usually met with in the Carnivora. The carina is prominent and situated approximately in the median vertical line of the posterior face of the articulation. The phalanx of the second row is depressed, short, and broad; its proximal articulation has two depressions separated by a broad convex ridge, while distally the facet for the terminal is evenly convex from side to side and rounded from the back forward, with an abrupt, though short, continuation upward on the dorsal face.

FIG. 3. Dorsal face of second metatarsal of *Harpagolestes uintensis*. No. 2961 C. M. Coll. ½ nat. size.

MEASUREMENTS

Lower jaw from articulating condyle to end of symphysis	360 mm.
" " depth opposite P_2	70 mm.
" " " " M_2	80 mm.
Length of cheek-dentition P_1-M_3	173 mm.
" " premolars	100 mm.
" " molars	73 mm.
Antero-posterior diameter of P_2	21 mm.
" " " " P_3	26 mm.
" " " " P_4	30 mm.
" " " " M_1	29 mm.
" " " " M_2	27 mm.
" " " " M_3	19 mm.
Length of Mt. II	106 mm.
" " phalanx, 2nd row	18 mm.

2. **Harpagolestes leotensis** sp. nov.

Type: Lower mandibular ramus of right side. No. 11,778, C. M. Coll.

Locality: Leota Ranch on Green River, six miles north and east of Ouray, Utah.

Horizon: Uinta Eocene, Upper part of horizon C.

Specific Characters. P_1 vestigial, or absent; shortening of the jaw between canine and P_2; canine of relatively greater diameter; heels of the cheek-dentition of greater length, when compared with the type of *H. uintensis.* Jaw slenderer than that of the specimen in the Carnegie Museum No. 2,961, referred to *H. uintensis.*

P_1 of the present species, if at all present, was quite functionless and dropped out early in life. Crowded against the external face of the anterior root of P_2 is a shallow pit, which may, or may not, represent the alveolus for P_1. Immediately in front of this shallow cavity is the posterior border of the large alveolus for the canine. The latter is of enormous size, judging from the alveolus. P_4 is very nearly as long as M^1 and in this respect resembles the condition found in the mandible, No. 2,961, of the specimen in the Carnegie Museum referred to *H. uintensis.* M_3, according to the empty alveolus, was evidently not reduced as much, as one should expect, in a species found in a horizon over two hundred feet higher than that, in which *H. uintensis* is found in the Uinta Basin. The mandible, as a whole, is slenderer, somewhat longer and straighter than in *H. uintensis*, or in *H. immanis* from the Washakie Basin. In *Harpagolestes immanis* according to Matthew's illustrations[4] the diastema between the canine and P_2 is greater and the angle of the jaw no doubt of greater depth, as is the case in *H. uintensis.*

In the type of *Harpagolestes macrocephalus* Wortman from the lower part of the Bridger beds, the lower jaws are represented only by the posterior parts. Wortman speaks of a strongly inflated angle, which is possibly more exaggerated in the Bridger form than in the present species.

Harpagolestes breviceps in the Yale Museum consists of a portion of a lower jaw, upon which Thorpe[5] established his species. It has larger teeth and was no doubt a larger individual. If Thorpe's illustration is correct (p. 220, fig. 2) it appears that the symphysis of the lower jaw extends further back than in *H. uintensis* or *H. leotensis.*

[4]Memoirs of the American Museum of Natural History, No. 1, VI, pp. 496, 498.

[5]Amer. Jour. Sci. (5) Vol. V, 1923, p. 219, fig. 1-3.

According to Thorpe *H. breviceps* was found on White River, Utah, and therefore more nearly in the horizon in which *H. uintensis* is generally found.

MEASUREMENTS.

Lower jaw from articulating condyle to anterior end of symphysis	340 mm.
" " depth of ramus, opposite P_2	62 mm.
" " " " " " M_3	71 mm.
Length of cheek-dentition P_2-M_3	167 mm.
" " premolars	87 mm.
" " molars	80 mm.
Antero-posterior diameter of crown of P_2	20 mm.
" " " " " " P_4	30 mm.
" " " " " " M_1	30 mm.
" " " " " " M_2	26 mm.

3. **Hessolestes*** **ultimus** gen. et sp. nov.

Type: Posterior part of angle with condyle, coronoid process, and M_2 in position; No. 11,763, C. M. Coll.

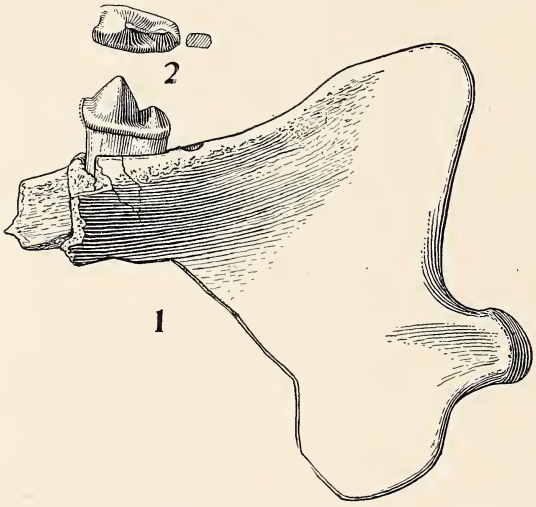


FIG. 4. 1, Back part of left mandible *Hessolestes ultimus* Peterson. 2. Crown view of M_2, *H. ultimus*. No. 11,763, ½ nat. size.

Horizon: Upper Uinta (=Basal Oligocene).

Locality: Titanothere Quarry, eleven miles west of Vernal, Uinta County, Utah.

*ἥσσων = less; λῃστης = robber.

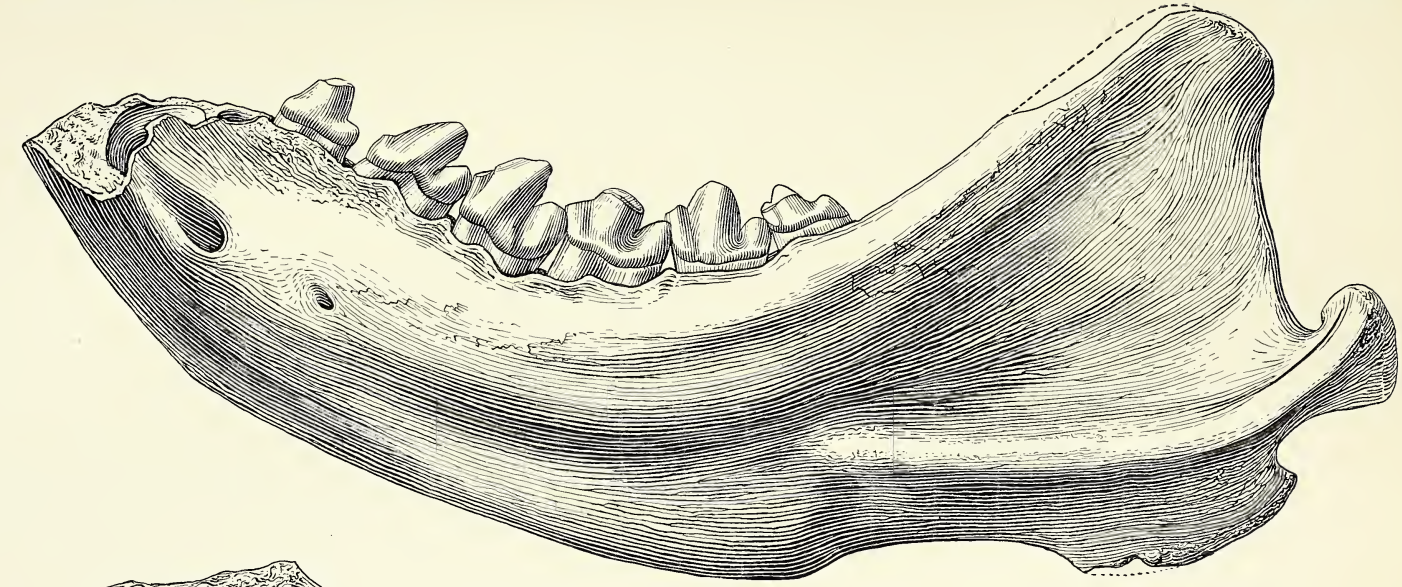
GENERIC CHARACTERS OBTAINED FROM THE TYPE.

M_3 rudimentary; M_2 with posterior basal heel more symmetrically rounded, a mere trace of the anterior basal cusp, the tooth relatively larger, the angle shorter and deeper than in *Harpagolestes*.

The fragment upon which this genus is based furnishes characters, which at once distinguish it from *Harpagolestes* found in the middle and upper Eocene. It seems quite evident that M_1 and M_2 have increased in size and otherwise changed, while M_3 has decreased to vestigial proportions being inserted in the jaw with probably only a single root. If one may be allowed to judge from the deeper and shorter angle, the ramus as a whole is probably shorter, thus causing a still shorter, deeper, and wider skull than in *Harpagolestes* of the lower horizons. That the genus should be placed with the Harpagolestid branch of the Mesonychidæ can hardly be doubted.

MEASUREMENTS.

From the alveolus of M_3 to summit of the coronoid process	60 mm.
Depth of angle in front of condyle	100 mm.
Antero-posterior diameter of M_2 approximately	24 mm.
Greatest transverse diameter of crown M_2	11 mm.



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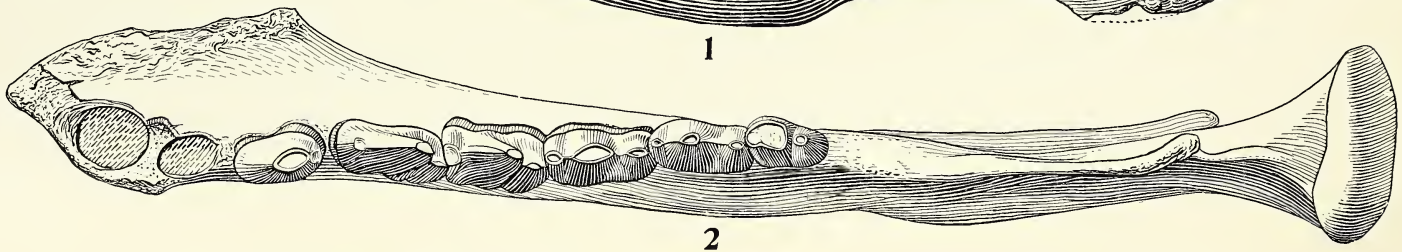

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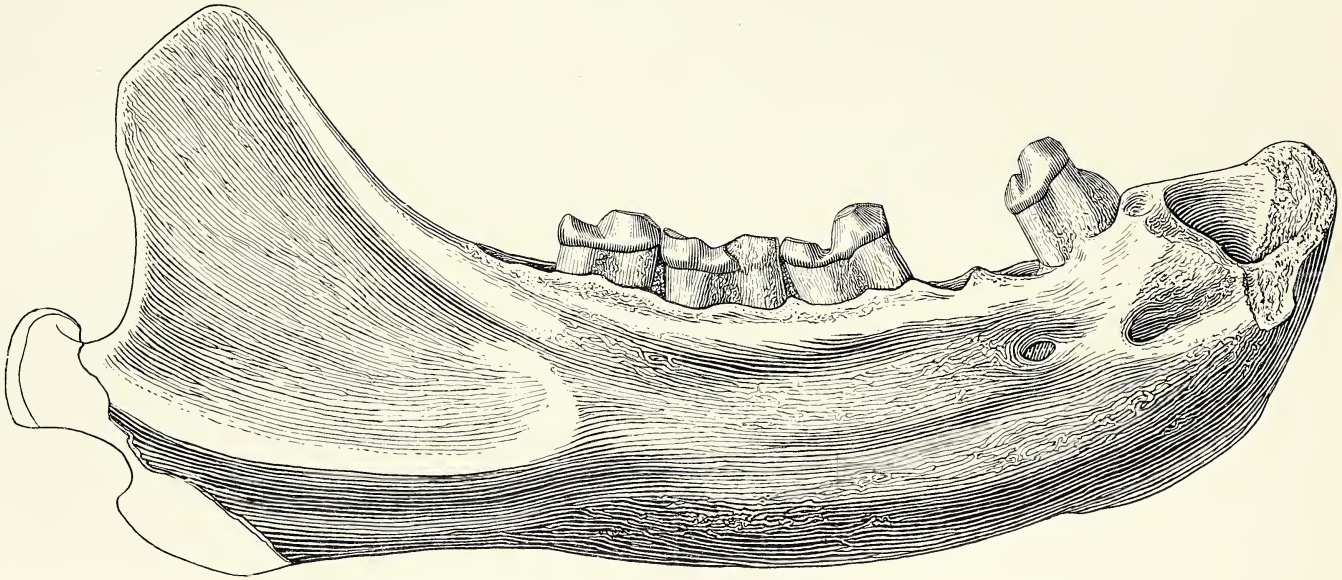
FIG. 1. Left mandible of *Harpagolestes uintensis* Peterson. ½ nat. size. FIG. 2. Do. viewed from above.



Right Mandible of *Harpagolestes leotensis* Peterson, type.

XVII. TWO NEW SPECIES OF AGRIOCHŒRIDS.

By O. A. Peterson.

(Plates XIX-XX.)

During the past two seasons (1929-1930) field-parties from the Carnegie Museum in search of fossil mammalian remains in northeastern Utah, Mr. J. LeRoy Kay in charge, made a number of fortunate discoveries in horizon C of the Uinta Eocene. Among other things there were found a number of specimens representing the family *Agriochœridæ*, which furnish much welcome information as to the anatomical structure of species from the Uinta heretofore little known. All the material, representing new species, came from higher levels in horizon C than any previously discovered.

The study of this collection satisfactorily reveals:

(1) That the upper and lower jaw-fragments tentatively associated with fragments of the limbs and the foot-bones, described in 1919 as *Diplobunops matthewi* by Peterson,[1] are actually a part of the type.

(2) It is now quite clear that the genus *Diplobunops* does not belong with the *Anoplotheres* of Europe, except as a distant relative.[2]

(3) Some, possibly all, of the Upper Eocene Agriochœrids had the limb and foot structure well differentiated from other contemporaneous Protoreodonts.

(4) The structure of the limbs and foot underwent less change throughout the known cycle of the family *Agriochœridæ* than certain dental characters, namely the disappearance of the anterior intermediate cusp of the upper molars, the molarization of P_4, and other modifications of the teeth.

(5) The specialization of the upper and lower canines and the lower premolars of the Agriochœrids and Oreodonts are of such a deep-seated nature, that we should hardly look for its origin any later than the lower Bridger, or even earlier Eocene strata.

In a paper now being prepared by the author, the detailed description and illustrations of the osteological structure of the Upper Eocene Agriochœrids will appear, together with the discussion of the points above stated.

[1]Annals Carnegie Museum, Vol. XII, 1919, p. 76, Pl. XXXVIII.

[2]Peterson erroneously placed *Diplobunops* in the family *Anoplotheriidæ*. Ann. Carn. Mus., Vol. XII, 1919, p. 76.

Family AGRIOCHŒRIDÆ Leidy.[3]

1. **Diplobunops matthewi** Peterson.[4]

Type: Fragmentary skeleton including the greater parts of radius and ulna, portions of carpus and tarsus, No. 2,974, C. M. Coll.

Paratype: Fragments of skull and lower jaws, No. 3,394, C. M. Coll.

Horizon: Uinta Eocene. Horizon C, near base.

Locality: Six miles east of Myton, Uinta County, Utah.

Generic Characters: From material recently acquired by the Carnegie Museum the genus may now be characterized as follows:

P^1 isolated by well defined diastemata. P^3 without distinct deuterocone, but with a heavy internal mass supported by strong root. P^4 with well developed deuterocone. Molars with anterior intermediate tubercles. Short and stout limbs; short and broad feet with high and laterally compressed unguals.

Specific Characters: The fragmentary condition of the skull, lower jaws and the dentition of the type specimen of *Diplobunops matthewi* permit of only partial comparison with specimens collected in strata over two hundred feet higher. However, in order to avoid the confusion which might later arise by associating the material under one species, I think it is preferable to present what few characters there are available pending the discovery of more complete specimens of *Diplobunops matthewi* from the lower level of horizon C. It is thus seen that the space for the premolar series on the alveolar border of the maxilla is slightly shorter, the deuterocone of P^4 smaller, and the depression on the muzzle immediately above P^1 shallower in *D. matthewi* than in the species *uintensis* from the later horizons. The specimens representing the two species are very nearly of equal size.

Measurements.	Paratype No. 3,394
Space between canine and M^1	50 mm.
Space for upper molars	40 mm.
Length of inferior molar series	45 mm.
" " M_1	10 mm.
" " M_2	15 mm.
" " M_3	21 mm.
" " P_3	10 mm.
" " P_4	12 mm.

[3]Journal of the Academy of Natural Sciences of Phila., Vol. VII, 1869, p. 131.

[4]Annals Carnegie Museum, Vol. XII, 1919, p. 76, Pl. XXVIII.

2. **Diplobunops uintensis** sp. nov.

Type: Skull, portions of two posterior lumbar vertebræ, one anterior caudal; the left fore-limb and foot; the greater part of the pelvis and the right femur. No. 11,769, C. M. Coll.

Horizon: Uinta Eocene; two hundred and fifty feet above the base of horizon C.

Locality: Green River, six miles above Ouray, Uinta County, Utah.

Specific Characters: Progressive elongation of the muzzle in the region of the premolars. Progressive development of the deuterocone of the posterior premolars, especially P^4. Twinned external median buttress on the molars.

THE SKULL. (Pl. XIX.)

It may be stated that the skull in *Diplobunops* departs slightly from the Eocene Protoreodonts by being relatively somewhat narrower and longer.[5] The nasals extend well forward and the occiput overhangs somewhat as in *Agriochœrus*. The sagittal crest of the newly discovered skull is broken off behind, but enough remains to determine that this element is high and rather thin. The postorbital process of the frontal is rather prominent, and in its crushed condition nearly meets the corresponding process of the jugal; the orbit is, however, not enclosed. The zygomatic process of the squamosal is thin and in the region of the glenoid articulation it is wider in the antero-posterior direction; it curves upward and outward, then rapidly inward, and terminates in a large, rounded process. The zygomatic process of the jugal is more rod-like. There are slight indications of lachrymal depressions. The exit of the infra-orbital foramen is above the anterior part of P^3. The nasals reach perhaps as far back as opposite the anterior border of the orbits. There is a noteworthy swelling of the muzzle opposite the diastemata and P^1. Immediately beneath this swelling and above the crown of P^1 there is a deep depression. The premaxillaries are mutilated, but enough remains to show that they were rather weak; the number of incisors of *D. uintensis* cannot be determined from the present specimen. The incisive foramen is nearly complete on the left side, of fairly large size, with the delicate spine which forms the internal border in place, terminating posteriorly

[5]In *D. uintensis* the skull is considerably depressed by crushing and thus gives a rather too broad, and faulty impression.

in a sharp point opposite P^1. The palate is of normal width and the posterior nares extend forward to opposite the anterior border of M^3. The base of the skull is considerably damaged. There is evidence of a tubular meatus in the relatively long region between the paroccipital and postglenoid processes. The structure of the skull in general suggests other contemporaneous Protoreodonts from the Uinta. The present specimen, as well as the type of *D. matthewi*, previously described, represent animals of approximately equal size to the type of *Protagriochœrus* described by Professor Scott, and are more than two-thirds as large as some of the largest forms (*e.g. Agriochœrus major*) of the Oligocene.

The canine is stout, long, recurved, sharply pointed, and in cross-section D-shaped, with the flat surface posterior, generally characteristic of the Oreodonts. P^1 is succeeded and followed by very decided diastemata. The tooth itself has not undergone the degree of reduction in size that one might expect when comparing it with the much reduced or absent P^1 in later representatives of the family. There is a curious deep pit on the side of the muzzle just above, or, one might say just at the alveolar border, which evidently must have so constricted the dental canal as to diminish the support for this tooth. The rest of the premolars and also the molars are remarkably similar to those of the Protoreodonts. P^2 has possibly advanced a stage beyond that in *Protagriochœrus*, the posterior portion of the body having developed a considerable spur, which continues from the protocone upward and backward to the postero-internal angle.

Except M^2 and M^3 of the left side, this series in the type is mutilated to a greater or less degree. The external median buttress on M^2 and M^3 is twinned, the bases of the twin-tubercles presenting inflation to an unusual antero-posterior extent, so that the region of the external buttresses, especially of M^3, might be better described by calling it a heavily serrated cingulum. The protoconule of the molars in this species may have undergone a still further reduction, when compared with Protoreodonts from the lower levels of horizon C of the Uinta.

MEASUREMENTS.

Length of skull, occiput to end of nasals*	225 mm.
Width of skull across zygomatic arches*	134 mm.
Width of muzzle at roots of canines	51 mm.

*Perhaps slightly exaggerated due to crushing.

Length of alveolar border	106 mm.
Length from anterior part of base of canine to and including M^3	103 mm.
Length of diastema, canine to P^2	27 mm.
" " premolars including diastemata	56 mm.
" " molar series	38 mm.

The Lumbar Vertebræ. The centra of the two last lumbar vertebræ are depressed, with no ventral keels, and the anterior face perhaps slightly more convex than the posterior. The base of the transverse process occupies the greater part of the side of the centrum, the process is thin and extends well out from the body of the vertebræ. The neural spines are also of considerable antero-posterior extent, but their height cannot be determined. Enough is left of the zygapophyses to determine that they have the characteristic double tongue and grooved articulations described in *Agriochœrus* by Wortman.

The Caudal Vertebræ. I judge the single caudal vertebra, which is all we have, to be the first. This bone has a well developed centrum with the usual convex anterior and concave posterior faces, strongly developed transverse process, a complete neural canal and well developed zygapophysis. In *Diplobunops* the tail was especially robust, and there is evidence that in the proximal region of the tail there were probably chevrons.

THE FORE-LIMB.

Scapula. The scapula is broader than in any Oreodont or Protoreodont known to me. What is known of the scapula in *Agriochœrus* appears to be more like that in the Oreodonts generally, and if correctly associated by Wortman,[6] is rather surprisingly different from that in *Diplobunops uintensis.* The scapula of the mounted skeleton of *Agriochœrus latifrons* (?) in the American Museum of Natural History, New York, illustrated by Matthew,[7] appears to have somewhat closer resemblance to that of the form under discussion.

The glenoid articulation of the scapula in the specimen being described has a subovate outline. There is a large coracoid, a short neck, a flaring blade and a prominent spine.[8] The acromion is partly

[6]See Wortman's description and illustration, Bull. Amer. Mus. Nat. Hist., Vol. VII, 1895, p. 152, Plate 1.

[7]Amer. Mus. Jour., XI, 1911, p. 162.

[8]Of four oreodont skeletons of different genera before me, one from the Oligocene and three from the Miocene, no scapula approaches the condition seen in *Diplobunops.* In *Promerycochœrus carrikeri* from the Miocene the blade is broad along the vertebral border, but the neck is long.

broken off, but, if complete, would no doubt extend at least even with the border of the glenoid articulation. In the region of the metacromion the spine is injured, but evidence of at least a small process is present. The spine is not entirely complete, but gives evidence of being as prominent as in most Oreodonts and divides the blade subequally, with the supraspinous fossa slightly the smaller of the two.

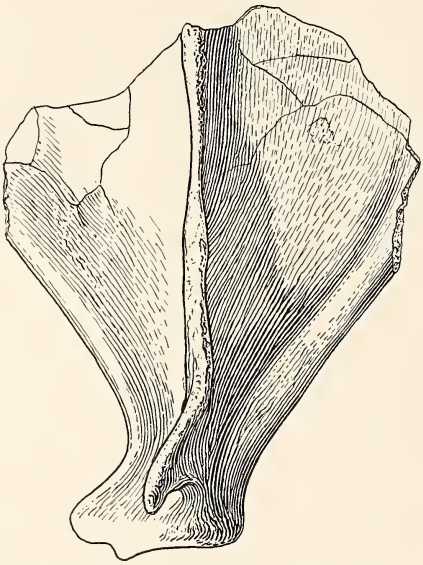


FIG. 1. External view of scapula of *D. uintensis* Peterson, No. 11,769. ½ nat. size.

The Humerus. The robustness of the humerus in proportion to its length is so vastly different from other Oreodonts, that I was at first inclined to regard the specimen as pertaining to two different individuals and possibly different genera. The humerus of this genus is only about one-fifth longer than that in *Protoreodon medius.*[9] The same measurements when compared with *Agriochœrus latifrons* as illustrated by Wortman[10] reveal the fact that the humerus of the Uinta form is between one-fourth and one-fifth shorter, while the transverse diameter at the distal end is very nearly equal to that in the spe-

[9]The type of *Protoreodon medius,* in the Carnegie Museum consists of the greater part of the skeleton and thus furnishes the most complete basis for comparison of any protoreodont known.

[10]Bull. Amer. Mus. Nat. Hist. Vol. VII, 1895, p. 154.

cies *A. latifrons* from the Oligocene. In the genus from the Uinta we have an unusually robust fore-limb. The head sits directly on the body of the shaft with little or no neck; posteriorly it slightly overhangs the shaft, which in part may be due to crushing. The detailed structure of the head is closely similar to that in *Agriochœrus*, except the lesser tuberosity, which appears to be relatively more robust. The greater tuberosity has the same, or nearly the same, shape and extent as that in the Oligocene genus, and the deltoid groove is similarly deep, wide, and single. The shaft of the humerus is very heavy; its internal border is rather thin, especially toward the internal condyle, from which point upward to the lesser tuberosity the border thickens and forms a decided outward curve. Between the very prominent deltoid crest and the internal border the shaft has a broad excavation extending down the shaft from the deltoid groove above to nearly the coronoid fossa below, unlike what is seen in any of the latter Agriochœrids or any of the Oreodonts known to me. In *Protoreodon medius* the

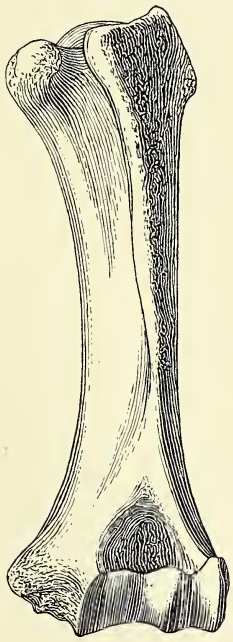


FIG. 2. Anterior view of left humerus of *D. uintensis* Peterson. Type, No. 11,769. ½ nat. size.

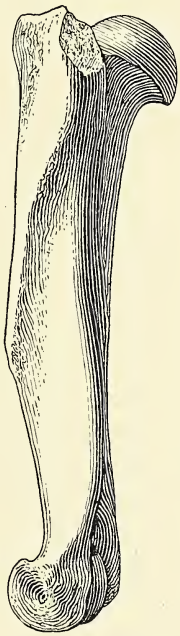


FIG. 3. Ulnar view of left humerus of *D. uintensis* Peterson. Type, No. 11,769. ½ nat. size.

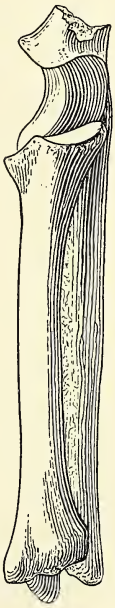


FIG. 4. Front view of radius and ulna. Type of *D. uintensis* Peterson. No. 11,769. ⅔ nat. size.

deltoid ridge of the humerus extends further down on the shaft than in the Oligocene forms, but even here the shaft of the humerus has already attained the typical structure seen in later genera of the Oreodonts. According to Wortman's description and illustration, *l.c.*, pp. 153-154, the deltoid crest of the humerus in *Agriochœrus* reaches well down the shaft, but not to the extent seen in *Diplobunops*. The external and posterior faces of the shaft are more rounded, but the surfaces for the different muscles are distinctly marked by well indicated ridges. The anconeal fossa is low and broad, but not pierced by a foramen. The supinator ridge is prominent, but does not extend high up on the shaft.

The distal end of the humerus is more nearly like that in *Agriochœrus* and the European *Anoplotheres* (*Cf. Diplobune*) than any other mammalia, with which comparisons have been made. In the three different genera the internal portion of the articulating trochlea is larger than the external; the two being separated by a prominent intertrochlear ridge, which is more prominent than in bears; otherwise the trochlea suggests that of the Ursinæ, as was observed by Wortman. In fact the humerus in *Diplobunops* as a whole strongly suggests that bone in the bears.

MEASUREMENTS.

Humerus, total length	161 mm.
" greatest transverse diameter at head	48 mm.
" greatest antero-posterior diameter at head	43 mm.
" greatest transverse diameter of distal end	55 mm.
" greatest antero-posterior diameter of distal trochlea	18 mm.

Radius and ulna. The radius and ulna were found articulated and in their proper relative position. A section of the shaft of the radius was, however, missing, which was restored in plaster before the limb was removed from the matrix. The lower end of the shaft of the ulna was also badly preserved and was similarly restored, before the limb was removed from its original position in the rock. In this specimen we have thus the relative length of all parts of the fore-limb which was lacking in the type of *D. matthewi*. The length of the radius and ulna, when compared with those bones in *Agriochœrus* as described and illustrated by Wortman, are relatively short. In *Diplobunops* the shaft of the radius is on the whole smaller than that of the ulna, and proportionally smaller than in *Agriochœrus*. The shaft of the ulna presents longitudinal deep grooves upon its inner and outer sides

similar to what is seen in *Agriochœrus*, but more pronounced and extensive than in the latter genus. So far as can be determined from Scott's and Wortman's descriptions and illustrations, the articular surfaces of the radius and ulna of *Diplobunops* are quite similar to those in *Agriochœrus*.

In the specimen before me (No. 11,769) the olecranon process of the ulna is lost and the distal end is also injured, but in the type of *D. matthewi* these parts are preserved and have been described (*l.c.*, p. 77).

MEASUREMENTS.

Radius, greatest length	118 mm.
" " transverse diameter of head	28 mm.
" " antero-posterior diameter of head	14 mm.
" " transverse diameter of distal end	23 mm.
" " antero-posterior diameter of distal end	14 mm.

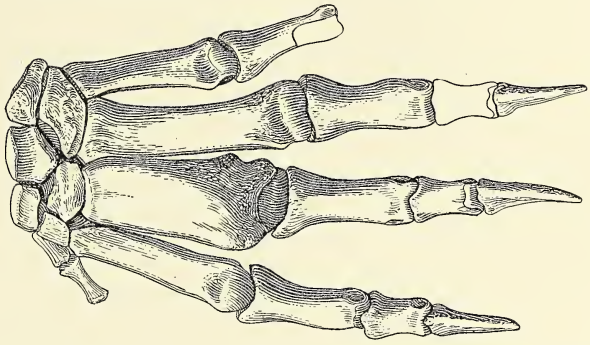


FIG. 5. Dorsal view of manus of *D. uintensis* Peterson, type, No. 11,769. Six-tenths nat. size.

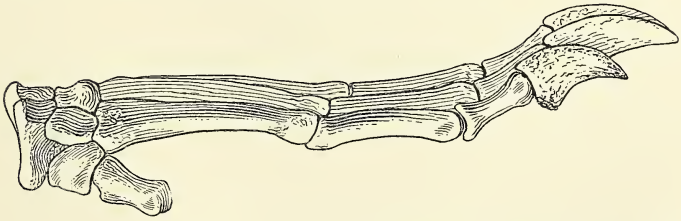


FIG. 6. Radial view of manus of *D. uintensis* Peterson, type, No. 11,769. Eight-tenths nat. size.

Manus. The fore foot was found articulated at the distal end of the radius and ulna. In comparing the carpal bones of the present

specimen with those found in the type of *D. matthewi* it is at once observed that these parts in the latter species evidently pertain to a larger individual, or that the carpus is proportionally larger in *D. matthewi.*

The manus in *Diplobunops* is short and broad. There is shown a pollux of considerable size, however, with perhaps only one phalanx. The distal articulations of the metapodials are rounded and like those of carnivores, but perhaps most similar to those in *Agriochœrus.* The terminal phalanges are high, compressed, and claw-like, as in the latter genus and the genus *Diplobune* of Europe.

In the carpus of the present specimen the different articular facets are indistinct, and therefore a detailed description, if here attempted, might be untrustworthy. Furthermore, the third metacarpal was evidently injured during the life of the animal, so that in its present state it is very much enlarged. The magnum, metacarpal two, and the trapezoid may be regarded as also slightly affected.

When the different elements of the forefoot are compared with the description of *Agriochœrus* by Wortman and Scott, general similarities are marked. However, the scaphoid in *Diplobunops* is perhaps broader; the beak of the lunar shorter, located more nearly in a middle vertical line, and, as a result, the distal articulations of that bone are more nearly of equal width and more horizontal with the unciform than in the specimens described by Scott, and especially that described by Wortman. The cuneiform is low, but has a close similarity to that bone in *Agriochœrus.* As in the latter genus the pisiform has a decided articulation with the lower end of the ulna as well as with the cuneiform. The trapezium is present, but some of its articular facets are rather indistinct, especially those for the trapezoid and metacarpal II. The facet for the scaphoid is oblique and articulated with what appears to be a corresponding surface on the radial palmar angle of the scaphoid. I judge that the trapezium articulated with the trapezoid and metacarpal II, as well as with the scaphoid and metacarpal I; there is a distinct and rather large facet for the latter. The bone upon the whole appears to be unlike those described by Scott and Wortman.[11]

Metacarpal I has an expanded head, on which is a large articulation

[11]The fore foot, especially with regard to the first digit and the problem of its opposability, will be taken up in a later publication, which will appear in the near future.

for the trapezium. The shaft is short, much constricted, and the distal end has an imperfect articulation, but there were undoubtedly one and possibly two phalanges. The metacarpals are short and stout, especially when compared with those in *Protoreodon*. In *Protoreodon medius*, described by Peterson,[12] metacarpal IV is complete and as long as in *Diplobunops*, but more delicate. In *Agriochœrus* the metacarpals are also apparently longer and slenderer. In an adult articulated skeleton of *Merycoidodon culbertsoni*, in the Carnegie Museum (No. 1,391) the carpus is of the same height as in the specimen being described, but narrower; the metacarpals are of equal length, but the shafts are thicker in the palmar-dorsal direction; the phalanges of the first and second rows are less depressed, but shorter, and the unguals are broader and shorter.

As stated above the terminal phalanges are characteristically like those in *Agriochœrus* of the American Oligocene and also of *Diplobune* of Europe.

MEASUREMENTS.

Carpus, greatest height—measured near radial angle of cuneiform	27 mm.
" " width	34 mm.
" length of m.c. IV	46 mm.
" " " proximal phalanx, digit IV	26 mm.
" " " median phalanx, digit IV	15 mm.
" " " terminal phalanx, digit IV	20 mm.
" greatest height of terminal phalanx, digit IV	10 mm.

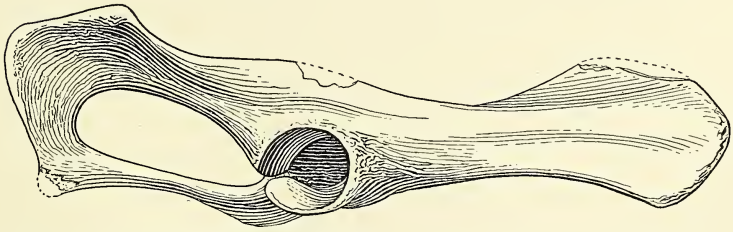


FIG. 7. *Diplobunops uintensis* Peterson. Right side of pelvis, type, No. 11,769, a trifle less than ½ nat. size,

THE HIND-LIMB.

Pelvis. When compared with other Oreodonts, the pelvis of *Diplobunops* is longer and more delicately constructed. According to the illustrations of *Agriochœrus* by Wortman (*l.c.*, pp. 164-165) the

[12](*l.c.* p. 82, Pl. XII).

femur is longer than the pelvis; while in *Diplobunops* the pelvis is the longer of the two, even when due consideration is taken of any slight crushing which may have occurred in the specimen under description. As in *Agriochœrus*, the transition into the expanded portion of the ilium is more gradual than in other Oreodonts, so far as known; and, while the superior portion of the border of the ilium is broken away in the present specimen, in *Diplobunops ultimus*, hereinafter described, it is observed that the gluteal surface is narrower than in *Agriochœrus*, and its posterior portion separated into two parts by a well marked ridge, as is also shown in *D. uintensis*. The region back of the acetabulum is relatively longer than in *Agriochœrus*, while posterior to the obturator foramen the whole structure in *Diplobunops* is less robust.

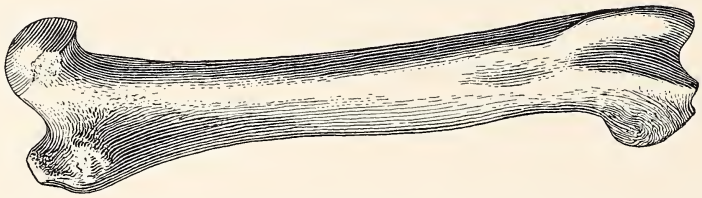


FIG. 8. Anterior view of right femur. Type of *D. uintensis* Peterson. No. 11,769, ½ nat. size.

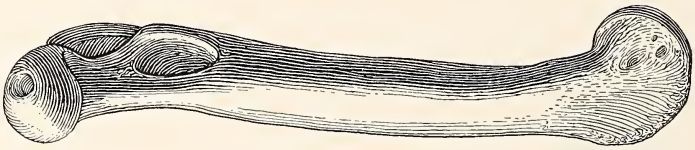


FIG. 9. Tibial view of femur of *D. uintensis* Peterson. No. 11,769, type, ½ nat. size.

Femur. The femur is relatively shorter and heavier than in *Agriochœrus*. In *Diplobunops* the head of the femur is well formed, has a longer neck, and is more carnivore-like than in the Oligocene genus. The greater trochanter appears to be approximately of the same proportion and in the same position as in *Agriochœrus*. The digital fossa is rather deep, narrow, and long. The lesser trochanter is well proportioned, and on its tibial face is a large excavation for muscular attachments; the shaft is heavy, trihedral in cross-section for the greater part of its length. The rotular trochlea extends well up; is rather narrow, and symmetrical, with the inner border the larger of the two, as observed in other genera. The antero-posterior extent

across from the rotular trochlea to the limit of the condyle is apparently as in *Agriochœrus*, and certainly of similar proportions to what is seen in other Oligocene Oreodonts.

MEASUREMENTS.

Pelvis, total length	210 mm.
Ilium from anterior border of acetabulum to extreme anterior end, approximately	108 mm.
Anterior border of acetabulum to end of ischium	113 mm.
Femur, total length	178 mm.
" transverse diameter at head	44 mm.
" transverse diameter at condyles of distal end	36 mm.
" transverse diameter of rotular trochlea	19 mm.

3. **Diplobunops ultimus** sp. nov. (Pl. XX).

Type: Part of skeleton with skull and lower jaws, No. 11,801a, C. M. Coll.

Paratype: Nearly complete vertebral column with ribs, limbs, and feet, together with fragments of skull, and lower jaws, No. 11,801 C. M. Coll.

Horizon: Uinta Eocene; approximately four hundred feet above base of horizon C.

Locality: Leota Ranch on Green River, six miles above Ouray, Uinta County, Utah.

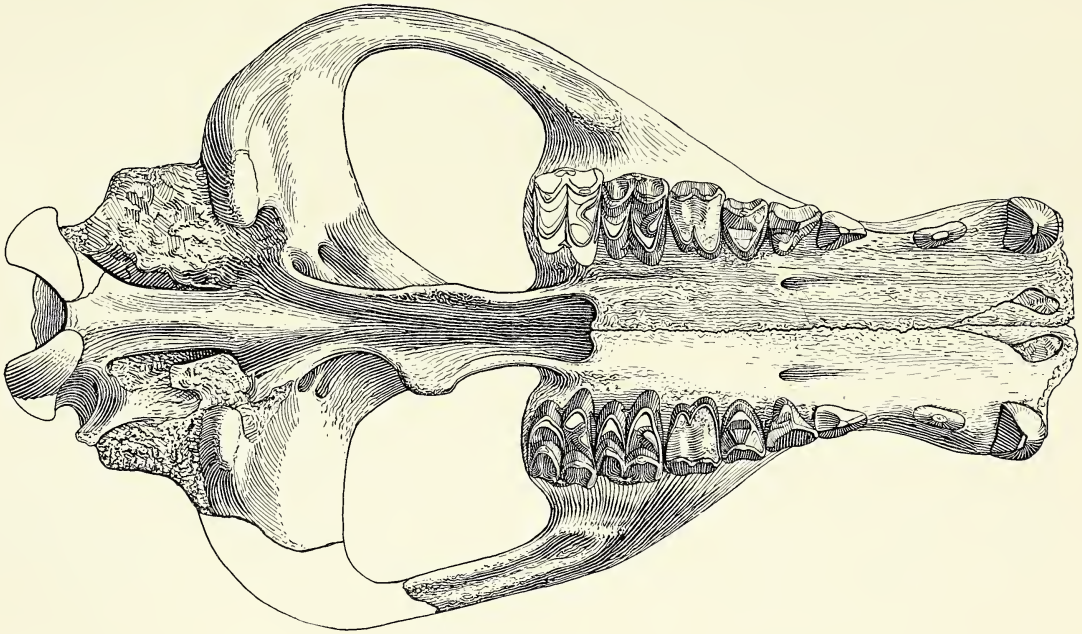
Specific Characters. The chief specific characters of this species, distinguishing it from the preceding, so far as at present studied, are its relatively longer and slenderer muzzle and the advanced dentition of the cheek; that is to say the vertical pillar on the antero-internal angle of the protocone of P^4 is more distinctly developed than in *D. uintensis*; the external median buttress of the molars is single and rounded at the base, not unlike what is seen in *Agriochœrus minimus* Douglass, found in the lower Oligocene, at Three Forks, Montana. The molars of this species are of relatively greater antero-posterior and less transverse diameter than those in *D. uintensis*. In other words the molars of the present species have very nearly the same square proportions as those in *Agriochœrus* of the Oligocene. The anterior intermediate tubercle, however, still persists in this species found in the uppermost strata of horizon C of the Uinta Eocene. The smaller size of the canines in *D. ultimus* may well be a sexual character, which perhaps goes with the smaller size of the skull.

Full description and illustrations of this species will appear soon in the publications of the Carnegie Museum.

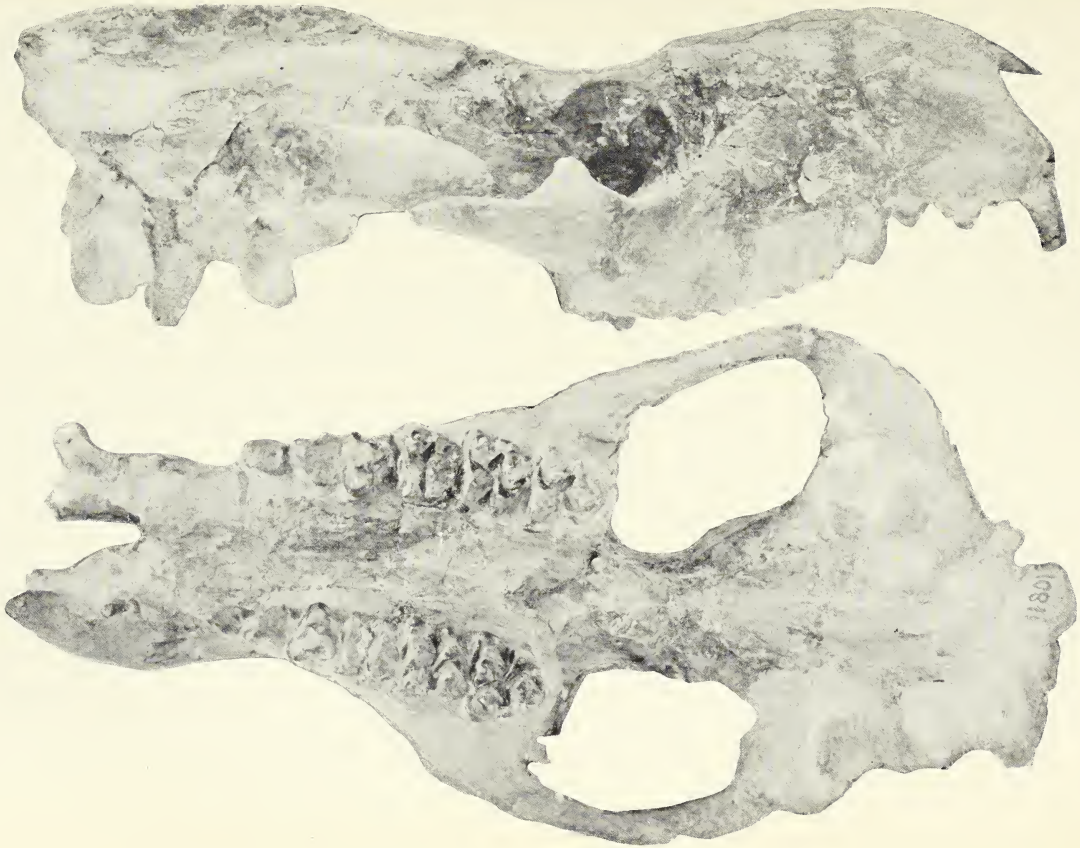
MEASUREMENTS.

Skull,	premaxillary to occipital condyle	195 mm.
"	premaxillary to M^3	107 mm.
"	canine to M^1	67 mm.
"	M^1 to M^3	39 mm.
"	M^3 to occipital condyle	92 mm.
"	transverse diameter at base of canines	39 mm.*
"	greatest transverse diameter including zygomatic arches	96 mm.*
"	transverse diameter of occipital plate	42 mm.
"	transverse diameter of occipital condyles	37 mm.

*Skull is crushed laterally, measurements may be slightly greater than in an uncrushed specimen.



Palatal view of skull of *Diplobunops uintensis* Peterson. No. 11,769, C. M. Coll. ½ nat. size.



Skull of type of *Diplobunops ultimus* Peterson. A trifle less than ¾ nat. size.

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