BULLETIN

FROM THE

Iowa, State University

LABORATORIES OF NATURAL HISTORY

OF THE

STATE UNIVERSITY OF IOWA.

VOLUME I.

PUBLISHED

BY AUTHORITY OF THE REGENTS.

IOWA CITY, IOWA.
1888-1890.

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ERRATA.

Page 10, 20th line, for "month" read "mouth."

Page 14, 13th line from bottom, for "Lower Carboniferous" read "Later Carboniferous."

Page 179, 12th line, for "Plate III." read "Plate II."

Page 179, 2d line from bottom of the page, for "Plate II." read "Plate III."

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IOWA CITY, IOWA.
November, 1888.

Secretary Wm. J. Haddock:

We have the pleasure of submitting through you to the Board of Regents of the State University of Iowa, this first Bulletin from the laboratories of Natural Science. The work of the University in this direction has of late years been rapidly growing in interest and efficiency. For this growth we recognize our indebtedness to no one more than to yourself.

Very respectfully,

THE EDITORS.

INTRODUCTORY.

It is the purpose of this Bulletin and its successors, if such there may be, to show somewhat the work done in the laboratories and museums of Natural Science in the State University of Iowa, and to publish such contributions to the knowledge of the natural history of the state as occasion and opportunity may afford. No systematic biological survey of the State has ever been attempted, much less effected. During the last thirty years contributions have been few and far between. Meanwhile changes incident to the occupancy of the country by civilization are rapidly sweeping away much that would be of special value and interest in such work. It is far from the purpose of the present editors to attempt such survey now. They can hope no more than to bring before those interested some idea of the natural history of the state of Iowa, and of the manner in which it may be studied; hoping in this way to stimulate an interest in such things sufficient to lead to greater results in the future.

The editorship for the present will be as follows:

For all subjects relating to Biology, Geology and Palæontology, Prof. S. Calvin.

Botany, Prof. T. H. McBride.

Systematic Zoology and Museum, Prof. C. C. Nutting.

Conchology, Prof. B. Shimek, (now of the University of Nebraska).

Entomology, Mr. H. F. Wickham.

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SOME GEOLOGICAL PROBLEMS IN MUSCATINE COUNTY, IOWA.

WITH SPECIAL REFERENCE TO THE RECTIFICATION OF THE SUPPOSED KINDERHOOK NEAR THE MOUTH OF PINE CREEK.

By S. CALVIN.

More than thirty years ago[1] Prof. James Hall, then State Geologist of Iowa, made a geological reconnaissance along the Mississippi River, from Lansing to Keokuk, for the purpose of obtaining a general knowledge of the geological structure of the eastern part of Iowa. The same ground had previously been traversed, at least in part, by the geologists D. D. Owen and B. F. Shumard, and the work of Hall, while correcting some mistakes, tended in the main to confirm and establish the conclusions of the earlier geologists. Considering the undeveloped condition of the country, the vastness of the field attempted to be covered in a short time by the surveys of Owen and Hall, and the scantiness of the materials for observation as compared with those now available in our quarries, railway cuttings and other artificial excavations, we cannot but admire the skill and success with which the several geological problems were worked out. Mistakes of course were made, mistakes were under the circumstances unavoidable. While Hall, by reason of better facilities for study, was able to rectify some of the errors of his predecessors, he was himself occasionally led into error, and one of these errors has been the cause of some confusion among geologists. The desire to correct this error must stand responsible for the addition of this paper to the already overburdened literature of geology.

1 In the years 1855 and 1856.

In the days of the geological reconnaissance referred to, the present town of Buffalo in Scott County, Iowa, was known as New Buffalo. New Buffalo figures in all these earlier reports, for near the village occurs an interesting fossiliferous limestone, exposed along the river or in the sides of the ravines; and the reports of Owen and Shumard[1] and Hall[2] are in accord in referring this limestone to the age of the Hamilton Group of New York.

The Hamilton limestone of Buffalo with its peculiar association of fossils, disappears beneath the level of the river at ordinary stages a short distance below Montpelier in Muscatine county. The last seen of it in that immediate region, it forms a low ledge or reef, exposed at low water, and running out into the Mississippi river a hundred yards or more at a point almost directly in front of the present residence of Mr. G. W. Robinson. If, however, we follow the bank of the Mississippi, we shall find, a short distance above the mouth of Pine Creek, an exposure of yellowish sandstone with interstratified shaly beds. The position of this sandstone leaves no doubt as to its relations to the Hamilton limestone. Although along the river the contact is not seen, the sandstone is evidently superimposed on the limestone.

The relation of the sandstone, coupled as it is with an entire change of lithological characters, led Hall to refer it to the Chemung period,[3] and a fossil spirifer that occurs abundantly in the form of internal casts in one of the layers, is described as a new species under the name of *Spirifer capax*[4] and occupies a conspicuous place among the figures of species supposed to represent the Chemung fauna of Iowa.

A yellowish sandstone resting upon greenish shales occurs in the bluffs along the river at Burlington. This sandstone contains casts of brachiopods in abundance, but it

1 Owen's Geological Survey of Wisconsin, Iowa and Minnesota, Philadelphia, 1852.

2 Report on the Geological Survey of Iowa, by James Hall, 1858.

3 Hall's Geology of Iowa, Vol. I, part 1, p. 89.

Id., Vol. I, part II, p. 520, Plate VII, Figs. 7 a-d.

does not contain a single specimen of *Spirifera capax*. Nevertheless Hall regards the Burlington sandstone as the equivalent of the spirifer-bearing sandstone of Muscatine county, and refers it likewise to the age of the Chemung Group of New York.[1]

Thus matters stood until Meek and Worthen, in a paper on the Goniatite limestone of Rockford, Indiana,[2] proposed the name *Kinderhook Group* to include, not only the Goniatite beds in question, but the yellow sandstone at Burlington and all the equivalent strata of the Mississippi Valley that had previously been referred to the age of the Chemung. Furthermore a study of the Kinderhook fauna at Burlington, near the town of Kinderhook in Illinois, at Rockford, Indiana, and at other localities where the formation is typically developed, showed that the Kinderhook Group is not only not Chemung, that it is not Devonian at all, but that it is related to the strata above it rather than to those below it, and must therefore be transferred to the Carboniferous series. Accordingly Meek and Worthen in their reports on the geology of Illinois,[3] have placed the Kinderhook Group, including the yellow sandstone at Burlington, at the base of the Sub-carboniferous. The conclusions of Meek and Worthen are justified by the total absence of Devonian species from the beds of the Kinderhook. Even such wide-spread Devonian genera as Atrypa, Strophodonta, Acervularia, etc., are conspicuously absent. On the other hand the Crinoids and Fishes, as well as the Productidæ among the brachiopods, all impart to the Kinderhook fauna an unmistakable Carboniferous *facies*.

Dr. C. A. White follows Meek and Worthen in referring the sandstones at Burlington to the Carboniferous instead of the Devonian.[4] Without quoting authorities farther it may be assumed that all competent geologists are now in accord as to

1 Hall's Geology of Iowa, Vol. I, part 1, p. 89 *et. seq*.

2 Am. Jour. Science, Vol. XXXII, No. 95, Sept. 1861.

3 Geological Survey of Illinois, Vols. I-VII. See particularly Vol. I, pp. 44 and 118.

4 White's Geology of Iowa, 1870, Vol. I, p. 189.

the correctness of the position in the geological series that later and more careful study has assigned to these sandstones.

Up to the present time no one so far as I know has called in question the propriety of assigning the yellow sandstones above the mouth of Pine Creek in Muscatine county to the same horizon as the yellow sandstones at Burlington. Hall's statement as to their equivalency has been accepted as final, and when the sandstones of Burlington were transferred from the Chemung period to the Sub-carboniferous, by common consent the spirifer-bearing sandstones of Muscatine county were supposed to be similarly transferred. White speaks of the Kinderhook beds as striking the Mississippi River at Muscatine,[1] S. A. Miller refers *Spirifera capax*,[2] Hall to the Kinderhook Group. Hall in a recent publication[3] speaks of *S. capax* as from the "Lower Carboniferous, mouth of Pine Creek, Iowa." Calvin influenced by the general concurrence of opinion states that "the Kinderhook is seen resting on the Hamilton in Muscatine county."[4] Other writers, similarly influenced have been led to support the view that the sandstones at Burlington and the sandstones near the month of Pine Creek belong essentially tc the same geological horizon.

During the past ten years the writer has made repeated excursions to the region near the mouth of Pine Creek, attracted first by unusual facilities offered for collecting beautifully preserved casts of the so-called *Spirifera capax*, and afterward by the desire to study anew the stratigraphical phenomena of the region. A very casual study of the facts now available in determining the geological problems of the region in question, is sufficient to demonstrate that the spirifer-bearing sandstone at Pine Creek is not the stratigraphical equivalent of the Kinderhook sandstone at Burlington. The

1 White's Geology of Iowa, 1870, Vol. I., p. 189.

2 American Palæozoic Fossils, S. A. Miller, 1887, p. 129.

3 Report of State Geologist for the year 1882, Albany, N. Y., Plate 52, Figs. 15, 16, and description of plate.

4 Notes on the Geological Formations of Iowa, p. 7. Prepared for distribution at the World's Industrial Exposition at New Orleans, 1885.

two sandstones do not belong to the same period, nor do they even belong to the same age. The writer has handled more than a thousand specimens of *Spirifera capax*, the specimens occuring in the form of casts in the supposed Kinderhook sandstone. Impressions of the external surface of the shell are often very perfectly preserved, revealing every detail of surface marking. From the study of such an array of material showing every phase and character of the species there can be but one conclusion, and that is that *Spirifera capax* is simply the cast of *Spirifera parryana*, Hall, a species more or less common in the limestones at Buffalo—limestones that Hall and Owen and Shumard, with the full concurrence of all geologists who have examined the region, referred to the horizon of the Hamilton Group of New York. *Spirifera capax* is therefore a synonym of *Spirifera parryana*.[1]

Associated with the casts of *Spirifera parryana*, (*S. capax*), in the sandstones about Pine Creek, occur the casts of such typical Devonian species as *Atrypa reticularis*, Lin; *Spirifera aspera*, Hall; *Strophodonta demissa*, Conrad; *Orthis impressa* or *Orthis iowensis*, Hall; and many other well known brachiopods. There is not a single Kinderhook species in the entire beds so far as observed, nor is there a species that could by any stretch or reasonable allowance be regarded as a representative of any of the Carboniferous or Sub-carboniferous groups. On the contrary all the species are identical with species occuring in the Hamilton limestones at Buffalo, Pine Creek Mills, Hanson's Quarry, Atalissa and all other points where limestone containing *Spirifera parryana* is exposed.

The yellow sandstones above the mouth of Pine Creek therefore are of the same age as the limestones near Buffalo. They are not even Chemung unless the limestones are also

1 The two species are described and illustrated in the same publication, Hall's Geology of Iowa, Vol. I, part 2. *S. parryana* however is entitled to precedence since it is characterized on page 509 and Plate IV, while the description and figures of *S. capax* are not given until we reach page 520 and Plate VII.

Chemung; much less are they *Lower Carboniferous* or Kinderhook.

Owen gives a recognizable figure of *Spirifera parryana* as it occurs with the shell preserved in the Hamilton limestones along Pine Creek, and another figure of a cast of the same species as it occurs in the overlying sandstones.[1] Both forms are described as *Spirifera euruteines*, but it is interesting to note that the specific identity of the two forms is distinctly recognized, and that furthermore the beds containing them are referred to the same period.

No Kinderhook or Sub-carboniferous of any kind has been observed by the writer in the region about Pine Creek in Muscatine county. A very complete section of the rocks of the region may be studied in the bed and banks of Robinson's Creek, a small stream emptying into the Mississippi a short distance below Montpelier. Near the mouth of the creek is the ledge of limestone already mentioned as exposed at low water, and extending out into the river for more than a hundred yards. This limestone is the same as that found at Hanson's Quarry, Pine Creek Mills and many other points, and is characterized by the presence among others of the following fossil species: *Spirifera parryana*, *S. aspera*, *Atrypa reticularis*, and *Athyris vittata*. Following up the channel of Robinson's Creek we find,—1, beds of arenaceous shale with some thin beds of limestone, containing branching polyzoa, *Atrypa reticularis*, *Strophodonta demissa*, very large forms, and *Orthis iowensis*;[2]—2, argillaceous shale only a few feet in thickness and containing no fossils;—3, layers of sandstone among which is a bed about 14 inches in thickness containing casts of *Spirifera parryana*, (*S. capax*) with which are associated either in the same bed or in adjacent beds both above and below, casts of *Atrypa reticularis*, *Strophodonta*

1 Owen's Geological Survey of Wisconsin, Iowa and Minnesota, Table III, Figs. 2 and 6.

2 No opportunity has yet been found to measure the thickness of the several members of the section.

demissa, *Orthis iowensis*, and *Spirifera aspera*;—4, a considerable thickness of sandstones containing no fossils as far as observed;—5, arenaceous beds containing casts or impressions of corals related to *Cladopora*, and impressions of what seem to be immense masses of *Stromatopora*;—6, a bed of fragmentary materials interstratified with irregularly interrupted flexuous beds of shale and sandstone, varying greatly in thickness and spread over the uneven and apparently eroded surface of the underlying sandstone;—7, flexuous beds of shale, with a bed of impure coal from two to three feet in thickness;—8, evenly bedded friable sandstone varying in color from yellow to gray, and containing in some of its layers numerous impressions of *Calamites*, *Sigillaria* and *Lepidodendon*. Casts of the stems of Lepidodendon, apparently of the species recognized by Owen as *L. aculeatum*, Sternberg,[1] were observed more than nine inches in diameter.

The beds 1–5 are of Devonian age and must all be referred to the same period as the limestones at Buffalo and Pine Creek Mills. Beds 6, 7 and 8 are of much later origin; they belong to the Carboniferous period and were probably contemporaneous with the Upper coal measures of southwestern Iowa.

Practically the same succession of strata as seen in Robinson's Creek, may be observed in what is known as the railroad quarry at Montpelier. An immense quantity of stone was taken out by the railway company and used as riprapping to protect the embankment from the wash of the river. The magnitude of the work performed here may be inferred from the fact that the riprapping extends, sometimes for miles continuously, as far as Muscatine, a distance of sixteen miles. The beds worked were Devonian sandstone, the equivalents of 3, 4 and 5 of the section on Robinson's Creek. The spirifer-bearing layer is here about two feet in thickness, it is harder than at the localities on Robinson's Creek or on the river above the mouth of Pine Creek, and it would seem to

1 Owen's Geological Survey of Wisconsin, Iowa and Minnesota, Table VI, Figs. 1, 2.

have furnished a very large proportion of the material used in riprapping. At the upper end of the quarry coal-measure shales and sandstones are seen resting unconformably on the Devonian sandstones. The lower beds are very flexuous and distorted. A well marked layer at any point may thin out and disappear in a distance of twenty feet. The conglomerate bed, number 6 on Robinson's Creek, is here well marked, the fragmentary materials being interstratified with irregularly contorted beds of shale and sandstone disposed at all imaginable angles and frequently thinning out within a few feet. At one point observed in the face of the bluff the conglomerate bed had a thickness of eight or ten feet, while only a short distance to the left the same layer had thinned to eight or ten inches. In the face of the bluffs at a height of about fifteen feet, occurs a layer of impure coal about ten inches in thickness, and above the coal are regular, horizontal, even-bedded layers of sandstones representing number 8 on Robinson's Creek. Below the coal seam all the strata are confused, contorted, irregular; above the coal seam the layers are even, regular and horizontal.

There are two distinct sandstones belonging to different ages, in the region about Pine Creek and Montpelier in Muscatine county, Iowa. One belongs to the Middle Devonian, the other to the Lower Carboniferous. To avoid confusion I have used at different times in this article the term *Spirifer-bearing sandstone* to denote the earlier of the two. We may speak of them hereafter respectively as *Devonian* and *Carboniferous* sandstones.

The Carboniferous sandstone is extensively developed throughout the region from Buffalo to Muscatine. An exposure of nearly a hundred feet in thickness may be seen at Wild Cat Den, a mile and a half above Pine Creek Mills. At Wyoming Hill, a short distance below Fairport, it is well exposed and furnishes numerous remains of coal-measure plants. In the lower part of the city of Muscatine it is again seen in the high bluff, lying as usual above a layer of rather impure coal. At one locality on Pine Creek, above Wild Cat Den, this sandstone is somewhat more indurated than usual, and is quarried to supply the local demand for building stone.

The coal seam which appears everywhere to accompany the Carboniferous shales and sandstones of the region, varies in thickness from eight or ten inches to two or three feet. For the most part the coal is of inferior quality, being more or less shaly, and containing large quantities of pyrites of iron. At a few localities, however, notably near Buffalo, the coal has been profitably worked.

The Devonian sandstone, as developed at and near Montpelier, seems not to have a very wide geographical distribution. The conditions favoring its deposition were evidently local. In the particular locality affected by them, these conditions, whatever they may have been, operated disastrously on most of the Devonian fauna. During a part of the time, however, *Spirifera parryana* found the conditions unusually favorable. The great number of casts of this species occurring in the spirifer-bearing layer would indicate that the sea-bottom was fairly crowded for a time with large, healthy, vigorous individuals; and that the species occupied the region to the almost total exclusion of everything else. *Spirifera aspera*, the constant associate of *S. parryana* in the underlying limestones is almost entirely absent, only two or three *S. aspera* being seen among many hundred *S. parryana*. Even *Atrypa reticularis*, that most ubiquitous of all Devonian brachiopods, apparently capable of living anywhere and under any circumstances, was represented by a comparatively few widely scattered individuals. The *Orthis iowensis* attained a larger size than usual, but the number of individuals was small. *Athyris vittata* which is one of the most abundant shells in the subjacent limestones, is unrepresented in collections from the sandstone. In the fossiliferous portion of the sandstone individuals of *Strophodonta demissa* are about as numerous as in the limestone.

It is only in one layer, and that not very thick, that *Spirifera parryana* occurs. Some of the species mentioned persisted after *S. parryana* abandoned the struggle. They range a foot or two above the spirifer bed, but brachiopod life soon ceased, and the sandstone through several feet of its thickness shows no traces of fossils.

There is but a single fish tooth in the collections from the sandstone, and it is apparantly identical with an undetermined species occuring in the Hamilton limestones at Solon and Iowa City.

The most significant facts recorded in the Devonian and Carboniferous strata of Muscatine county have been recognized by all geologists who have personally examined the region. These facts are detailed with scientific minuteness in the reports on the geology of Iowa and Illinois. Briefly stated, we have evidence that at the close of the Hamilton period, after the limestone and sandstone strata had been finished the sea retired southward and westward, and Muscatine county became a part of the growing continent. The strata of the Kinderhook, Burlington, Keokuk and St. Louis epochs were successively deposited in the gradually retreating sea, and at successively greater and greater distances from Muscatine county. All this while the agents of erosion were at work in what is now the region of Pine Creek and Montpelier. There is absolutely no evidence that the region ever received any Sub-carboniferous deposits. The epochs of the Lower and Upper coal-measures seem successively to have followed the St. Louis epoch in Iowa, and the Iowa coal basin proper, occupies an area to the south and west of the region occupied by the St. Louis group. While, however the Carboniferous shales and sandstones about Buffalo and Montpelier are of the same age as what is known as the Middle or Upper coal-measures, I do not believe that any very direct connection exists between them and our Iowa coal field. The connection seems more direct with the Illinois coal field. After a period of subaërial exposure, represented by the strata of the Sub-carboniferous and probably by a considerable portion of the coal-measures, the region about Pine Creek that had been left bare at the close of the Devonian, was, by subsidence, carried down beneath a sea that gradually encroached upon it from the southeast and caused the Illinois coal field along the Mississippi above and below Davenport, to overlap eroded strata, not only of the Devonian, but of the Upper Silurian age.

Channels and ravines had been cut in the older strata during the long interval they were above the sea level, and in these channels and ravines the encroaching sea deposited strata of the Carboniferous age. The Carboniferous deposits may have overtopped the ridges and highlands, but the relation of their upper limit to the present strata cannot be ascertained. Subsequent erosion, the chief agent being probably the great ice sheet of the glacial period, has stripped off the larger part of these Carboniferous beds in their northwestern extension, leaving but fragments of the strata as outlying patches in areas that were in some manner peculiarly sheltered. It will be remembered that some of the strata were originally deposited in ravines walled in by relatively hard beds of Silurian or Devonian age, and it is in such ravines that the outlying patches chiefly occur. The conditions would be most favorable for the protection of the soft sandstone strata, at least from the agents that operated during the glacial period, when the ravine occupied by the strata was comparatively narrow and had a direction at right angles to the flow of the ice sheet. The largest masses and most extensive area of outlying coal-measures occur along the Mississippi, between Buffalo and Muscatine. Between these points the river runs from east to west. Was there an old Mississippi occupying the same channel practically in pre-carboniferous times. Were these great masses of shales and sandstones laid down in a valley of erosion, and have they been preserved from denudation because the valley had a direction at right angles to the ice flow when glacial conditions and glacial erosion were at their culmination? These questions may be answered affirmatively or negatively by some one who has time and facilities for working out the problem.[1]

1 For particulars relating to the distribution of outliers of the Carbonifer-

A sentence or two in the fifth volume of the Geological Survey of Illinois, page 223, would seem to have some bearing on the questions under discussion. The authors of the chapter on the Geology of Rock Island county, Messrs. Worthen and Shaw, say: "There are also some brown beds near Andalusia that contain numerous *Gasteropods* and *Orthoceratites*, and a few miles below, these are overlaid by from eight to ten feet of a brown magnesian limestone that contains casts of a large *Spirifer* like *S. Parryanus* and *Strophomena demissa.* These brown beds are directly overlaid near the mouth of Stonecoal creek by the sandstones and shales of the coal-measures."

Near Andalusia then it would seem that we have essentially the same geological phenomena as in the region about the mouth of Pine Creek, with this difference, that the sandstone containing casts of *Spirifera parryana* (*S. capax*, Hall) is represented by a magnesian limestone. A magnesian limestone as all know, does not preserve calcareous structures, and so in the Devonian dolomite near Andalusia, as in the Niagara and other dolomitic limestones of the northwest, the fossil brachiopods are, for the most part, preserved only as internal casts of the shell.

The fact that a dolomitic bed near Andalusia passes into a bed of sandstone farther west in the region of Pine Creek, Iowa, would be in perfect accord with what I have already pointed out in the American Geologist for January, 1888, Vol. I, page 30,—namely, that the great dolomitic masses of strata representing the Niagara, Galena and Lower Magnesian limestones of Iowa, were formed off shores, and that further seaward, or at least further to the south and west, where they are generally concealed by newer strata, the place of the dolomites was taken by sandstones and shales.[1]

ous age, the reader is referred to Hall's Geology of Iowa, Vol. I, part 1, pp. 120-133; White's Geology of Iowa, pp. 228-9; Geological Survey of Illinois, Vol. V, pp. 228-232.

1 Notes on the Formations passed through in boring the Deep Well at Washington, Iowa, by Professor S. Calvin, American Geologist, Vol. I, p. 28 *et. seq.* Published January, 1888.

NOTES ON THE SYNONYMY, CHARACTERS AND DISTRIBUTION OF SPIRIFERA PARRYANA, HALL.

BY S. CALVIN.

We have only two large spirifers that occur in sufficient numbers to be at all conspicuous in the Devonian fauna of Iowa, and these are *Spirifera pennata*, Owen, (*Spirifera atwaterana*, S. A. Miller,) and *Spirifera parryana*. Both of these species were known to Owen as early as 1848 or 1849 and both are figured and described in his report on the Geological Survey of Wisconsin Iowa and Minnesota, published in 1852. Owen, it is true, figured and described *S. parryana* under the impression that the Iowa spirifer was identical with *S. euruteines*, and so it is under this name that the species appears in his report.

Spirifera euruteines is a species that was early recognized and named by Owen. It seems that a figure of it was given in his report for 1839, published probably in 1844. The species which American palæontologists now universally recognize as Owen's *S. euruteines*, and the species certainly of which he distributed authenticated examples with the above name attached, as early as 1841, is a well marked form occuring in Devonian limestones near the Falls of the Ohio. In the light of present knowledge, *S. euruteines* is certainly very distinct from any species found in the Devonian strata of Iowa. While therefore our Iowa species is undoubtedly the *S. euruteines*, Owen, 1852, we are compelled to conclude that it is not *S. euruteines*, Owen, 1839–1844. Owen's mistake as to the identity of the Iowa species left it for a time, even after it had been figured and described, without appropriate specific designation. It remained in this condition until 1858, when Hall, in his report on the Geology of Iowa, described and figured a small individual of not quite average proportions, under the name *Spirifer parryanus*. The specimen described is from the limestones near Buffalo in Scott county, and the beds from which it was obtained are referred to the age of the Hamilton group of New York. Notwithstanding the unmistakable specific identity of Hall's specimen with that illustrated by Owen in his report of 1852, Plate III, Fig. 6, 6 a-b, there is no reference to the fact that the species has ever appeared before in geological literature. Indeed Hall seems to have regarded Owen's figures as illustrating a typical form of *S. euruteines*, and later, Pal. N. Y., Vol. IV, p. 210, he expresses the belief that they may have been made from Ohio or Indiana specimens.

The description and figures of *S. parryana* are found in Hall's report on, page 509, Plate IV, Fig. 8 a. b. In the same report, on page 520, Plate VII, Fig. 7 a-d, another specimen of the same species, the specimen being preserved as an internal cast in sandstone, is described as a new species and called *Spirifer capax*. The sandstone whence the *S. capax* form was obtained, although belonging essentially to the same geological horizon as the limestone near Buffalo, is referred to the age of the Chemung group of New York. Owen, in 1852, had figured one of the sandstone casts—Plate III, Fig. 2, 2 a.—as part of his illustration of *S. euruteines*, and the identity of *S. capax*, Hall, with the form so figured, is appropriately noted in connection with Hall's description.

Owen recognized the fact that the forms of the spirifer under consideration in both limestone and sandstone are specifically the same and that they belong essentially to the same geological horizon. He identified both, however, with the very distinct species *Spirifera euruteines*. Hall recognized the fact that these forms were distinct from *S. euruteines*, Owen, 1839-1844, but he made the mistake of separating them one from the other as distinct species and referring them to distinct geological horizons.

As shown in the preceding paper, *S. parryana*, Hall, has precedence over *S. capax*, and must embrace the forms originally referred to the last named species.

In the Geological reports of Illinois, Vol. III, p. 433, Plate

XIII, Fig. 8 a-c, Meek and Worthen described a specimen of *Spirifera parryana* under the name *Spirifer fornacula*, Hall. A young, medium sized individual, with the shell partly exfoliated, was chosen for illustration. The hinge is perhaps a little longer than in the average *S. parryana*, but the form is by no means unusual in collections embracing representative series of this species.

Two of Meek and Worthen's figures are copied under the erroneous name, *Spirifer fornacula*, in Le Conte's Elements of Geology, Fig. 391 a. b.

Spirifera fornacula is a name applied by Hall to a small species said to have been obtained from Devonian limestone at Bake Oven, Illinois. The description was published without illustrations in the Tenth Report on the State Cabinet of New York. Very few species so published can be identified with certainty even by expert palæontologists, and so an exfoliated *S. parryana* from the Bake Oven was referred as above described, but with grave doubts on the part of the authors, to *S. fornacula*. The form which had been described in the Tenth Report, State Cab. N. Y. as *S. fornacula*, was afterward figured and described in Palæontology of New York, Vol. IV, p. 211, Plate XXXI, Fig. 11, 12, 13, as *Spirifera euruteines* var. *fornacula*. By means of the excellent figures given we are now able to appreciate the characters of the form so designated. The species is certainly very distinct from *S. parryana*. The shell is smaller and of different proportions. The plications, the hinge area, and the mesial fold and sinus present characteristic differences.

There is one reference to *Spirifera parryana* in Hall's Geology of Iowa, Vol. I, Part 2, p. 512, that I confess I do not understand. After mentioning "the narrow linear area, mucronate cardinal extremities, shallow sinus and slight mesial elevation, which are covered by dichotomizing plications," as characters distinguishing *Spirifer marionensis*, Shumard, the author proceeds to say that "*Spirifer parryanus* simulates this one in its dichotomizing plications on the mesial fold and sinus." He further adds: "From this similarity I had at one time supposed the *Spirifer marionensis* to be found among the Burlington fossils." Prof. Hall evidently intended to refer to some other species than *Spirifera parryana*, probably to *S. biplicata* which occurs in the Kinderhook beds at Burlington. *S. parryana* has no plications, dichotomizing or otherwise, on the mesial fold and sinus, and further it is scarcely possible that similarity to a Hamilton species, if such similarity had actually existed, could lead one to suppose that *Spirifera marionensis* would be found among the *Burlington* fossils.

Spirifera capax, Hall, is cited as a distinct species and referred to the Kinderhook group in Miller's Palæozoic Fossils, page 129.

Spirifera capax is retained as a specific designation for sandstone casts of *S. parryana* in the report of the State Geologist of New York for the year 1882. Two of the figures originally employed in illustrating *S. capax* in Hall's Geology of Iowa, are copied among generic illustrations of the *Spiriferidæ* on plate 52, and in the description of the plate the species is said to come from the "lower carboniferous, mouth of Pine Creek, Iowa." On the same plate figures 8 and 9, are good illustrations of a common phase of *S. parryana*. The species is appropriately named in the description, and referred to the "Hamilton group of Iowa."

In the Palæontology of the Eureka District, by C. D. Walcott, page 137 Plate XIV, Fig. 10, we find a small spirifer from Devonian limestone, Eureka District, Nevada, described and illustrated under the name *Spirifera parryana*, Hall?. Walcott expresses some doubt as to the identity of the specimen from Nevada, with Hall's species from Iowa. The drawing represents a ventral valve with a moderately deep sub-angular sinus which presents a strongly marked contrast with the broad, shallow, evenly rounded sinus of typical forms of *S. parryana*. More perfect specimens will undoubtedly prove the Nevada form to be quite distinct from the species to which it has been provisionally referred.

Walcott cites a reference to this species, which I have not seen—namely, an article by Billings, 1861, Canadian Journal, Vol. VI, page 261, Figs. 77, 78.

Spirifera parryana is enumerated in the list of Devonian fossils from Rock Island county, Illinois, Geological Survey of Illinois, Vol. V, page 222.

Spirifera parryana, like very many other organic forms, varies within somewhat wide limits. The variation, however, is not greater than in *Spirifera pennata*, Owen, or any other species that occurs at a number of widely separated localities. There are differences in size depending on differences in age, but even adult individuals differ greatly in this respect. The largest specimen before me, and the largest of the species *S. parryana* I have seen anywhere, has, measured in inches, the following dimensions,—length 1.60, width 2.35, thickness 1.48. Between this extreme and immature specimens only a fraction of an inch in their greatest measurement there are all possible gradations. Perhaps the most obvious variations are those that concern the relative proportions of length, width and thickness. There are thick forms with short hinge and rounded cardinal angles at one extreme, and relatively thin forms with extended hinge and acute cardinal angles at the other. At one extreme the thickness, length and width are approximately equal; at the other, the length is one and one-half and the width two and one-ninth times the thickness. The average form it would seem has not yet been illustrated. Hall's and Owen's figures are all short-hinged forms. The figures of Meek and Worthen, Geological Survey of Illinois, Vol. III, page 433, Plate XIII, Fig. 8 a-b, described as *S. fornacula*, Hall, more nearly represent the average individual of *S. parryana* than any other so far published.

The width of the hinge area along the hinge line, in an extremely globose form, is but little more than twice the height. In average specimens the width is three and three-fourths to four times the height, but in one instance before me the width is fully seven times the height. The area may vary from nearly flat to strongly concave, and the angle that the areas of the two valves make with each other at the hinge line is also quite inconstant.

In all cases the convexity of the two valves is approximately equal, the mesial fold and sinus are well defined to the beak, and the valves are quite regularly convex, both longitudinally and transversely. In average specimens the dorsal valve is sub-elliptical, the transverse being to the vertical diameter about in the ratio of twenty to thirteen, with the cardinal angles measuring about ninety degrees. The mesial fold is low, flattened or evenly rounded from side to side, distinctly set off from the lateral areas by furrows somewhat deeper than usual, in many instances not rising above the general convexity of the valve, though generally more or less elevated. The mesial sinus of the ventral valve is broad and shallow, rapidly widening to the front margin and evenly concave from side to side. A more or less perfectly defined sub-angular ridge marks the boundary between the sinus and the lateral areas. Two well defined furrows in the sinus, situated respectively about a fourth of the width of the sinus from each margin, is an interesting feature apparently affecting all the individuals from certain localities. From other localities the specimens of this species show no trace whatever of furrows in the sinus, while from still other localities a part of the individuals may exhibit them in varying degrees of perfection. The furrows seem to mark the boundaries of two rather broad rudimentary plications, one on each side of the sinus. There are no corresponding indications of plications on the mesial fold.

The surface is marked by from eighteen to twenty-two plications on each side of the mesial fold and sinus. The first twelve or fourteen of these plications are distinct, the remainder being small, rudimentary, and more or less obscure. In typical specimens the plications are low and flat, and separated from each other by narrow furrows, but this, like nearly all the other characters, is exceedingly variable. The plications in not a few instances are distinctly rounded and separated by furrows that are as wide as the plications themselves. When the shell is exfoliated, even in specimens having the low flat plications with narrow intervening furrows, the ridges on the cast are rounded, and both ridges and furrows are of equal width. This feature is fairly well exhibited to the left of the mesial fold in 8 c. of Meek and Worthen's figures of *S. fornacula* already referred to.

The whole surface of both valves is ornamented with fine radiating striæ, and these may be intersected by still finer concentric striæ, the result being to impart to the shell a minutely granular appearance. The radiating striæ are better developed on some individuals than on others, and in all cases are much stronger on the mesial fold and sinus than elsewhere. The concentric striæ are very variable; in some individuals they are quite strong and closely crowded together, and the resulting granular character of the surface is very pronounced. In others they are scarcely visible; in some instances they seem to be entirely absent, and the radiating striæ pass apparently without interruption from beak to margin. In a few instances in which the concentric striæ are separated by unusually wide intervals and the granules are consequently elongated in the direction of the radiating markings, the granules are highest at their anterior end and closely resemble the bases of setæ or small spines.

Spirifera parryana seems to be confined to one particular horizon or platform and to have as associates a few species that are confined to the same platform. In the first place it is not associated with our other large spirifer, *Spirifera pennata*, Owen (not *S. pennata*, Atwater sp.). The two spirifers may be found near together, they may even be found in the same quarry, but so far as I have observed, the beds that furnish *S. parryana* always lie above those in which *S. pennata* occurs. This relation of the two series of beds may be readily observed in the quarries at Buffalo in Scott county. Some years ago a small quarry very rich in fossils representing a number of species, was opened near Atalissa, and at the same time another quarry was worked two or three miles away, near the Cedar river, and at a point many feet lower than the first. In the Atalissa quarry *Spirifera parryana* and its associated species were unusually abundant; the Cedar river quarry was in the platform marked by the presence of *S. pennata* and its associates.

At Buffalo in Scott county, and at Pine Creek Mills, Hanson's quarry, Atalissa and other points in Muscatine county where *Spirifera parryana* occurs in the shaly limestone, it has as its associates *Spirifera aspera*, Hall, *Cyrtina umbonata*, Hall, *Athyris vittata*, Hall, *Atrypa reticularis*, Linnæus, a small *Strophodonta* and a *Terebratula* of somewhat variable form which I have regarded as an unusually large variety of *Terebratula* (*Cryptonella*) *linckalœni*, Hall. The *Atrypa reticularis*, that is found in this association is always a small globose variety, rather coarsely striated, with ventral valve flat or concave, and dorsal valve very convex. This form of *Atrypa* is never, so far as I have seen, found in the same beds with *S. pennata*, nor can any of the other species mentioned be said properly to occur on the *S. pennata* platform. An apparent exception may be made with respect to a few straggling specimens of *Athyris vittata* met with occasionally in company with *S. pennata* in the limestones at Independence, Iowa; but they are curiosities in collections from that locality, or from any other affording species from equivalent strata. On the other hand, however, *A. vittata* is the most abundant species at Atalissa, Pine Creek and related localities; its broken, crowded and cemented shells furnishing the entire material for layers of considerable thickness.

Atrypa aspera var. *occidentalis* that is so common at Independence and other localities furnishing *S. pennata*, is never found with *S. parryana*, nor are any of the varieties of spiniferous atrypas ever associated with it.

Hall (Geology of Iowa, Vol. I, part 2, page 508–9,) describes *Spirifera aspera* and credits it positively to Independence, Iowa; but seems to have some doubt as to whether it occurs at Rock Island, Illinois, or not. The fact is that *S. aspera* as a characteristic species of the *S. parryana* platform may be found near Rock Island; but so far as I know it has never been found, and is not likely to be found, at Independence. Prof. Whitfield, who has had abundant opportunity for knowing whereof he speaks, is undoubtedly correct when (Geology of Wisconsin, Vol. IV, page 332,) he says that the type specimens of this species described and figured by Prof. Hall were "from rocks of Devonian age at Rock Island, Illinois."

The localities at which *S. parryana* occurs in Scott and Muscatine counties have been frequently referred to in this paper. It remains only to mention one or two other localities at which the species has been recognized. Crushed and more or less broken and distorted specimens are found along the Iowa river near Iowa City. Near Linder's boat-house they are comparatively abundant. Here we have the same grouping of species as in Muscatine county, except that the *Cyrtina umbonata* is replaced by a small form of *C. hamiltonensis*, probably the variety *recta*. A short distance further up the river there are exposures of rocks with *S. pennata* and its associated variety of *Atrypa aspera*.

Regarding Buffalo and Pine Creek as the central and typical localities for *S. parryana*, the most distant station at which the species has been recognized in Iowa is at an old railway cut and embankment a few miles north of Fayette. As might be expected the individuals here depart most widely from the typical form of the species; none are exactly like the average forms from Muscatine county. In some extreme cases the hinge area is narrow and strongly concave, and the beak of the ventral valve is brought almost directly behind that of the dorsal. The plications are in all cases more rounded and elevated than in specimens farther south. The fine radiating and concentric striæ remain the same, and the traces of two rudimentary plications in the sinus are frequently quite pronounced. At Fayette there are none of the short-hinged, wide-areaed forms that are frequently seen at Pine Creek.

Concerning the associated species at Fayette we may observe that *Athyris vittata* is present, but in greatly diminished numbers; the *Cyrtina* has become a true *C. hamiltonensis;* the *Atrypa reticularis* has the same globose form as farther south, but attains a very large size; *S. aspera* has entirely disappeared, at least none are represented in all the collections from that locality, although collections have been made at intervals for the past twelve years.

The most striking feature, however, of the assemblage of fossils at Fayette is the remarkable development in numbers and size of *Terebratula.* Terebratulas are very rare fossils in Muscatine and Scott counties; they are more abundant in some beds near Iowa City; they become the predominant species, literally crowding some of the beds, at Fayette.

Our two large spirifers, *S. pennata* and *S. parryana* respectively, mark two distinct platforms in the Hamilton strata of Iowa, and each is associated with its own special assemblage of fossil species. A third very distinct platform, with a distinct grouping of species, is represented by the Rockford shales and characterized by the presence of *Spirifera whitneyi* and *S. hungerfordi.* The discussion of this third platform must be reserved for a subsequent paper.

DESCRIPTION OF A NEW SPECIES OF SPIRIFER FROM THE HAMILTON GROUP, NEAR IOWA CITY, IOWA.

By S. CALVIN.

Spirifera urbana, n. s. Shell of medium size, sub-triangular in outline, slightly longer than wide, valves unequally convex, hinge line in the type specimen about equal to half the greatest width.

Dorsal valve transversely elliptical, regularly convex, most prominent near the center; beak somewhat prominent, only slightly incurved; area relatively wide, directed backward; middle of valve occupied by an indistinct mesial fold that becomes entirely obsolete near the umbo.

Ventral valve sub-triangular as seen from the side, a little more convex than the dorsal, arcuate from beak to margin with curvature most abrupt in the umbonal region: mesial sinus shallow, imperfectly defined in the anterior and middle portions of the valve and fading out toward the beak; hinge area wide, its surface forming an isosceles triangle with sides equal to two thirds the base; the area is strongly concave, curving downward, backward, then upward through an arc of slightly more than ninety degrees; foramen large, three fourths as wide as long, open to the beak.

Surface marked by from eight to ten obscure plications on each side of the mesial fold and sinus. The plications are only visible on the anterior and the antero-lateral portions of the valve, fading out on the umbonal and postero-lateral portions. The finer markings, if there were any, have been removed by weathering from the only specimen of this species that has fallen under observation. There are a few concentric lines of growth on both valves.

Length 1.3 inches, width 1.2, thickness 0.65 inches.

The type specimen was found free in a small ravine cut in the Hamilton limestone and shales near Iowa City, Iowa. There is every reason to believe that it was derived from the same beds that furnished the other species of fossils with which it was associated.

The short hinge, triangular outline, elliptical dorsal valve, wide concave area, prominent incurved beak, obscure fold and sinus, and rudimentary plications constitute a combination of characters whereby this species may be distinguished from all other described forms.

THE SAPROPHYTIC FUNGI OF EASTERN IOWA.

T. H. McBRIDE.

The fungi make appeal to our interest in a variety of ways. In the first place many are highly esteemed as articles of food —have been for ages. Again all exhibit a certain kind of beauty whether of color or form; all attain to a certain perfection in the performance of their work as organized structures and accordingly for every investigator of the natural world possess a charm not to be put aside. In the third place many fungi are notorious parasites, assailing more or less seriously the food-producing plants of the world, and affecting to a greater or less degree the well-being and prosperity of man. For these and other reasons which might be named the author believes this class in the vegetable world deserving of more and closer attention than it has heretofore received. The great obstacle in the way of the study of these plants has ever been the lack of proper, easily accessible literature. For our American fungi the literature is not lacking, but is simply not easily accessible. Descriptions there are, but lost in sundry reports or spread on the proceedings of local societies, so that the very best work of our American systematists is largely unappreciated, and so far fails to accomplish the mission it might fill under different circumstances. Berkeley's Outlines of British Fungology, Cooke's Handbook of British Fungi, but especially the reports of the state botanist of New York, and Morgan's Mycologic Flora of the Miami Valley are our best English sources of information.

It is the purpose of the author to begin here a somewhat extended review of our Iowa fungi giving lists of such as have been recognized. More particular attention will be paid to the saprophytic forms which will so far be described, as to enable the student to identify our native species. In this way it is hoped not only to increase the public interest in the subject in hand, but also to make some contribution to the more perfect kncwledge of our indigenous flora.

Fungi are flowerless plants, whose most obvious characteristic is the absence of green color, or as the botanist would say, of *chlorophyl*, the green coloring matter of leaves and herbaceous plants generally. In consequence of this lack, fungi are in large measure dependent for their food upon matter organized by other plants or by animals, and cannot or at least do not elaborate for themselves food out of inorganic material. The organic matter upon which fungi subsist may be either dead or living, hence we find these plants everywhere where organic matter is present, on leaves and stems, flowers and fruits, on plants of their own kind, on the tissues of living animals as well as upon the detritus of all these things dead and returning to their original elements. Fungi which live upon living organisms are *parasites*—parasitic in habit—those that feed upon dead organisms are *saprophytes*—saprophytic in habit. The same fungus may live in both ways or in either way according to circumstances. Thus the little green mould with which everybody is familiar, usually saprophytic, may, on occasion, be parasitic, attacking the sound tissues of an apple, for instance, where the skin is broken. Usually however these plants are quite restricted in their diet, and are either purely parasitic or purely saprophytic. In the case of such as are parasitic the plant bearing the fungus is known as the *host*. Ordinarily the parasite affects always the same host, although sometimes more than one species of green plant is called upon to furnish entertainment for a given parasite, and sometimes the parasite is migratory, spends different phases of its life-history on different widely unlike host-plants, as for instance the grain rust, to be further discussed hereafter. Again there are certain fungi which occur only as associated with certain *algae*, (green plants of lowly habit and structure), hardly as parasites for the parties to the strange union seem, in many cases at least, not to interfere with the well-being of each other. The structures resulting from this union are known as lichens, and were until recently considered a distinct group of plants, quite as distinct as the fungi themselves.

In structure fungi, though always to be classed among the simpler organisms, exhibit the greatest diversity. Some consist of but a single cell, others show a very considerable amount of differentiation either in the modification of the individual cell, or, of an aggregate of cells. Most are soft, perishable, ephemeral; some are dense, hard, enduring; all fail to reach the differentiation of distinct tissues and groups of tissues, such as appear in the higher plants.

Nearly all fungi consist when at maturity of two distinct parts; the first, the nutrient portion or *mycelium*, made up usually of minute cobwebby threads,[1] more or less aggregated, spreading upon or through the substance affording nutrition; and, second, the fruit-bearing portion, *sporocarp* or *fructification*.

This latter part, the fructification, often in popular estimate passes for the fungus entire.

In their reproduction fungi are all sporiferous, *i. e.* all have spores, usually single cells, which when set free from the parent plant become under favoring conditions propagative. Fungi, as other plants are known by their fruits,—by their spores and sporocarps.

All our more conspicuous saprophytic fungi belong to the order *Basidiomycetes*, complete definition of which, must for lack of plates, at present be deferred. It is sufficient to say that the spores are in this order produced by simple abstriction

1 The mycelial threads are in reality so many most thin-walled and delicate tubular cells called *hyphae*, and the sporocarps are aggregations formed by the compact interweaving of the threads modified in various ways to meet varied purposes and conditions,—to adapt the plant to its position in the world.

from larger cells which associated together form a more or less distinct fruiting surface or layer known as the *hymenium.* The order falls naturally into two sub-orders according as the hymenium *is* or *is not* at the time of spore formation, or separation enclosed by surrounding tissues. Hence we have—

Hymenium exposed, - - - - - - - - HYMENOMYCETES.
Type, the common Toadstool.
Hymenium enclosed in cavities of various sorts and sizes, GASTEROMYCETES.
Type, the Puff-ball.

The sub-order *Hymenomycetes*, according to the manner in which the hymenial layer is exposed, includes several families, thus:

FAMILIES OF THE HYMENOMYCETES.

Hymenium exposed on the surface of usually radiating plates or gills, *lamellae*, - - - - - - - - AGARICINEÆ.
Hymenium exposed on the inner surface of pits or tubules more or less deep, - - - - - - - - POLYPOREÆ.
Hymenium exposed on the surface of papillæ or teeth, - HYDNEÆ.
Hymenium spread over a branching, erect fructification, CLAVARIEÆ.
Hymenium smooth, usually inferior and horizontal, - THELEPHOREÆ.
Hymenium superior, lobed, convolute, or disk-like, gelatinous, (fertile threads not compacted into a true hymenium)—*Cooke*, - - - - - - - - TREMELLINEÆ.

As including more familiar forms we begin with the family first named—

THE AGARICINEÆ.

The members of this family may for description all be compared with the common English mushroom, and the terms used in description are best defined with a plant in hand. (Almost any of our larger native species will answer just as well). We have in the first place the expanded umbrella-shaped top—the *pileus*, mounted upon a stalk—the *stipe.* The stipe may be centrally attached, as in the case now supposed, or lateral, or wanting entirely, in which instance the pileus will be fastened to its support (*sub-stratum*) by margin or top. Extending from the edge of the pileus to the stipe in young unexpanded specimens will be found a web more or less dense, at first, in typical specimens, completely concealing the lamellae on the lower surface of the pileus. This web is called the *veil* and when enclosing simply the hymenial surfaces as we have here supposed, is said, to be *partial*; when more extensive so as to enclose stipe and all, we have a *volva* and the condition described as "*veil universal.*" As the pileus expands the veil is rent, often in such a fashion as to leave a portion of it surrounding the stipe as a collar or frill—the *annulus* (ring).

Other terms used will be for the most part self-explanatory, or will be explained in their proper connection.

The group or family as here described includes a number of genera distinguished by characters pertaining to the pileus and lamellae. The twelve following are represented in our flora:

Section I. *Fungi putrescent, soon perishing.*

1.	Lamellae thin membranaceous, not deliquescent, "trama[1] filamentous continuous with the substance of the pileus: edge acute,[2]" - -	Genus AGARICUS.
2.	Lamellae as in *Agaricus* but soon melting into an inky fluid, - - - - -	Genus COPRINUS.
3.	Lamellae as in *Agaricus* trama floccose, "spores rusty ochre:" "veil cobwebby," - -	Genus CORTINARIUS.
4.	Lamellae as in *Agaricus* but more or less waxy or watery, - - - - - - -	Genus HYGROPHORUS.
5.	Lamellae as in *Agaricus*, but with milky juice,	Genus LACTARIUS.
6.	Lamellae as in *Agaricus*, but rather dry and fragile; "trama vesiculose," - - -	Genus RUSSULA.
7.	Lamellae with edge obtuse, - - - -	Genus CANTHARELLUS.

Section II. *Fungi persistent, becoming dry and tough.*

8.	Lamellae with edge acute, entire but dry and persistent, - - - - - - - -	Genus MARASMIUS.
9.	Lamellae thin, tough, more or less distinctly serrate or denticulate, - - - - -	Genus LENTINUS.
10.	Fungi soft and fleshy when moist; lamellae acute entire, - - - - - - - - - -	Genus PANUS.
11.	Lamellae cleft, the parts revolute, - -	Genus SCHIZOHPYLLUM.
12.	Lamellae disposed in concentric circles, -	Genus CYCLOMYCES.

1. The trama is the body or central portion of the lamella. It is hoped that our next issue will contain plates illustrating this and such other structural peculiarities as cannot be pointed out to the naked eye.

2. Berkeley's Outlines.

The genus first named, *Agaricus*, is typical of the whole group and contains by far the greater number of forms. In our flora the remaining genera are outliers, so to speak, with here and there a species. Some as we shall see are represented in our flora by but a single form.

The further classification of this dominant genus proceeds primarily according to the color of the spores, as follows[1]:

a. Spores white, - - - - - - - - - - - - *Leucospori.*
b. Spores salmon-colored, - - - - - - - - - *Hyporhodii.*
c. Spores ferruginous or tawny, - - - - - - - *Dermini.*
d. Spores purplish, or purplish brown, - - - - - - *Pratelli.*
e. Spores black, - - - - - - - - - - - - *Coprinarii.*

SERIES I. LEUCOSPORI—The white-spored Agarics.

Subgenus Amanita.

Veil universal distinct from the cuticle of the pileus; hymenophorum (pileus) distinct from the stem.—*Berk.*

Plants of this subgenus are easily recognized. The universal veil is readily seen in the unopened specimens. After the elevation and expansion of the pileus the remnants of the volva appear as fragments more or less conspicuous on the pileus, and surrounding the base of the stipe as a sheath. The stipe is articulated with the pileus and easily detachable from it.

The following are our species:

1. AGARICUS MUSCARIUS.—*L.*

Pileus at first hemispherical, then expanded, convex, the margin striate, orange, or yellow with the disk reddish, the whole surface under favorable circumstances covered with angular patches of the disrupted volva; lamellae narrowed toward the stipe, white, free; stipe bulbous, sheathed with the scaly volva, as with imbricating layers. Stipe annulate, pithy, or at length hollow.

Height 4′-6′, width 3′-5′. August.

1. To see the color of the spores cut from the stipe the pileus and lay it gills down upon a sheet of paper, white or black. Cover now with a bell-jar or tumbler or leave entirely uncovered, and in a short time spores will have fallen in sufficient quantity to show the color.

A very remarkable and pretty fungus not rare in our wooded districts, in midsummer, though usually small. The species is found in all parts of the northern hemisphere and is everywhere reckoned poisonous. Specimens brought into the house fresh from the woods are death to flies which happen to visit them, a fact which the scientific name brings to mind. The savage tribes of Eastern Asia are said to use the "Fly Mushroom" to produce intoxication. European specimens are very much larger and taller.

2. AGARICUS VERNUS.—*Fr.*

Pileus ovate, then expanded, smooth snow-white; lamellæ free, concolorous: stipe pithy, annulate, bulbous, sheathed.

Height 6′. Pileus 2′-3′. July–August.

An elegant white species, rather rare with us but found often in clearings in woods. Its spotless purity of color makes it very attractive looking, but it is nevertheless inedible.

3. AGARICUS PHALLOIDES.—*Fr.*

Pileus at first campanulate, then expanded, smooth and subshining, grey or slaty in color; lamellae and flesh white; stipe annulate and bulbous, white; volva loose and sheathing the bulb only.

Height about 4′. Pileus 2′-3′. August–September.

This species occurs in the deep woods. I often find it where some log has gone entirely to decay. A colony is usually to be found in one place and specimens of all ages are easily secured.

4. AGARICUS VAGINATUS.—*Bull.*

Pileus thin, margin conspicuously striate, smooth, expanded, almost flat, brown: lamellae white free: stipe white, not annulate, slightly bulbous sheathed with the remains of the volva.

Height 4′-5′. Pileus 2′-4′. August.

Not common. Inedible as are nearly all the members of the subgenus.

Subgenus Lepiota.

Veil universal and concrete (blended) with the cuticle of the pileus. Hymenophorum distinct from the stem.—*Berk.*

The veil is blended with the cuticle of the pileus, but put under tension by the expanding pileus breaks up and usually gives the whole surface a scurfy appearance.

5. AGARICUS PROCERUS.—*Scop.*

Pileus at first ovate then expanded, umbonate, the margin incurved, rather fleshy but becoming somewhat tough and leathery when dry, white, spotted with more or less conspicuous pale brown patches or scales; lamellae pale flesh colored, remote from the stipe which is tall slender bulbous, somewhat scaly and furnished with a movable ring.

Height 8′-16′. Pileus 5′-6′. August and September.

This is by all odds our finest mushroom. Common in woods and orchards, it towers above all others and is conspicuous from far. Specimens frequently reach sixteen inches, and I have seen them taller. Said to be edible.

6. AGARICUS ACUTESQUAMOSUS.—*Weinm.*

Pileus convex, sub-umbonate, covered with small erect acute scales; lamellae narrow and free: stipe bulbous witb a fixed broad annulus.

Height 3′-4′. Pileus 2′-3′. August and September.

Not common. The specimens referred to this species are found in rich woodland, are pale brown in color with something of a reddish cast and retain color in drying.

7. AGARICUS AMERICANUS.—*Pk.*

Pileus convex, umbonate, squamose with distinct rather narrow retreating scales; lamellae free; stipe hollow, smooth, bulbous, the bulb greatly elongated, annulate with fixed ring.

Height 3′-4′. Pileus 2′-3′ August.

Common along the line of the C. R. I. & P. railway. The plant may have been so introduced. Dr. Peck mentions the color assumed in drying, "dull pinkish red." This seems a very characteristic feature.

8. AGARICUS NAUCINOIDES.—*Pk.*

Pileus at first spheroidal, then convex expanded, fleshy, soft and smooth, white or sometimes alutaceous, shining; lamellae white at length with a pinkish tinge, free; stipe smooth and white, bulbous and furnished with conspicuous ring.

Height 3′-4′. Pileus 2′-4′. August and October.

This very pretty species is exceedingly common in its season on lawns and grassy places generally. The blue grass which is fatal to so much of our flora seems but to afford this fungus nutritious habitat.

The species is edible and said by epicures to compare favorably with *Agaricus campestris*, the English mushroom.

In the 23rd Report of the N. Y. State Museum Dr. Peck referred this species to *A. naucinus* Fr. Subsequently in the 29th Report of the same admirable series, he gives reasons for creating a new species for the American plant, viz., the sub-elliptical spores, very smooth pileus, and absence of an umbo. Our specimens would be often well described as umbonate, but the spores are sub-elliptical and of the size quoted —.006 x .0075 mm.

Subgenus Armillaria.

Veil partial, annular. Hymenophorum confluent with the stem.—*Berk.*

9. AGARICUS MELLEUS.—*Vahl.*

Pileus fleshy, margin at first incurved then expanded, rough with minute blackish hair-like scales; lamellae white, almost decurrent; stipe fibrous, tough, solid, white or of the color of the pileus, yellowish brown; annulus, slight.

Height 3′-8′. Pileus 2′-4′. September.

Very common throughout the autumn months and very variable both in color, form and habit. Sometimes it occurs solitary, sometimes in dense tufts and clusters at base of stumps etc. It is consequently very variable in size. The veil hangs from the margin in thin webs and is evanescent, as likewise the annulus. Under favoring circumstances the plant grows rank, strong, and coarse grained. In dry seasons plants are smaller, and often present the pileus deeply checked with fissures running in all directions.

Subgenus Tricholoma.

Stem fleshy; gills with a sinus behind. Veil obsolete, or, if present, flocose and adhering to the margin of the pileus.—*Berk.*

10. AGARICUS PERSONATUS.—*Fr.*

Pileus fleshy, convex, involute, then expanded, thick, smooth and shining, pale blue or violet in color; stipe short thick, tapering upwards, white solid; lamellae narrow; free, white or bluish, crowded: veil evanescent.

Height 2′-4′. Pileus 2′-4′. August.

This, the only Tricholoma I have yet seen in our limits, is very well marked. It might be confused with *Cortinarius violaceus*, which differs in the color of the spores (decidedly brown), and in having the lamellae thick and deeply stained with the accumulating fruit.

Agaricus terreus is also reported from the state.

Subgenus Clitocybe.

Stem elastic with a fibrous outer coat: lamellae decurrent or acutely adate.—*Berk.*

11. AGARICUS INFUNDIBULIFORMIS.—*Schaeff.*

Pileus at first convex, then depressed, at length funnel-shaped, brown; lamellae white, distinctly decurrent, narrow; stipe paler than the pileus, smooth, even.

Height 2′-3′. Pileus 2′. June.

Not common.

12. AGARICUS ILLUDENS.—*Schw.*

Pileus convex, then more or less perfectly expanded, smooth, slightly umbonate, orange yellow; lamellae narrow unequally decurrent; stipe long solid, tapering downward.

Height 4′-10′. Pileus 2′-6′. September.

One of the most common of our autumnal species. It is densely cæspitose growing in clusters two or three feet in diameter at the bases of stumps. Very showy, the plant receives general attention and is more frequently collected than any other agaric. The flesh is yellow, tough and inedible.

13. AGARICUS OCHROPURPUREUS.—*Berk.*

Pileus rounded, the margin involute, pale bluish white, fleshy but tough and persistent, at length depressed, but not fully expanded; stipe concolorous, long, even, rather deep-rooted; lamellae distant, thick, decurrent but broadest behind, purple, generally dusted with the white spores.

Height 5′-8′. Pileus 2′-3′. August and September.

This is one of our most striking species. Its firmness and persistence, its uniform color, and above all its broad, distant, bluish gills make it easily recognizable. These characters are quite well preserved in the dry specimens. The whole make-up of the plant is so different from that of ordinary agarics that some authorities are inclined to place this and the following species in another genus, *Laccaria.*

The species is quite common on wooded hill-sides in all the eastern part of the State.

14. AGARICUS LACCATUS.—*Scop.*

Pileus thin but fleshy, convex, at length depressed and somewhat scurfy or scaly, hygrophanous (changing color if wet), dull reddish brown, paler when dry; stipe tough and fibrous, equal, pithy, slender; lamellae broad, not decurrent, purplish in color, at length powdered with the falling spores.

Height 2′-4′. Pileus 2′-3′. August.

Rather rare, well marked and not likely to be confused with any other species unless perchance *A. purus* which *A. laccatus* sometimes resembles in color. The latter is however solitary in habit and has colored gills (not pure white). Found at the base of stumps etc.

15. AGARICUS RADICATUS.—*Relh.*

Pileus convex, then expanded, umbonate, smooth and glutinous when fresh, at length wrinkled; stipe long, slender, concolorous or paler, with a long tapering root-like base; lamellae distant, white, attached but not decurrent.

Height 4′-8′. Pileus 2′ or 3′. June–November.

Common in clearings at base of stumps etc. Recognizable by its long rooting stipe and sticky more or less rugose cap.

16. AGARICUS DRYOPHILUS.—*Bull.*

Pileus thin expanded, generally depressed, glabrous, pale, whitish or yellowish; lamellae white, narrow and crowded sub-free; stipe hollow, smooth, yellowish brown, smooth and shining with enlarged base.

Height, 2′-3′. Pileus 1′-2′. June–October.

Common in woodlands everywhere, often gregarious.

17. AGARICUS VELUTIPES.—*Curt.*

Pileus fleshy, thin, convex, viscid, yellowish brown, often unsymmetrical and distorted; stipe velvety, brown, hollow, often arcuate and rooting; lamellae slightly attached, yellow.

Height 2′-8′. Pileus 1′-3′. September.

Not uncommon: found in damp places springing from crevices of old logs, dead roots etc., often in clusters as if cæspitose. Easily known by its tomentose stem, instantly suggesting the scientific name—*velutipes*, velvet-footed.

Subgenus Mycena.

Pileus campanulate, more or less striate, at first straight and appressed to the stipe. Stipe tubular cartilaginous, tapering upward. Lamellae not decurrent, only uncinate by a tooth Fungi epiphytal or rooting.—*Morgan.*

18. AGARICUS GALERICULATUS.—*Scop.*

Pileus conic, campanulate, umbonate, striate nearly to the summit, smooth, generally some shade of brown; lamellae white, decurrent-toothed, connected above by vein-like ridges; stipe smooth, shining, slender, rooting.

Height 2′-4′. Pileus ½′-¾′. July–November.

Exceedingly common on old stumps, rotten logs and the like in shady places. Often cæspitose, variable in size and color; the gills sometimes with a reddish tinge. Collected sometimes in midwinter.

19. AGARICUS PURUS.—*Pers.*

Pileus, convex or campanulate, smooth purple or lilac, somewhat hygrophanous and evidently paler when dry; lamellae pale, often pure white, broad, distant, connected by veins, rounded within and slightly attached; stipe smooth rigid even, white, villous at base.

Height 3′-4′. Pileus about 1′. September.

A beautiful agaric, quite common amongst leaves in moist ravines. Generally gregarious and with strong odor. Authorities give the lamellae as concolorous though paler. Our specimens have the gills oftenest purest white, rarely with a bluish cast as if tinted from the royal purple pileus.

Subgenus Omphalia.

Lamellae decurrent. Stipe cartilaginous and tapering upward until it blends with the pileus which is thin or membranaceous and depressed or umbilicate.

20. AGARICUS UMBELLIFERUS.—*L.*

Pileus thin somewhat fleshy, radiate striate when fresh, margin at first inflexed, crenate, or wavy, white or yellowish. Lamellae broad distant decidedly decurrent. Stipe short, slightly pubescent at base, concolorous.

Height ½′-1′. Pileus ½ inch more or less, usually less. July–September.

A curious little fungus, not rare in wet places. Said to be lignatile, but so far with us found upon the ground only. Gregarious.

21. AGARICUS FIBULA.—*Bull.*

Pileus convex, smooth, very delicate, dull yellow, slightly striate. Lamellae paler, long decurrent narrow but not crowded. Stipe smooth, concolorous, hollow.

Height abont 1′. Pileus ¼′. June–November.

A most dainty little species commonly found on patches of moss in protected situations.

Subgenus Pleurotus.

Stipe lateral when present, generally poorly defined or entirely lacking. Lignatile.

22. AGARICUS SAPIDUS.—*Kalch.*

Pileus fleshy with thin margin compound, irregular and distorted, depressed behind, glabrous, dull white, or yellowish; lamellae narrow decurrent white not crowded; stipe solid, several divisions arising from a common trunk as in the merismatic Polypori. Spores lilac-tinted.

Stipe 1′-2′ long. Pileus various, some times 5′-6′. June to November.

Very common on all sorts of decaying tree trunks. Easily recognized by the irregular compound structure, but especially by the tinted spores which are readily secured in quantity sufficient to exhibit the lilac color.

SERIES II. HYPORHODII—Rosy-spored Agarics.

Subgenus Pluteus.

Veil wanting. Pileus distinct from the stem. Lamellae free.

23. AGARICUS CERVINUS.—*Schaeff.*

Pileus fleshy, campanulate, then expanded; at first smooth then more or less fibrillose, brown or sooty; lamellae, free crowded, white then flesh-colored; stipe solid, sordid white with adherent blackish fibrils.

Height 4′-6′. Pileus 2′-3′.

Common during the entire season, specimens frequently so late as to be frozen with the ground at approach of winter. Lignatile. Frequently seen on the decaying sawdust about ice-houses.

Subgenus Entoloma.

Pileus somewhat fleshy, the margin incurved; stipe fleshy or fibrous, soft; lamellae sinuate attached behind or seceding. —*Morgan.*

24. AGARICUS RHODOPOLIUS.—*Fr.*

Pileus somewhat fleshy, campanulate. then expanded, convex, margin wavy, in color pale brown, hygrophanous; lamellàe adnate, sinuate, white then pale roseate; stipe hollow, equal, white, pruinose above.

Height 4′-5′. Pileus 2′-3′. August–September.

A very handsome species, not common: characteristic of moist shades in undisturbed woodlands.

The preceding list of species belonging to the first two series of the great genus *Agaricus* must be regarded as largely preliminary. No species has been admitted which has not been confidently identified, generally after having been collected again and again for successive years. The description of our remaining agarics and of the species belonging to the closely related genera, *Coprinus* and *Cortinarius*, will occupy our attention in the next number.

Thanks are due Dr. Chas. H. Peck, of Albany, N. Y.. and to Mr. J. B. Ellis, of Newfield, N. J., for assistance in determinations; and to Miss M. F. Linder of Iowa City for constant assistance as a collector.

THE PERONOSPOREÆ OF IOWA.

By T. H. McBRIDE and A. S. HITCHCOCK.

The *Peronosporeæ* are delicate fungi mostly parasitic on other and higher plants. So far as they are popularly recognized at all, they are variously reckoned with moulds, mildews and blights. The botanist distinguishes four well defined genera, *Pythium*, *Phytophthora*, *Peronospora*, and *Cystopus*, all of which are known in this country, three appearing in the accompanying list of Iowa species. As will be observed our species are all parasitic and affect a very considerable number of plants, few however of any economic value. The different species run through the entire season; some appear on the leaves of their respective hosts before the latter are fairly above the ground in the spring, some attack the cotyledons of bursting seeds, while others, as the species of *Cystopus* and *Peronospora leptosperma*, come late in the fall, the last named whitening the leaves of *Artemisia* in September and October, simulating the hoar frost before which at length host and parasite sink together. As already intimated the Peronosporas attack the leaves of plants they infest, but sometimes the young and growing stems are by no means exempt. The mycelium of the fungus spreads through all the succulent tissues of the leaf attacked, passing between but not through the cells in all directions diverting to the development of the parasite that which should go to the development of the host. The fungus is reproduced in two ways: by spores formed in special receptacles developed within the tissues of the host, and by *conidia*, spores more simply produced by abstriction from the ends of certain branches of the mycelium which project, either by way the stomata or of the ruptured epidermis, from the surface of the leaf, or supporting structure whatever it may be. It is by means of the conidia and the modes of their abstriction and germination that the current classification is effected. Most of the species are consequently of comparatively easy identification to anyone possessed of a good microscope.

Nos. 1 and 24 of the list subjoined are most interesting of all because of the importance of the host-plants which they affect. *Phytophthora infestans* occurs on the potato and is the fungus connected with the notorious "potato murrain" or "potato disease" and so like many an other nuisance, has a place in human history. The development of the fungus is favored by sultry and wet weather, alternating periods of fog and sunshine. The climate of Iowa seems on the whole too dry. At all events our potato crops have seldom been generally, or even seriously affected, although the parasite is here. It is interesting to note that the Tomato (member of the same family as Potato) suffers a similar invasion from *P. infestans.*

No. 24 is, it would appear, more to be dreaded. In the Government Report on the Fungus Diseases of the Grape Vine Mr. Scribner makes this statement:

"The downy mildew (*P. viticola*) is common to both the wild and cultivated grapes of this country, and from the former it doubtless was conveyed to the latter in the earliest days of American grape culture. In all the region east of the Missisippi, particularly in the central and middle Atlantic states it has long been known as a serious pest. It is now reported in California where the loss it occasions in some localities is variously estimated at from ten to fifty per cent. In New England and along the northern tier of states although of frequent occurrence, its action is comparatively insignificant."

In Iowa the native species suffer far more than those cultivated in vineyards although the latter are often affected. It is not uncommon to see plants of *Vitis riparia* white from top almost to bottom with the downy mildew. In vineyards it is the old and neglected stocks only, whose enfeebled leaves turn yellow and fall before the onset of the parasite. The fungus sometimes attacks the ripening fruit when, of course, it attracts general attention as entailing palpable damage and loss.

For introductory studies in this group of plants no species is more convenient than *P. effusa* occurring on *Chenopodium album* ("lambs quarters"). It is readily available in early summer, and by its abundance and color (when seen in quantity sordid violet) easy to discover. Sections of the leaf affected are easy to make and satisfactory in demonstrating the mycelium of the fungus.

The genus *Cystopus* is distinguished from the other genera here mentioned in that its conidiophores (fertile or fruiting branches of the mycelium) are formed not in the open air but inside the leaf of the host plant, just beneath the epidermis. In consequence, the appearance of the fungus when in fruit is peculiar. In the typical *Peronospora* the fruit appears as delicate patches of frost or down on the lower surface of the leaf (where the stomata abound), whereas in *Cystopus* dull whitish somewhat swollen spots often on the upper surface of the leaf are the only signs of fruiting to be seen. It will be observed that this genus is limited to but few hosts. That on *Portulaca oleracea*, purslane, is very common.

McB.

As is usual with parasitic fungi the *Peronosporeæ* produce two kinds of spores, oospores, or resting spores which carry the species through unfavorable conditions, and the conidia which serve for immediate propagation.

The oospores are formed within the tissues of the host plant. They are usually dark brown, nearly globular cells, with the surface smooth or covered with the ridges or tubercles. The number is so great in some cases, as to distort the host.

The three genera which have been reported from this state are defined by conidial characters as follows:

Phytophthora: conidia ovate, nearly sessile on the simple or sparingly branched conidiophore. In most cases the spores have fallen off when the specimen is examined, but the conidiophore may be recognized by the swellings at intervals upon the upper part. These are rather abrupt below, but above gradually taper to the next swelling. The conidia are really terminal but as each conidium is formed the conidiophore swells out and grows past the spore which it pushes to one side.

Peronospora: conidia elliptical, borne singly at the extremities of pinnately or dichotomously branching conidiophores, issuing from the stomata. In some cases the branching is reduced to a minimum, the conidiophore being very short, with mere points for branches.

Cystopus: the conidia which are produced in chains, collect under the surface and break through by rupturing the epidermis, instead of passing through the stomata.

In the list given below I have followed Dr. Farlow's "Enumeration of the Peronosporeæ of the United States" as nearly as possible.

I owe many thanks to Mr. E. W. D. Holway, of Decorah, Prof. T. H. McBride, of Iowa City, and Prof. B. D. Halsted, of Ames.

The specimens from Decorah were contributed by Mr. Holway, the others were collected by myself unless otherwise mentioned.

1. PHYTOPHTHORA INFESTANS.—*DeBy*.
   On *Solanum tuberosum*. Decorah. The "potato rot." Destructive in wet seasons.

2. PERONOSPORA ALISNEARUM.—*DeBy*.
   On *Cerastium nutans*. Decorah.

3. P. ALTA.—*Fkl*.
   On *Plantago major*. Ames, Iowa City (McBride), Decorah.

4. P. ARTHURI.—*Farl*.
   On *Œnothera biennis*. Ames, Decorah.

5. P. AUSTRALIS.—*Speg*.
   On *Echinocystis lobata*. Decorah, Shenandoah.

6. P. CALOTHECA.—*DeBy.*
   On *Galium boreale.* Decorah.

7. P. EFFUSA.—*Rahb.*
   On *Chenopodium album.* Ames, Decorah, Iowa City.
   On *C. hybridum.* Iowa City.

8. P. EUPHORBIAE.—*Fkl.*
   On *Euphorbia serpyllifolia*, *E. maculata*, *E. glyptosperma.* This species was found in Hamilton county in 1886. Last summer (1888) it was observed on the three hosts mentioned in great abundance in all parts of the state.

9. P. FICARIÆ.—*Tul.*
   On *Ranunculus repens.* Iowa City, Decorah.

10. P. GANGLIFORMIS.—*DeBy.*
    On *Lactuca ludoviciana.* Ames, Iowa City, (McBride).

11. P. GERANII.—*Peck.*
    On *Geranium carolinianum.* Iowa City.
    On *G. maculatum.* Decorah, Iowa City, (McBride).

12. P. GRAMINICOLA.—*Schroeter.*
    On *Setaria viridis.* Ames.
    S. italica. Ames.

13. P. HALSTEDII.—*Farl.*
    On *Bidens frondosa*, *B. chrysanthemoides*, *B. connata*, *B. cernua*, *Ambrosia trifida*, *A. artemisiaefolia Helianthus grosse-serratus*, *H. doronicoides*, *Silphium perfoliatum.* Ames. *Ambrosia trifida*, Iowa City, (McB.)
    On *Rudbeckia laciniata*, *R. triloba.* Decorah, Iowa City (McBride).

14. P. LEPTOSPERMA.—*DeBy.*
    On *Artemisia biennis.* Ames (Halsted), Iowa City, (McBride).

15. P. LOPHANTHI.—*Farl.*
    On *Lophanthus scrophulariaefolius.* Ames, Iowa City, Decorah.

16. P. OBDUCENS.—*Schroeter.*
Impatiens pallida. Decorah.

17. P. PARASITICA.—*Tul.*
On *Brassica nigra*, *Sisymbrium canescens*, *Nasturtium palustre*, *Capsella bursa-pastoris*, *Lepidium virginicum.* Ames. Iowa City.
Dentaria laciniata. Decorah.
Very common in the spring on Cruciferae. In the case of Nasturtium, Capsella and Lepidium, it covers the under surface of the seedling leaves with a dense white fleece. Conidia were found on the ripe pods of Brassica. In Sisymbrium the stems and pedicels were very much distorted.

18. P. POLYGONI.—*Thuem.*
On *Polygonum aviculare.* Iowa City.
On *P. dumetorum*, var. *scandens.* Ames, (Halsted).

19. P. POTENTILLÆ.—*DeBy.*

20. P. PYGMÆA.—*Unger.*
On *Anemone dichotoma.* Ames.
This species is peculiar in having short, stout conidiophores, with very short pointed branches for the attachment of the spores.

21. P. SORDIDA.—*Berk.*
On *Scrophularia nodosa.* Ames, Iowa City, Decorah.

22. P. TRIFOLIORUM.—*DeBy.*
On *Vicia americana.* Ames, Decorah.
On *Astragalus canadensis.* Ames.

23. P. URTICAE.—*DeBy.*
On *Laportea canadensis.* Ames, Aug., 1888.

24. P. VITICOLA.—*DeBy.*
On *Vitis riparia.* Ames, Iowa City, Decorah.
On cultivated grapes. Ames (Halsted), Iowa City, (McBride).
During the dry seasons of '86 and '87 the "grape mil-

dew" was not plentiful, but where it had obtained a foothold, the host plant was dwarfed and entirely covered with the fungus to the ground.

25. CYSTOPUS CANDIDUS.—*L.*

On *Sisymbrium officinale*, *S. canescens*, *Capsella bursa-pastoris*, *Nasturtium palustre*, *N. sessiliflorum*, *Lepidium virginicum*, *Brassica nigra*. Ames, Iowa City.

26. C. CUBICUS.—*Lev.*

On *Ambrosia artemisiaefolia*. Ames, Iowa City, (McBride).

27. C. BLITI.—*Lev.*

On *Amarantus retroflexus*, *A. blitoides*, *A. albus*, *Acnida tamariscina*. Ames.

28. C. PORTULACAE.—*Lev.*

On *Portulaca oleracea*. Common.

PERONOSPORA—sp.

On *Hydrophyllum virginicum*. Decorah, Iowa City, Ames, (Halsted).

This was first reported byMr.Holway last spring (1888). About the same time that I received a specimen from him, I found it at Iowa City. The next day it was discovered by Dr. Halsted at Ames. Thus it appeared almost simultaneously in three widely separated districts. The species is in the hands of Dr. Farlow at present.

On *Phlox divaricata*. Decorah.

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BOTANICAL NOTES.

By T. H. McBRIDE.

SPORE-DISPERSAL AMONG FUNGI.

In the *American Naturalist* a year or so ago attention was called to the peculiar manner in which certain species of Agaricus disperse their spores. The spores do not simply fall from the lamellae but are in some way distributed from the plant, projected in all directions for a considerable distance. This was first noticed in the case of *Agaricus illudens*, but has since been observed in connection with many other species, *A. sapidus*, *A. adiposus*, etc. One species which I am disposed to consider new, very cæspitose and in consequence having the pilei much overlapping and, so to speak, in each other's way, exhibits a wonderful degree of projectile energy. From a colony of plants placed upon a laboratory table the snow-white spores were dispersed in quantity in all directions within a circle having a radius of two or three feet. Such projection is hardly to be explained by the operation of the forces and apparatus which cause in all Hymenomycetes the simple abjection of the spores. The propulsion is best seen when the plants are placed in a dry atmosphere, as in a steam-heated room. A dry air out of doors will, however, effect the same result. I am inclined to think that the hymenial layer in many Agarics is decidedly a hygroscopic structure. When the air is dry dispersal takes place freely, when wet, the amount of abjection is small.

Certain species of myxomycetous fungi seem to exhibit a similar projectile energy. Having placed a colony of the sporangia of *Stemonitis fusca* in a box furnished with a lid and standing quietly in a drawer, I was a few days later surprised to find the whole inner surface of the box-lid as well as the sides of the box all around stained perfectly brown with spores. Specimens of *Hemiarcyria rubiformis* exhibit the same peculiarity. In this case I have supposed that the tension of the imprisoned capillitium might be sufficient on the breaking of the upper part of the sporangium to account for the scattered spores. No such explanation is applicable to the *Stemonitis*. In both instances the change from the outdoor atmosphere to the warm dry laboratory had something to do in the results. Still I believe the results are often attained in conditions purely natural.

SOME INTERESTING PLANTS.

We have in the herbarium of the State University several specimens interesting to students of distribution. Two species of Lycopodium from the immediate vicinity of the institution were noticed in the *American Naturalist* sometime since. Specimens of *Sphagnum* ——— sp? found in a woodland pool in this county, are believed to be the first peat-mosses reported from the state. A single specimen of *Cyclomyces greenii*, Berk, is of unusual interest. The species is based upon specimens first discovered at Tewksbury, Mass., and is not only very rare as a species, but belongs to a rare genus. Only four other species are known, viz: *C. turbinatus*, East Indies, *C. beccarianus* Borneo, *C. stereoides* Malacca, *C. fuscus* Mauritius. That we should have here in North America a single species whose only relatives are to be found in regions the most distant possible, there scattered from island to island, is a fact certainly worthy of consideration. That our particular species should occur in New England, and then here in Iowa west of the Mississippi river is also remarkable.

AN UNDESIRABLE IMMIGRANT—*Solanum rostratum*. As illustrating the manner in which artificial conditions affect plant distribution, the case of *Solanum rostratum*, may be cited. The plant is a native of our dry plains from Nebraska south and west. The species does not appear in the list of our Iowa flora and I much doubt if it could have been found here prior to about the year 1880. In that year it was reported from Hamburg, the south-west corner of the state. Three years ago a single specimen was found by the railroad track in this (Iowa) city. Two years ago the plant occurred in quantity about the glucose factory here and on sandy banks along the river, and it is reported from a similar situation at Des Moines and other points west and south. In 1885 carload after carload of corn was brought from Kansas and points west and south for use in the factory above named. It would seem accordingly that the railroad trains have in this case been the means of transporting what may prove a very troublesome weed.

A NOVEL HABITAT FOR MOULD.

In a carboy of Hydrochloric acid in the Chemical Laboratory of the University appeared not long since a curious vegetable growth. Certain small spherical bodies of flocculent appearance just heavy enough to keep their place at the bottom of the carboy first attracted attention. Investigation showed a mass of rather nodose mycelium, chains or groups of cells of very unequal size, but all more or less spherical in outline. One was reminded of Torula or some saccharomycetous fungus, except that the number of cells adherent was so much greater. Each mass seemed evidently a colony, the outcome from a single spore, but every thing was distorted and irregular as if the plant labored under the most disadvantageous conditions. With a view to a possible determination of the species, three of the colonies were transferred with greatest care from the acid to a plate of sterilized gelatin and placed in a moist chamber, every precaution being taken to insure a pure culture. In about forty-eight hours a vigorous growth was manifest from each colony and in a few days each was perfectly green with the fruit of *Penicillium glaucum*. The tufts were lower than ordinary and the spores were smaller, but the branching of the hyphæ and the spore-formation were sufficiently characteristic. About the time when the green color first appeared a new centre of growth was to be seen on the gelatin plate. This proved to be also Penicillium, and presently produced abundant fruit of the ordinary size and kind. A second culture from spores of the first gave again colonies of Penicillium with spores of the usual sort. It would seem that the growth in Hydrochloric acid represented simply the distorted or depauperate mycelium of the common and universal green mould. Similar mycelial developments are reported as occurring in certain organic acids as Phosphoric acid etc., but Hydrochloric would seem to afford conditions unfavorable even to a fungus. The acid was 3.6 per cent solution.

THE MOLLUSCA OF EASTERN IOWA.

By B. SHIMEK.

The following list of the *Mollusca* of Eastern Iowa, though incomplete, is offered as the result of observations continued for a number of years. Many of our *Mollusca* are restricted to very small and often obscure areas in their distribution and consequently, unless a most searching investigation is made, some will pass unobserved. Such an investigation has not been made in this state except in limited localities and no doubt many species exist which have not yet been reported. This applies more particularly to the northern and western portions of the state, the waters of which teem with molluscan life which is as yet imperfectly known. It was the writer's intention to spend the past summer in these portions of the state, but no time could be spared and he was reluctantly compelled to postpone this study. For this reason the following notes apply more particularly to the molluscan fauna of the eastern half of the state, though occasional references are made to forms from other portions.

The classification employed is in the main that of Tryon's "*Structural and Systematic Conchology*." While portions of this may be objectionable it is well to remember that classifications usually change much more rapidly than do the characters on which they are founded, and if we thoroughly understand the latter we are prepared for a grouping of these characters as employed in *any* classification.

While great care was exercised in the following in excluding species of doubtful standing it is very probable that some of those which are listed are mere varieties, but a much more thorough study of them will have to be made before this can be satisfactorily determined.

The genera *Amnicola*, *Campeloma*, *Succinea*, *Limnæa*, *Planorbis*, *Physa*, *Sphaerium*, *Pisidium*, and *Anodonta* are particularly difficult, and the final decision in many of these must be reserved until a much more careful comparison of the shells, and in the *Gasteropoda*, of the dentition can be made. While we do not regard dentition of itself as sufficient to determine species, it certainly should be taken into consideration with other characters. No reference to the dentition is made in these notes because much of the material in our possession has not yet been worked out and the notes would necessarily be fragmentary.

No descriptions of species are attempted but attention is given rather to the variation in the characters of some species, and to habitat. The majority of the forms listed were collected and studied by the writer, but where notes were obtained from other sources due credit is givem under the species. The comparison of notes with Prof. F. M. Witter's "Mollusca of Muscatine Co.," proved to be especially interesting, as did also the study of specimens donated to the University by Prof. Witter.

CLASS—GASTEROPODA.

SUB-CLASS—PROSOBRANCHIATA.

ORDER—PECTINIBRANCHIATA.

FAMILY—STREPOMATIDÆ.

Genus Pleurocera.—Raf.

P. SUBULARE.—*Lea.*

Very common in the larger, rocky streams. Usually found near the shore on rocks which are covered with a thin layer of mud. The coloration and sculpture vary. Some forms are light horn-colored, others of a deep purplish brown. Some are almost smooth, others with sharp spiral lines. The latter has been received by us labelled *P. lewisii.*

On the whole the variation is such that if the rule which has been adopted by conchologists for the classification of southern *Strepomatidæ* should be applied several species (?) could be established.

Genus Goniobasis.—Lea.

G. CUBICOIDES.—*Anth.*

Reported from the Cedar river by Prof. F. M. Witter.

FAMILY—RISSOIDÆ.

SUB-FAMILY—HYDROBIINÆ.

Genus Bithynella.—Moquin-Tandon.

B. OBTUSA.—*Lea.*

Locally common on muddy bottoms in quiet waters. Readily distinguished from *Amnicola* by its more elongated form and obtuse spire.

Genus Pyrgulopsis.—Call and Pilsbry.

P. MISSISSIPPIENSIS.—*Call and Pils.*

This interesting little Rissoid was discovered near the mouth of the Rock river in Illinois.

While not strictly an *Iowa* mollusk it occurs so near that it is extremely probable that it occurs on the Iowa side of the Mississippi river. Its habitat is on muddy bottoms.

Genus Amnicola.—Gould and Hald.

A. CINCINNATENSIS.—*Anth.*

Very common on muddy bottoms in ponds and sluggish streams.

A. LIMOSA.—*Say.*

Very common on muddy bottoms of ponds and on lily leaves and sticks, particularly in June during oviposition.

SUB-FAMILY—LITHOGLYPHINÆ.

Genus Somatogyrus.—Gill.

S. SUBGLOBOSUS.—*Say.*

Quite common on muddy bottoms in quiet streams. This is the form which is commonly called *S. isogonus*, *Say.*

S. INTEGER.—*Say.*

Locally very common on rocks in rapid streams. Very common in portions of the Iowa river, especially near Eldora in Hardin county. We also have specimens which are said to have come from some of the small lakes in the north-western part of the state. This species is generally called *S. depressus.—Try.*

SUB-FAMILY—POMATIOPSINÆ.

Genus Pomatiopsis.—Tryon.

P. LAPIDARIA.—*Say.*

Common under leaves and logs on low creek and river bottoms.

FAMILY—VALVATIDÆ.

Genus Valvata.—Muell.

V. TRICARINATA.—*Say.*

Common on muddy bottoms in ponds.

V. BICARINATA.—*Lea.*

This is usually regarded as a mere variety of the preceding but we believe it to be distinct. It is much larger than *V. tricarinatæ*, *Say*, has a much broader umbilicus, and the apex is flat, in fact usually concave. In a series of several hundred specimens, these characters were found to be very constant. Both forms occur in the same ponds near Iowa City.

FAMILY—VIVIPARIDÆ.

Genus Vivipara.—Montf.

V. SUBPURPUREA.—*Say.*

Found in ponds in the eastern part of the state.

V. INTERTEXTA.—*Say.*

Common in ponds in the eastern part of the state, especially along the Mississippi.

V. CONTECTOIDES.—*W. G. B.*

Dead specimens have been found on the Cedar river both by Prof. Witter and by the writer. The species occurs in the Mississippi. Was it introduced?

Genus Campeloma.—Raf.

The mollusca of this genus (*Melantho* of authors) are exceedingly difficult to classify. Several species are recognized but they are probably mere varieties of the same species. The forms are so extremely variable that it is impossible to satisfactorily separate them.

Sinistral shells are frequently found. The following are commonly recognized as species:

C. DECISUM.—*Say.*

This is the most slender form, with relatively the longest spire. Less common than the following, and usually found in ponds or lakes.

C. SUBSOLIDUM.—*Anth.*

Larger and heavier than the preceding, often reaching a length of two inches. This frequently occurs in running waters and is the most common form.

C. RUFUM.—*Hald.*

Broader and with larger aperture than the preceding. It is also usually thinner, and is frequently tinged with purplish-red within the aperture and on the spire. It is rather rare, though we found it in the Cedar river at Cedar Rapids in considerable numbers in 1882. We consider these as mere varieties of one species.

Genus Lioplax.

L. SUBCARINATA.—*Say.*

Rather common on muddy bottoms in quiet waters, especially along the Mississippi river.

FAMILY—HELICINIDÆ.

Genus Helicina.

H. OCCULTA.—*Say.*

This species is very peculiar in its distribution. It was found in great abundance some years ago, under leaves on a steep hillside facing north, near Iowa City by Mr. H. A. Pilsbry and the writer in a tract less than two acres in area. The most careful search continued for a number of years failed to bring the species to light outside of this area in this section of the state. It has also been found in Hardin county by Dr. King, Mr. J. W. Preston and the writer. Thousands of specimens were taken in both localities. It is a very common *Lœss* fossil.

SUB-CLASS—PULMONATA.

ORDER—STYLOMATOPHORA.

FAMILY—ZONITIDÆ.

Genus Zonites.

Subgenus Hyalina.—Fer.

H. ARBOREA.—*Say.*

Very common under logs, etc., in woods. Also found fossil in the *Lœss.*

H. NITIDA.—*Muell.*

Not as common as the preceding. Found in rather low, moist places.

H. RADIATULA.—*Alder.*

Common under leaves and sticks, on creek and river bottom lands. Also fossil in the *Lœss.* This is commonly called *H. viridula.* and *H. cellaria.*

H. INDENTATA.—*Say.*

Found both in low, damp places and on rocky hillsides.

Subgenus Pseudohyalina.—Morse.

P. MINUSCULUS, *Binn.*

Very common. Occurs both in high rocky places and in low swamps.

P. LIMATULA.—*Ward.*

Living specimens of this species have not been found in Iowa, but a form referable to it occurs quite commonly in the *Lœss.*

The diameter of the shell and also of the whorls is so much greater than in any of the recent specimens examined by us that it may be necessary to separate this as a distinct species.

Subgenus Conulus.—Fitz.

C. FULVUS.—*Drap.*

Quite common under leaves and logs in moist woods. A fossil, larger than the recent form, occurs in the *Lœss.*

Subgenus Helicodiscus.—Morse.

H. LINEATUS.—*Say.*

Quite common in moist (low or high) places under sticks and leaves. Also fossil in the *Lœss.*

Subgenus Punctum.—Morse.

P. PYGMMÆUM.—*Drap.*

This, the most minute of our *mollusca*, is not uncommon under pieces of bark and wood in moist, high places.

It is often mistaken for the young of other species but a close examination soon reveals its well-marked characters.

FAMILY—SELENITIDÆ.

Genus Selenites.—Fischer, (*Macrocyclis*).

S. CONCAVA.—*Say.*

Quite common on shaded, rocky hillsides. Very common with *Helicina occulta*, *Say*, on which it feeds, the animal being secured by rasping through the body-whorl just back of the operculum.

The dentition of this group should separate it from the family *Zonitidæ*. Fischer proposes the family *Selenitidæ* for its reception.

FAMILY—HELICIDÆ.

Genus Helix.—L.

Subgenus Patula.—Hald.

P. ALTERNATA.—*Say.*

This gregarious species is very common under boards, logs, stones, etc.

P. PERSPECTIVA.—*Say.*

Locally rather common under logs and stones, usually in rather high places.

P. STRIATELLA.—*Anth.*

Very common uuder logs and leaves on creek bottom-lands. It is also very abundant in the *Lœss* deposits in which also we have found fossil eggs of the species.

P. STRIGOSA.—*Gld.*

The form which is known as *var. cooperi* occurs as a fossil in the *Lœss*, but no recent specimens have been found in the state.

Subgenus Stenotrema.—Raf.

S. HIRSUTUM.—*Say.*

Quite common under logs etc., mostly in deep woods.

S. MONODON.—*Rack,*

Common in rather high, especially rocky woods. Also fossil in the *Lœss.*

S. LEAII.—*Ward.*

Commonly regarded as a variety of the preceding, but quite constant in its characters. It is common in low swamps on the prairies, whereas the preceding form occurs in wooded country.

Subgenus Triodopsis.—Raf.

T. APPRESSA.—*Say.*

Rare. One specimen was found by Mr. H. F. Wickham in Louisa county. It has also been reported from Marshall county.

Subgenus Mesodon.—Raf.

M. ALBOLABRIS.—*Say.*

Not generally distributed. Abundant near Des Moines and reported from Muscatine by Prof. Witter. We have specimens from the extreme northern part of the state.

M. MULTILINEATA.—*Say.*

Very common in rather low places throughout the state, and exceedingly variable. The color is often a uniform brown or in other cases a deep reddish-brown, the latter especially in specimens taken in swamps in the open prairie in which "bog-iron ore" has accumulated. Specimens from such places are usually also much smaller, but heavier proportionally than forms occuring in timbered regions. Some of the smaller heavier specimens have a rudimentary parietal tooth. The variation in diameter is from fifteen to twenty-seven mm. It is also found in the *Lœss.* The fossils vary from twelve and one-half to sixteen mm., in diameter, the total range of variation in the species being from twelve and one-half to twenty-seven mm!

M. CLAUSA.—*Say.*

Rather common under logs and leaves on high timber-lands.

M. PROFUNDA.—*Say.*

Very common on steep, shaded hillsides. Specimens without bands are not uncommon. A reversed specimen was found by us near Iowa City.

Subgenus Strobila.—Morse.

S. LABYRINTHICA.—*Say.*

Not rare in high shaded places. Formerly this species was very common near Iowa City, but is now quite rare.

Subgenus Vallonia.—Risso.

V. PULCHELLA.—*Muell.*

Very common in yards under boards, etc. It is also a *Lœss* fossil.

V. PULCHELLA, *var* COSTATA.—*Muell.*

Quite common on dry, rocky hillsides and steep bluffs. It seems to be quite constant in its characters.

FAMILY—ACHATINIDÆ.

Genus Cionella.—Jeff.

C. SUBCYLINDRICA.—*L.*

Locally common in low places. Occurs in the *Lœss.*

FAMILY—PUPIDÆ.

Genus Pupa.—Lam.

P. PENTODON.—*Say.*

Very common among the roots of small plants in high, rocky places. Many hundreds were taken by us near Iowa City.

P. FALLAX.—*Say.*

Usually restricted to small areas in which it occurs in considerable abundance. It is found in rather high places under stones.

P. ARMIFERA.—*Say.*

Very common and very generally distributed. A *Lœss* fossil.

P. CONTRACTA.—*Say.*

Very common in both high and low moist places. This and the preceding are our most common species of *Pupa.*

P. CORTICARIA.—*Say.*

Locally common among the roots of grasses in high, rocky places.

P. MUSCORUM.—*L.*

Occurs only as a *Lœss* fossil, as does also the following:

P. BLANDI.—*Morse.*

Very common in the *Lœss.*

Genus Vertigo.—Muell.

V. OVATA.—*Say.*

Rather rare, in low moist places.

V. MILIUM.—*Gld.*

Very rare. Only five specimens were found by us near Iowa City.

V. GOULDI.—*Binn.*

Not uncommon locally, in high, rocky places.

V. SIMPLEX (?)—*Gld.*

A form referable to this species is very common in the *Lœss*. It is longer and has a greater number of whorls than the typical *V. simplex*.

FAMILY—LIMACIDÆ.

Genus Limax.—L.

L. CAMPESTRIS.—*Binn.*

Very common in woods and gardens, sometimes so common in the latter that it becomes a nuisance.

FAMILY—TEBENNOPHORIDÆ.

Genus Tebennophorus.—Binn.

T. CAROLINENSIS.—*Binn.*

Not rare; in rotten stumps and logs.

Sub-genus Pallifera.—Morse.

P. DORSALIS—*Binn.*

A small slug, probably this species, occurs in damp woods under logs and leaves.

FAMILY—SUCCINIDÆ.

Genus Succinea.—Drap.

S. OVALIS.—*Gld.*

Rather common in low, wet places. A *Lœss* fossil.

S. HIGGINSI.—*Bld.*

Occurs in low, wet places. Principally among grasses on mud-flats near ponds and streams. Some specimens show the parietal tooth very distinctly. A form similar to this, but with no trace of the parietal tooth, is quite common in treeless swamps. It has been received by us under the name of *S. nuttalliana*. Its position is questionable;—it may simply be a large form of *S. ovalis*.

S. AVARA—*Say.*

Two forms occur. The small one in high, rocky places, the larger (probably *var. vermeta—Say*) in low, wet places. The latter is very common, and much more gregarious. Both forms are very common *Læss* fossils.

S. OBLIQUA.—*Say.*

Very common on low timbered bottoms. Also abundant in the *Læss.*

The fossil Succineas are a puzzle. They seem to unite *S. obliqua* with the larger form of *S. avara*, which again grades into the smaller form. It is practically impossible to definitely identify some of these fossil forms with any of the recognized species. While this difficulty is encountered in the study of recent specimens it is tenfold greater in the case of the fossils. No doubt many of the recognized species will be reduced to synonyms.

ORDER—BASOMMATOPHORA.

SUB-ORDER—GEHYDROPHILA,

FAMILY—AURICULIDÆ.

Genus Carychium.—Muell.

C. EXIGUUM.—*Say.*

This minute pupa-like species is very common under logs, etc., in moist places.

SUB-ORDER—HYGROPHILA.

FAMILY—LIMNÆIDÆ.

SUB-FAMILY—LIMNÆINÆ.

Genus Limnæa.—Lam.

Sub-genus—Limnæa.

L. STAGNALIS.—*L.*

Not uncommon in some of the lakes and ponds in the northern part of the state.

Sub-genus Bulimnæa—Hald.

L. MEGASOMA.—*Say.*

This fine species is not uncommon on floating masses of vegetation in some of the ponds and lakes of the northern part of the state.

Sub-genus Limnophysa.—Fitz.

L. REFLEXA.—*Say.*

Very common in the northern and also the eastern part of the state. The longitudinally banded forms known as *L. zebra* are quite common, but it is absurd to consider these as a distinct species.

L. PALUSTRIS.—*Muell.*

Locally very common, especially in the northern part of the state. It occurs in swamps on the edges of small lakes. Somewhat variable.

L. NUTTALLIANA.—*Lea.*

This species which is referred to *L. palustris* by Binney is not uncommon in the lakes of the northern part of the state. It certainly is a distinct species.

L. DESIDIOSA.—*Say.*

Very common on mud-flats at the edges of ponds and sluggish streams. This is a variable species approaching *L. humilis* in some of its forms and *L. pallida* in others. The latter may be only a synonym.

It is also very common in the *Lœss* at Iowa City with *L. caperata* and *L. humilis*. They occur in a narrow exposure not more than three feet wide in an old railroad cut in the northeastern portion of the city.

L. PALLIDA.—*Ad.*

A form referable to this species was found by us in several localities. Prof. Witter reports it from Muscatine.

L. CAPERATA.—*Say.*

Locally very common in ponds in the eastern half of the state. It also occurs in the western portion, but in what abundance we are unable to say.

L. HUMILIS.—*Say.*

Locally very common on mud near ponds and streams. Quite variable.

Genus Physa.—Drap.

P. LORDI.—*Baird.*

A form occasionally occurs which has been referred to this species by Prof. R. E. Call. It may be simply a large form of *P. heterostropha* with deeply-folded columella.

P. HETEROSTROPHA.—*Say.*

Locally very common in ponds and sluggish streams. Often mistaken for the following species but quite distinct.

P. GYRINA.—*Say.*

The most common of our Physas. It is found in every pond and sluggish stream. It is a narrower shell with more elevated spire, less convex whorls, less inflated body-whorl and smaller aperture than the preceding.

P. SAYI.—(?) *Tappan.*

A species which we can not place anywhere else, was found by us at Cedar Rapids and less commonly at Iowa City. It has been referred by some of our correspondents to *P. heterostropha* but it is certainly distinct. As compared with *P. heterostropha* it is more ventricose taken as a whole, though with proportionally less inflated body-whorl, has a less impressed suture and the shell is much lighter in texture. There may be some question as to its being *P. sayi*, but it certainly is distinct from all other forms here listed.

P. ANCILLARIA.—(?) *Say.*

Specimens probably belonging to this species are not uncommon.

P. VIRGATA.—*Gld.*

Found by Prof. Witter at Muscatine.

Genus Bulinus—Adan.

B. HYPNORUM.—*L.*

Locally very common in the northern half of the state in ponds and sluggish streams. We have specimens from Franklin county (collected by Mr. J. W. Preston), which are curiously spirally banded with white.

SUB-FAMILY—PLANORBINÆ.

Genus Planorbis—Guett.

Sub-genus Planorbella—Hald.

P. CAMPANULATUS—*Say.*

Quite common, especially in the ponds and lakes of the northern portion of the state.

Sub-genus Helisoma.—Swains.

P. TRIVOLVIS.—*Say.*

Exceedingly common. A depressed, wrinkled form is commonly sent out as *P. glabratus*—an entirely distinct southern species. Two distinct forms occur. One much larger, is found in the lakes and ponds of the northern part of the state and is probably a distinct species.

P. BICARINATUS.—*Say.*

This clearly marked species is common in sluggish waters.

Sub-genus Menetus—H. & A. Ad.

P. EXACUTUS.—*Say.*

Common in ponds, on sticks, etc.

Sub-genus Gyraulus.—Ag.

P. DEFLECTUS.—*Say.*

Occurs sparingly in the northern and eastern portions of the state.

P. DILATATUS.—*Gld.*

This small Planorbis with dilated aperture is probably more common than is now supposed. It is undoubtedly often mistaken for *P. parvus*. Thus far its presence has been ascertained only near Davenport and at Iowa City.

P. ALBUS.—*Muell.*

A few specimens from the northern part of the state, which are in our collection, probably belong to this species.

P. PARVUS.—*Say.*

Very common. Great numbers may often be taken in ponds, if one but has the patience to wait for them to come to the surface to breathe, when they float about very much as Physæ do.

The species of *Limnæa*, *Physa*, and *Planorbis* are still in a state of confusion. There is so much variation in these fresh-water forms that it is practically impossible in some cases to draw specific lines, and it will continue so no doubt until a thorough study is made of the dentition and soft parts.

Genus Segmentina.—Flem.

S. ARMIGERA.—*Say.*

Locally common in ponds throughout the state, Often called *wheatleyi.*

SUB-FAMILY—ANCYLINÆ.

Genus Ancylus—Geof.

A. DIAPHANUS.—*Hald.*

Quite common on sticks, etc., in some of the larger ponds or sloughs.

A. PARALLELUS.—*Hald.*

A few were found near Iowa City with the preceding.

A. RIVULARIS.—*Say.*

Exceedingly common on stones and shells in ponds and streams.

Genus Gundlachia—Pfr.

G. MEEKIANA.—*Stimp.*

While this species has not been found *in* Iowa, Mr. Pilsbry discovered it in a pond near Rock Island. It is very probable that it occurs on the Iowa side of the Mississippi also.

CLASS.—LAMELLIBRANCHIATA.

ORDER.—SIPHONIDA.

FAMILY—CYRENIDÆ.

Genus Sphærium.—Scopoli.

S. SULCATUM.—*Lam.*

Common in small streams and ponds.

S. STRIATINUM.—*Lam.*

Very common on mud and sand in creeks and rivers.

S. SOLIDULUM.—*Pr.*

Formerly very common in the Iowa river, but now largely displaced by the preceding species.

S. STAMINERUM.—*Con.*

The only specimens known to us were found by us near Iowa City. Only three or four specimens were observed. A pretty species for which some forms of *S. sulcatum* are often mistaken.

S. RHOMBOIDEUM.—*Say.*

Not common. It occurs in ponds. One of the prettiest of Sphæriums.

S. FABALIS.—*Prime.*

Rare. Only three specimens were found by us near Iowa City.

S. PARTUMEIUM.—*Say.*

Quite common in ponds near Iowa City where it occurs with the following species. The species does not seem to be as gregarious as most of the Sphæriums.

S. JAYANUM.—*Prime.*

Less common than the preceding. Specimens collected near Des Moines by Mr. C. R. Keyes are in the University Cabinet.

S. TRANSVERSUM.—*Say.*

One of the most common species of the genus. Found in mud in ponds and sluggish streams.

S. SECURIS.—*Prime.*

Found quite commonly in ponds near Iowa City. Mr. L. B. Elliott collected specimens probably of this species, in Jasper County.

S. SPHÆRICUM.—*Anth.*

Found by Prof. Witter near Muscatine.

S. TRUNCATUM.—*Linsl.*

This species was found by us in considerable abundance in a small pond near Iowa City. The pond is isolated and is found at some distance from the river. Over 100 specimens were taken in an area of less than twenty square feet. This, as far as we know, is the only report of its occurence in the state.

Three forms of *Sphærium* distinct from the preceding have been found by us, but in small sets, which render identification very difficult. They may be new species but we reserve them for future comparison and study.

Genus Pisidium.—Pfr.

P. COMPRESSUM.—*Pr.*

Found in a swamp southeast from Iowa City, and also reported from Muscatine by Prof. Witter.

P. ABDITUM.—*Hald.*

Our most common species; found everywhere in rather sluggish waters. A very large form which was found in a small pond near Iowa City, and which was referred to this species may be distinct. Our species of *Pisidium* call for much more careful attention than has been given them thus far. A *Pisidium*, species undetermined, was found by us in the *Lœss* at Iowa City.

ORDER—ASIPHONIDA.

FAMILY—UNIONIDÆ.

Genus Unio.—Retz.

U. ÆSOPUS.—*Green.*

Quite common in the larger streams. Very abundant on sandy bottoms in the Iowa river. It varies in color from a deep brown to a very light straw color.

U. ALATUS.—*Say.*

Very common, particularly on muddy bottoms. The young shells are often distinctly rayed. Nacre usually purple, sometimes white.

U. ANODONTOIDES.—*Lea.*

Very common on sandy bottoms. Both the rayed and the uniform light yellow forms occur. The rays become less distinct with age.

U. CAPAX.—*Green.*

Not common. Found in the larger eastern streams.

U. COCCINEUS.—*Hild.*

Very common in the Iowa river and occurs in most of the larger eastern streams. Beautifully rayed specimens are common near Iowa City. Sometimes pink-nacred.

U. CORNUTUS.—*Barnes.*

Not rare, particularly on mud-covered rock bottoms. Specimens are sometimes found which are almost perfectly smooth. Varies in color from a deep greenish-brown to a straw color.

U. CRASSIDENS.—*Lam.*

Found sparingly in the larger eastern streams.

U. DONACIFORMIS.—*Lea.*

Very common in the larger streams on both sandy and muddy bottoms. Those which are found on sandy bottoms are usually beautifully marked, sometimes pink-nacred, and occasionally uniform in color. This species is commonly known as *U. zigzag*.

U. DORFEUILLIANUS.—*Lea.*

Specimens referable to this species were received by us from the northwestern part of the state. Reported from the Cedar river doubtfully by Prof. Witter.

U. EBENUS.—*Lea.*

Common in the Mississippi river. Rare at Iowa City.

U. ELEGANS.—*Lea.*

Common in the larger streams, particularly among stones on muddy bottoms. Sometimes pink-nacred and varying in coloration as much as *U. donaciformis.*

U. ELLIPSIS.—*Lea.*

Common in all the larger streams. Young shells are rayed.

U. FRAGOSUS.—*Con.*

This interesting species was very common a few years ago in the Iowa river at Iowa City, but it is becoming rare. Over a bushel of fine specimens was taken by us in 1883. Young shells are beautifully marked with green. The epidermis is remarkable for its silky appearance. This species is remarkably constant in its characters.

U. GIBBOSUS.—*Barnes.*

Very common in the Mississippi, Skunk and Shell Rock rivers. White-nacred forms are called *U. arctior.* A rayed specimen in the University Cabinet, which is marked *U. arctior*, is a young *U. rectus.*

U. GRACILIS.—*Barnes.*

Very common in the larger streams on both muddy and sandy bottoms. Usually rayed. Old specimens lose the wing.

U. GRANIFERUS.—*Lea.*

Regarded as distinct from *U verrucosus* by Prof. R. E. Call, and by him reported from Iowa.

U. LACHRYMOSUS.—*Lea.*

Found in the Skunk, Iowa and Mississippi rivers. Also in the northwestern and western parts of the state.

U. LÆVISSIMUS.—*Lea.*

Quite common on muddy bottoms in the larger streams. The epidermis is highly polished. Old specimens are scarcely alate.

U. LIGAMENTINUS.—*Lea.*

Extremely common and very variable. Nacre, white, pink or purple. Rays green or brown, or wanting, when the shells become uniform brown. Forms like *U. upsoni*, which is clearly a synonym, are often found.

U. LUTEOLUS.—*Lam.*

A common species. The form which sometimes occurs in ponds has a thinner shell and is more distinctly rayed. Found in streams or ponds in mud or sand.

U. METANEVER.—*Raf.*

Common, sometimes with pink nacre. More compressed forms are called *U. wardi*, but there is no excuse for the use of this name.

U. MULTIPLICATUS.—*Lea.*

Not common. Found in the Mississippi.

U. MYTILOIDES.—*Raf.*

Reported from the Mississippi by Prof. Call and Prof. Witter.

U. OBLIQUUS.—*Lam.*

Reported from the Mississippi.

U. ORBICULATUS.—*Hild.*

Not common. Found in the Mississippi, Cedar and Iowa rivers. Some forms approach *U. ellipsis* very closely. This is the same as *U. higginsi.*

U. PARVUS.—*Barnes.*

Very common in the Iowa and Cedar rivers and their tributaries. Found in mud and sand. Young specimens are rayed.

U. PLICATUS.—*Le Seuer.*

Very common, especially on muddy bottoms. Found in all of our large streams. Old specimens are very oblique. The adults are black, the young greenish yellow.

U. PRESSUS.—*Lea.*

Found in the Skunk and Shell Rock rivers. Rather rare.

U. PUSTULATUS.—*Lea.*

Not common; in the Mississippi.

U. PUSTULOSUS.—*Lea.*

Very common. Sometimes rayed. Pustules often entirely wanting. Found in all the tributaries of the Mississippi in this state. This is the same as *U. schoolcraftii.* The latter is not even a distinct, constant variety.

U. PYRAMIDATUS.—*Lea.*

Reported from the Mississippi. Scarcely a good species.

U. RECTUS.—*Lam.*

Common in the Mississippi drainage. Nacre often almost white. The young are rayed.

U. RUBIGINOSUS.—*Lea.*

Rather common. Found in the Mississippi, Des Moines, Skunk, Iowa, Cedar and Shell Rock rivers. Specimens from the Skunk river are particularly fine.

U. SECURIS.—*Lea.*

Common in the Mississippi. Rare in the Cedar and Iowa rivers.

U. SOLIDUS.—*Lea.*

Reported from this state. Scarcely a good species.

U. SPATULATUS.—*Lea.*

Very common in portions of the Iowa and Cedar rivers, especially in mud among stones. Nearly all are distinctly rayed.

U. SUBROSTRATUS.—*Say.*

Very common in ponds, creeks, etc., near Iowa City and along the Mississippi. This is commonly called *U. mississippiensis.*

U. TENUISSIMUS.—*Lea.*

Rather rare. We collected probably one hundred specimens at Cedar Rapids and Iowa City. This species shows clearly the insufficiency of the characters of the genera

Unio, *Margaritana*, and *Anodonta*. We have specimens with both cardinal and lateral teeth, others with only the cardinal teeth, and still others with no teeth at all! Individual specimens of this species then possess characters which would make it possible for us to divide the species among *three genera*. This is a much clearer case than that of some Margaritanas and Anodontas which it is difficult to separate.

U. TRIANGULARIS.—*Barnes*.

Rare. Found in the Mississippi and Cedar rivers.

U. TRIGONUS.—*Lea*.

Very common. Nacre sometimes salmon-colored.

U. TUBERCULATUS.—*Barnes*.

Very common in the rivers of the Mississippi drainage, especially on muddy bottoms.

U. UNDULATUS.—*Barnes*.

We believe this to be distinct from *U. plicatus*. It is found more commonly in smaller streams. We have specimens from Benton, Cerro Gordo, Johnson, Linn and Cedar Counties.

U. VENTRICOSUS.—*Barnes*.

Very common and very variable. Often without rays. Sometimes pink-nacred. We believe that *U. occidens* is synonymous with this.

U. VERRUCOSUS.—*Barnes*.

Common in the Mississippi at Davenport. Rare at Iowa City. Nacre deep purple.

Genus Margaritana.—Schum.

M. CALCEOLA.—*Lea*.

Not common. Reported from Delaware County. The same as *M. detoidea*.

M. COMPLANATA.—*Barnes*.

Very common and somewhat variable. Young specimens are extremely compressed. Found principally on muddy bottoms.

M. CONFRAGOSA.—*Say.*

Rare. Reported from Muscatine by Prof. Witter.

M. HILDRETHIANA.—*Lea.*

Exceedingly abundant in the Iowa river at Iowa City. We do not know of its occurence in other portions of the state excepting in the Cedar river near Cedar Rapids, and in the Des Moines. In 1887 we found it very abundant in mud under large slabs of limestone in the Iowa river. Some conception of its abundance may be formed from the fact that we found *324* specimens under a single slab measuring 16x18 inches. We collected several thousand specimens of all sizes. The young are light brown, the adults dark brown.

M. MARGINATA.—*Say.*

Not common. We have seen specimens from the Mississippi, Des Moines, Skunk, Iowa, Cedar and Shell Rock rivers.

M. MONODONTA.—*Say.*

Rare in the Mississippi river at Davenport, Muscatine, etc. Commonly called a *Unio.*

M. RUGOSA.—*Barnes.*

Locally very common in the Cedar and Iowa rivers, especially in mud among stones. This in common with several other species of the same habits is often considered rare where it is quite common. Being found among stones neither dredging nor wading will suffice to reveal their abundance. It is often only when the water is unusually low and they are fully exposed that we ascertain their occurrence in great numbers.

M. UNDULATA.—*Say.*

Specimens probably of this species were received from Davenport.

Genus Anodonta.—Cuvier.

A. CORPULENTA.—*Coop.*

Found in the Mississippi.

A. DECORA.—*Lea.*

Found in mud in sluggish streams. We have specimens from the Cedar and Iowa rivers and from several of their tributaries.

A. GRANDIS.—*Say.*

Specimens referable to this species have been found at several points.

A. OVATA (?)—*Lea.*

Specimens which were referred to this species by Prof. Call were found at Cedar Rapids.

A. PLANA—*Lea.*

Common in the Iowa, Skunk, Cedar and other eastern and central streams.

While in accordance with a common custom we list the five preceding forms as distinct species, we believe that they are mere modifications produced by environment to some extent, though certainly not entirely, for from a series obtained at one time from the same place we have been able to select at least three of the above species (?) which however were connected by an unbroken chain of intermediate forms. They should not even rank as varieties. We list them simply to indicate something of the variation of *A. grandis* (to which we think all are referable), in this state. It is a deplorable fact that many conchologists who rigidly draw the line excluding useless synonyms in some groups of *Mollusca*, still give their imaginations (for it does require a wonderfully vivid imagination to identify some of the Anodontas) full sway when they treat of this genus.

A. EDENTULA.—*Say.*

Not uncommon in the larger streams with *Marg. rugosa Unio spatulatus*, etc.

A. PAVONIA.—*Lea.*

Specimens agreeing in every particular with those received from Ohio and other eastern states, occur commonly at Iowa

City and Cedar Rapids. We believe this to be synonymous with the preceding.

A. FERUSSACIANA—*Lea.*

Found throughout the eastern half of the state, especially in the smaller streams.

A. SALMONIA.—*Lea.*

Specimens referable to this species are not uncommon in ponds and sluggish streams in the northern and central parts of the state.

A. SUBORBICULATA.—*Ray.*

Common in some portions of Muscatine county, as reported by Prof. Witter.

A LIST OF THE COLEOPTERA OF IOWA CITY AND VICINITY.

BY H. F. WICKHAM.

The following list of Coleoptera includes species collected by myself in the last four years; and, as my local collection is quite fully determined, includes all the species known from this locality, except a few *Homalota*, *Cryptophagus* and *Cis*, which I have so far been unable to identify.

For valuable aid in identifying species I am indebted to Messrs. Chas. W. Leng of New York, Fred'k. C. Bowditch of Brookline, and Dr. George H. Horn of Philadelphia.

CICINDELIDÆ.
Cicindela—Linn.
celeripes—Lec.
v. rugifrons—Dej.
v. Lecontei—Hald.
sexguttata—Fab.
purpurea—Oliv.
v. limbalis—Klug.
v. generosa—Dej.
vulgaris—Say.
repanda—Dej.
v. 12 guttata—Dej.
punctulata—Fab.
macra—Lec.

CARABIDÆ.
Omophron—Lat.
americanum—Dej.
tessellatum—Say.
Cychrus—Fab.
stenostomus—Web.
elevatus—Fab.

Nomaretus—Lec.
bilobus—Say.
Carabus—Linn.
sylvosus—Say.
serratus—Say.
vinctus—Web.
Calosoma—Web.
externum—Say.
scrutator—Fab.
willcoxi—Lec.
calidum—Fab.
Elaphrus—Fab.
ruscarius—Say.
Notiophilus—Dum.
æneus—Hbst.
semistriatus—Say.
Pasimachus—Bon.
elongatus—Lec.
Scarites—Fab.
subterraneus—Fab.
Dyschirius—Bon.
æneolus—Lec.
globulosus—Say.
sphæricollis—Say.
Clivina—Lat.
dentipes—Dej.
americana—Dej.
ferrea—Lec.
bipustulata—Fab.
Schizogenius—Putz.
lineolatus—Say.
Panagæus—Latr.
fasciatus—Say.
Bembidium—Lat.
paludosum—Sturm.
inequale—Say.
americanum—Dej.
chalceum—Dej.
lugubre—Lec.
picipes—Kby.
patruele—Dej.
versicolor—Lec.
flavopictum—Mots.
affine—Lec.
quadrimaculatum—Linn
lævigatum—Say.

Tachys—Schaum.
lævus—Say.
nanus—Gyll.
flavicauda—Say.
vivax—Lec.
incurvus—Say.
Patrobus—Dej.
longicornis—Say.
Pterostichus—Bon.
constrictus—Say.
coracinus—Newm.
sculptus—Lec.
permundus—Say.
sayi—Brulle.
lucublandus—Say.
corvinus—Dej.
mutus—Say.
erythropus—Dej.
patruelis—Dej.
femoralis—Kby.
Evarthrus—Lec.
seximpressus—Lec.
Amara—Bon.
avida—Say.
pallipes—Kby.
interstitialis—Dej.
terrestris—Lec.
Loxandrus—Lec.
brevicollis—Lec.
Dicælus—Bon.
dilatatus—Say.
splendidus—Say.
sculptilis—Say.
elongatus—Bon.
Badister—Clairv.
notatus—Hald.
pulchellus—Lec.
Calathus—Bon.
gregarius—Say.
impunctatus—Say.
Platynus—Bon.
sinuatus—Dej.
extensicollis—Say.
decorus—Say.
melanarius—Dej.
cupripennis—Say.
basalis—Lec.

octopunctatus—Fab.
obsoletus—Say.
æruginosus—Dej.
ruficornis—Lec.
lululentus—Lec.
Olisthopus—Dej.
parmatus—Say.
Leptotrachelus—Lat.
dorsalis—Fab.
Casnonia—Lat.
pennsylvanica—Linn.
Galerita—Fab.
janus—Fab.
Lebia—Lat.
grandis—Hentz.
atriventris—Say.
viridis—Say.
pumila—Dej.
viridipennis—Dej.
ornata—Say.
vittata—Fab.
Dromius—Bon.
piceus—Dej.
Callida—Dej.
decora—Fab.
Brachynus—Web.
medius—Harr.
fumans—Fab.
Chlænius—Bon.
erythropus—Germ.
sericeus—Forst.
laticollis—Say.
æstivus—Say.
solitarius—Say.
tricolor—Dej.
pennsylvanicus—Say.
niger—Rand.
purpuricollis—Rand.
Anomoglossus—Chd.
emarginatus—Say.
pusillus—Say.
Brachylobus—Chd.
lithophilus—Say.
Geopinus—Lec.
incrassatus—Dej.
Cratacanthus—Dej.
dubius—Beauv.

Agonoderus—Dej.
pallipes—Fab.
Discoderus—Lec.
parallelus—Hald.
Harpalus—Lat.
erraticus—Say.
calignosus—Fab.
pennsylvanicus—Degeer
v. compar—Lec.
herbivagus—Say.
rufimanus—Lec.
Stenolophus—Dej.
conjunctus—Say.
ochropezus—Say.
Acupalpus—Lat.
carus—Lec.
Tachycellus—Moraw.
atrimedius—Say.
Anisodactylus—Dej.
rusticus—Dej.
nigerrimus—Dej.
baltimorensis—Say.
verticalis—Lec.
lugubris—Dej.
sericeus—Harr.
interstitialis—Say.

HALIPLIDÆ.
Haliplus—Lat.
triopsis—Say.
borealis—Lec.
ruficollis—De G.
Cnemidotus—Er.
12 punctatus—Say.
edentulus—Lec.

DYTISCIDÆ.
Laccophilus—Leach.
maculosus—Germ.
fasciatus—Aubé.
Desmopachria—Bab.
convexa—Aubé.
Bidessus—Sharp.
affinis—Say.
granarius—Aubé.
Cœlambus—Thoms.
nubilus—Lec.
dissimilis—Harr.
Deronectes—Sharp.
catascopium—Say.
Hydroporus—Clairv.
undulatus—Say.
striatopunctatus—Melsh.
modestus—Aubé.
stagnalis—Gyll.
Ilybius—Er.
pleuriticus—Lec.
biguttalus—Germ.
Coptotomus—Say.
interrogatus—Fab.
Copelatus—Er.
glyphicus—Say.
Matus—Aubé.
bicarinatus—Say.
Agabus—Leach.
obtusatus—Say.
æruginosus—Aubé.
occidens—Sharp.
Rhantus—Esch.
bistriatus—Bergst.
Colymbetes—Clairv.
sculptilis—Harr.
Hydaticus—Leach.
piceus—Lec.
Dytiscus—Linn.
fasciventris—Say.
Acilius—Leach.
semisulcatus—Aubé.
mediatus—Say.
Graphoderes—Esch.
liberus—Say.
fasciatocollis—Harr.
Cybister—Curt.
fimbriolatus—Say.

GYRINIDÆ.
Gyrinus—Linn.
dichrous—Lec.
ventralis—Kby.
maculiventris—Lee.
affinis—Aube.
Dineutes—Mac. L.
assmilis—Aube.

HYDROPHILIDÆ.
Helophorus—Fab.
obscurus—Lec.
lineatus—Say.
Hydrochus—Leach.
scabratus—Melsh.
squamifer—Lec.
Hydrophilus—Geoff.
triangularis—Say.
Tropisternus—Sol.
nimbatus—Say.
glaber—Hbst.
Hydrocharis—Lat.
obtusatus—Say.
Berosus—Leach.
peregrinus—Hbst.
striatus—Say.
Chœtarthria—Steph.
pallida—Lec.
Laccobius—Er.
agilis—Rand.
Philhydrus—Sol.
nebulosus—Say.
fuscus—Mots.
perplexus—Lec.
Hydrobius—Leach.
fuscipes—Linn.
subcupreus—Say.
Cercyon—Leach.
prætextatum—Say.
pygmæum—Ill.
Cryptopleurum—Muls.
vagans—Lec.

SILPHIDÆ.
Necrophorus—Fab.
americanus—Oliv.
orbicollis—Say.
marginatus—Fab.
pustulatus—Hersch.
tomentosus—Web.
Silpha—Linn.
surinamensis—Fab.
lapponica—Hbst.
inæqualis—Fab.
noveboracensis—Forst.
americana—Linn.

Choleva—Lat.
clavicornis—Lec.
Liodes—Lat.
basalis—Lec.
Agathidium—Ill.
oniscoides—Beauv.

SCYDMÆNIDÆ.
Scydmænus—Lat.
fossiger—Lec.
basalis—Lec.
Lecontei—Schauff.
salinator—Lec.
Eumicrus—Lap.
grossus—Lec.

PSELAPHIDÆ.
Ctenistes—Reichenb.
piceus—Lec.
Pselaphus—Hbst.
erichsoni—Lec.
Decarthron—Brend.
abnorme—Lec.
Batrisus—Aube.
spretus—Lec.
lineaticollis—Aube.
Rybaxis—Saulcy.
conjuncta—Lec.
Bryaxis—Leach.
rubicunda—Aube.
propinqua—Lec.

STAPHYLINIDÆ.
Falagria—Mann.
dissecta—Er.
venustula—Er.
Hoplandria—Kraatz.
corni—Zimm M S.
Homalota—Mann.
elevata—Fvl. M S.
crenata—Fvl. M S.
Lomæchusa—Grav.
cava—Lec.
Aleochara—Grav.
lata—Grav.
bimaculata—Grav.
Gyrophæna—Mann.
vinula—Grav.
Listotrophus—Perty.
cingulatus—Grav.
Creophilus—Kirby.
villosus—Grav.
Staphylinus—Linn.
vulpinus—Nordm.
tomentosus—Grav.
cinnamopterus—Grav.
violaceus—Grav.
Ocypus—Kirby.
ater—Grav.
Philonthus—Curt.
æneus—Rossi.
debilis—Grav.
thoracicus—Grav.
fusiformis—Melsh.
lomatus—Er.
cyanipennis—Fab.
blandus—Grav.
sordidus—Grav.
cephalotes—Grav.
microphthalmus—Horn.
Actobius—Steph.
pæderoides—Lec.
Xantholinus—Serv.
obsidianus—Melsh.
externus—Fauvel M S.
Diochus—Er.
Schaumii—Kraatz.
Stenus—Lat.
colon—Say.
femoratus—Say.
strangulatus—Casey.
erythropus—Melsh.
vicinus—Casey.
inornatus—Casey.
stygicus—Say.
flavicornis—Er.
reconditus—Casey.
Euæsthetus—Grav.
brevipennis—Casey.
Cryptobium—Grav.
bicolor—Grav.
pallipes—Grav.
Lathrobium—Grav.
angulare—Lec.
brevipenne—Lec.
simile—Lec.
longiusculum—Grav.
collare—Er.
Scopæus—Er.
exiguus—Er.
Stilicus—Lat.
angularis—Lec.
Lithocharis—Er.
corticina—Grav.
confluens—Say.
Pæderus—Grav.
littorarius—Grav.
Sunius—Steph.
prolixus—Er.
binotatus—Say.
longiusculus—Mann.
Tachinus—Grav.
flavipennis—Dej.
pallipes—Grav.
Tachyporus—Grav.
jocosus—Say.
brunneus—Fab.
Erchomus—Mots.
ventriculus—Say.
Conosoma—Kraatz.
pubescens—Payk.
basale—Er.
Boletobius—Leach.
cinctus—Grav.
Mycetoporus—Mann.
americanus—Er.
Oxyporus—Fab.
lepidus—Lec.
Osorius—Lat.
latipes—Grav.
Bledius—Leach.
fumatus—Lec.
analis—Lec.
annularis—Lec.
tau—Lec.
emarginatus—Say.
Platystethus—Mann.
americanus—Er.
Oxytelus—Grav.
sculptus—Grav.
pennsylvanicus—Er.
nitidulus—Grav.
Trogophlæus—Mann.
quadripunctatus—Say.

Apocellus—Say.
sphæricollis—Say.
Geodromicus—Redt.
brunneus—Say.
Lesteva—Lat.
pallipes—Lec.
Olophrum—Er.
rotundicolle—Sahlb.
Anthobium—Leach.
hornii—Fvl.
Glyptoma—Er.
costale—Er.
Eleusis—Lap.
pallidus—Lec.
Micropeplus—Lat.
cribratus—Lec.

Trichopterygidæ.
Limulodes—Matth.
paradoxus—Matth.
Trichopteryx—Kirby.
atomaria—De G.

Scaphidiidæ.
Scaphidium—Oliv.
quadriguttatum—Say.
Scaphisoma—Leach.
suturale—Lec.

Phalacridæ.
Olibrus—Er.
consimilis—Marsh.
nitidus—Melsh.

Corylophidæ.
Sacium—Lec.
fasciatum—Say.
Sericoderus—Steph.
flavidus—Lec.

Coccinellidæ.
Megilla—Muls.
maculata—De G.
Hippodamia—Muls.
convergens—Guer.
13 punctata—Linn.
parenthesis—Say.
Coccinella—Linn.
novemnotata—Hbst.
sanguinea—Linn.
Anatis—Muls.
15 punctata—Oliv.
Psyllobora—Muls.
vigintimaculata—Say.
Chilocorus—Leach.
bivulnerulus—Muls.
Brachyacantha—Chev.
ursina—Fab.
v. 10 pustulata—Melsh.
quadripunctata—Melsh.
Hyperaspis—Chev.
undulata—Say.
signata—Oliv.
proba—Say.
Scymnus—Kug.
americanus—Muls.
hæmorrhous—Lec.

Endomychidæ.
Lycoperdina—Lat.
ferruginea—Lec.
Endomychus—Panz.
biguttatus—Say.

Erotylidæ.
Languria—Lat.
mozardi—Lat.
v. trifasciata—Say.
gracilis—Newm.
Megalodacne—Cr.
fasciata—Fab.
Ischyrus—Lac.
quadripunctatus—Oliv.
Tritoma—Fab.
biguttata—Say.
unicolor—Say.
thoracica—Say.
flavicollis—Lec.

Colydiidæ.
Ditoma—Ill.
quadriguttata—Say.
Cerylon—Lat.
castaneum—Say.
Philothermus—Aube.
glabriculus—Lec.

Cucujidæ.
Silvanus—Lat.
surinamensis—Linn.
planatus—Germ.
imbellis—Lec.
advena—Waltl.
Catogenus—Westw.
rufus—Fab.
Cucujus.—Fab.
clavipes—Fab.
Lœmophlœus—Lap.
biguttatus—Say.
fasciatus—Melsh.
adustus—Lec.
testaceus—Fab.
Brontes—Fab.
dubius—Fab.
Telephanus—Er.
velox—Hald.

Cryptophagidæ.
Tomarus—Lec.
pulchellus—Lec.
Antherophagus—Lat.
ochraceus—Melsh.
Cryptophagus—Hbst.
sp?
Atomaria—Steph.
ephippiata—Zimm.

Mycetophagidæ.
Mycetophagus—Hellw.
punctatus—Say.
flexuosus—Say.
bipustulatus—Melsh.
pluripunctatus—Lec.
Litargus—Er.
tetraspilotus—Lec.
didesmus—Say.
Typhœa—Steph.
fumata—Linn.

Dermestidæ.
Byturus—Lat.
unicolor—Say.

Dermestes—Linn.
marmoratus—Say.
caninus—Germ.
lardarius—Linn.
Attagenus—Lat.
piceus—Oliv.
Trogoderma—Lat.
ornatum—Say.
Anthrenus—Geoff.
musæorum—Linn.
Orphilus—Er.
glabratus—Fab.

HISTERIDÆ.
Hololepta—Payk.
fossularis—Say.
Hister—Linn.
merdarius—Hoffm.
? remotus—Lec.
abbreviatus—Fab.
furtivus—Lec.
bimaculatus—Linn.
sedecimstriatus—Say.
exaratus—Lec.
subrotundus—Say.
carolinus—Payk.
lecontei—Mars.
Paromalus—Er.
bistriatus—Er.
Saprinus—Er.
assimilis—Payk.
fitchii—Mars.
Aeletes—Horn.
politus—Lec.

NITIDULIDÆ.
Cercus—Lat.
abdominalis—Er.
Carpophilus—Steph.
brachypterus—Say.
Conotelus—Er.
obscurus—Er.
Eupurea—Er.
rufa—Say.
ovata—Horn.
labilis—Er.
Nitidula—Fab.
bipustulata—Linn.
rufipes—Linn.
Prometopia—Er.
sexmaculata—Say.
Phenolia—Er.
grossa—Fab.
Omosita—Er.
colon—Linn.
Cryptarcha—Shuck.
ampla—Er.
Ips—Fab.
fasciatus—Oliv.

LATRIDIIDÆ.
Stephostethus—Lec.
liratus—Lec.
Corticaria—Marsh.
grossa—Lec.
americana—Mann.
pumila—Lec.

TROGOSITIDÆ.
Tenebrioides—Pall.
mauritanica—Linn.
marginata—Beauv.
Thymalus—Duft.
fulgidus—Er.
Bactridium—Lec.
ephippigerum—Guer.

BYRRHIDÆ.
Cytilus—Er.
sericeus—Forst.
Byrrhus—Linn.
murinus—Fab.
Limnichus—Lat.
ater—Lec.

PARNIDÆ.
Dryops—Oliv.
fastigiatus—Say.
striatus—Lec.
Elmis—Lat.
vittatus—Melsh.
Stenelmis—Dup.
crenatus—Say.
vittipennis—Zimm

HETEROCERIDÆ.
Heterocerus—Fab.
substriatus—Kies.

DASCYLLIDÆ.
Ptilodactyla—Lat.
serricollis—Say.
Eucinetus—Germ.
strigosus—Lec.
Scirtes—Ill.
tibialis—Guer.
Cyphon—Payk.
ruficollis—Say.
obscurus—Guer.
variabilis—Thunb.

ELATERIDÆ.
Fornax—Lap.
badius—Melsh.
Alaus—Esch.
oculatus—Linn.
Esthesopus—Esch.
claricollis—Say.
Cryptohypnus.
choris—Say.
pulchellus—Linn.
æstivus—Horn.
Œdostethus—Lec.
femoralis—Lec.
Monocrepidius—Esch.
vespertinus—Fab.
auritus—Hbst.
Elater—Linn.
nigricollis—Hbst.
linteus—Say.
rubricus—Say.
Drasterius—Esch.
elegans—Fab.
Ludius—Lat.
attenuatus—Say.
abruptus—Say.
Agriotes—Esch.
mancus—Say.
Dolopius—Esch.
lateralis—Esch.
Melanotus—Esch.
communis—Gyll.
opacicollis—Lec.

Limonius—Esch.
griseus—Beauv.
Athous—Esch.
acanthus—Say.
cucullatus—Say.
Corymbites—Lat.
cylindriformis.—Hbst.
hieroglyphicus—Say.
Oxygonus—Lec.
obesus—Say.
Asaphes—Kirby.
decoloratus—Say.
memnonius—Hbst.
Melanactes—Lec.
piceus —De G.

THROSCIDÆ.
Drapetes—Redt.
geminatus—Say.
Throscus—Lat.
chevrolatii—Horn.

BUPRESTIDÆ.
Dicerca—Esch.
obscura—Fab.
Anthaxia—Esch.
viridicornis—Say.
Chrysobothris—Esch.
femorata—Fab.
dentipes—Germ.
Acmæodera—Esch.
pulchella—Hbst.
Agrilus—Steph.
arcuatus—Say.
ruficollis—Fab.
v pusillus—Say.
bilineatus—Web.
fallax—Say.
Taphrocerus—Sol.
gracilis Say.
Brachys—Sol.
ovata—Web.
Pachyscelis—Sol.
purpureus—Say.

LAMPYRIDÆ.
Lycostomus—Mots.
lateralis—Melsh.
Calopteron.—Guer.
terminale—Say.
reticulatum—Fab.
Eros—Newm.
aurora—Hbst.
Lucidota—Lap.
atra—Fab.
Ellychnia—Lec.
corrusca—Linn.
Pyropyga—Mots.
nigricans—Say.
Pyractomena—Lec.
angulata—Say.
Photinus—Lap.
pyralis—Linn.
scintillans—Say.
Photuris Lec.
pennsylvanica—De G.
Chauliognathus—Hentz.
pennsylvanicus—De G.
Podabrus—Westw.
rugulosus—Lec.
diadema—Fab.
tomentosus—Say.
lævicollis—Kirby.
Silis—Lat.
percomis—Say.
Telephorus—Schaff.
dentiger—Lec.
carolinus—Fab.
lineola—Fab.
scitulus—Say.
luteicollis—Germ.
bilineatus—Say.
Trypherus—Lec.
latipennis—Germ.
Malthodes—Kies.
exilis—Melsh.

MALACHIDÆ.
Collops—Er.
quadrimaculatus—Fab.
Pseudebeus—Horn.
apicalis—Say.
Attalus—Er.
cincetus—Say.

CLERIDÆ.
Cymatodera—Gray.
bicolor—Say.
inornata—Say.
Trichodes—Hbst.
nuttalli—Kirby.
Clerus—Geoff.
rosmarus—Say.
Thanoclerus—Spin
sanguineus—Say.
Hydnocera—Newm.
longicollis—Ziegl.
Necrobia—Lat.
violacea—Linn.

PTINIDÆ.
Ptinus—Linn.
brunneus—Duft.
quadrimaculatus—Melsh
Hadrobregmus—Thom.
errans—Melsh.
carinatus—Say.
Trypopitys—Redt.
sericeus—Say.
Cœnocara—Thom.
oculata.
Bostrychus—Geoff.
bicornis—Web.
Dinoderus—Steph.
pusillus—Fab.
Lyctus—Fab.
striatus—Melsh.

CUPESIDÆ.
Cupes—Fab.
concolor—Westw.

CIOIDÆ.
Cis—Lat.
fuscipes—Mellie.
Ennearthron—Mellie.
thoracicornis—Ziegl.

LUCANIDÆ.
Lucanus—Linn.
elaphus—Fab.
dama—Thunb.

Ceruchus—Mac. L.
piceus—Web.

SCARABÆIDÆ.
Canthon—Hoffm.
lævis—Drury.
Copris—Geoff.
minutus—Drury.
anaglypticus—Say.
Phanæus—MacL.
carnifex.—Linn.
Onthophagus—Latr.
hecate—Panz.
janus—Panz.
pennsylvanicus—Har.
Pleurophorus—Muls.
cæsus—Panz.
Atænius—Harold.
abditus—Hald.
Dialytes—Harold.
striatulus—Say.
Aphodius—Ill.
fossor—Linn.
fimetarius—Linn.
granarius—Linn.
inquinatus—Hbst.
stercorosus—Melsh.
concavus—Say.
bicolor—Say.
femoralis—Say.
Bolboceras—Kirby.
farctus—Fab.
lazarus—Fab.
Odontæus—Kl.
filicornis—Say.
Geotrupes—Lat.
splendidus—Fab.
opacus—Hald.
Trox—Fab.
tuberculatus—DeG.
unistriatus—Beauv.
sordidus—Lec.
foveicollis—Har.
terrestris—Say.
æqualis—Say.
Hoplia—Ill.
modesta—Germ.
Dichelonycha—Kirby.
elongata—Fab.
Serica—MacL.
vespertina—Gyll.
sericea—Ill.
Lachnosterna—Hope.
longitarsis—Say.
inversa—Horn.
implicita—Horn.
fusca—Froh.
rugosa—Melsh.
crenulata—Froh.
tristis—Fab.
Anomala—Kœppe.
minuta—Burm.
Strigoderma—Burm.
arboricola—Fab.
Pelidnota—MacL.
punctata—Linn.
Cotalpa—Burm.
lanigera—Linn.
Ligyrus—Burm.
relictus—Say.
Aphonus—Say.
tridentatus—Say.
Xyloryctes—Hope.
satyrus—Fab.
Euphoria—Burm.
fulgida—Fab.
inda—Linn.
Cremastochilus—Knoch.
knochii—Lec.
Osmoderma—Lep.
eremicola—Knoch.
Trichius—Fab.
affinis—Gory.

SPONDYLIDÆ.
Parandra—Lat.
brunnea—Fab.

CERAMBYCIDÆ.
Orthosoma—Serv.
brunneum—Forst.
Prionus—Geoff.
imbricornis—Linn.
Chion—Newm.
cinctus—Drury.
Eburia—Serv.
quadrigeminata—Say.
Romaleum—White.
atomarium—Drury.
Elaphidion—Serv.
villosum—Fab.
Molorchus—Fab.
bimaculatus—Say.
Cyllene—Newm.
pictus—Drury.
robiniæ—Forst.
decorus—Oliv.
Calloides—Lec.
nobilis—Say.
Xylotrechus—Chev.
undulatus—Say.
Euderces—Lec.
picipes—Fab.
Acmæops—Lec.
bivittata—Say.
Strangalia—Serv.
famelica—Newm.
luteicornis—Fab.
Typocerus—Lec.
velutinus—Oliv.
sinuatus—Newm.
Leptura—Serv.
rubrica—Say.
proxima—Say.
vittata—Germ.
pubera—Say.
Psenocerus—Lec.
supernotatus—Say.
Goes—Lec.
debilis—Lec.
Plectrodera—Lec.
scalator—Fab.
Acanthoderes—Serv.
decipiens—Hald.
Liopus—Serv.
variegatus—Hald.
alpha—Say.
Dectes—Lec.
spinosus—Say.

Lepturges—Bates.
v. angulatus—Lec.
signatus—Lec.
Hyperplatys—Bates.
aspersus—Say.
Eupogonius—Lec.
subarmatus—Lec.
Saperda—Fab.
calcarata—Say.
candida—Fab.
tridentata—Oliv.
lateralis—Fab.
Mecas—Lec.
inornata—Say.
Oberea—Muls.
schaumii—Lec.
tripunctata—Swed.
v. mandarina—Fab.
Tetraopes—Serv.
canteriator—Drap.
tetraophthalmus—Forst.

Chysomelidæ.
Donacia—Fab.
hirticollis—Kirby.
æqualis—Say.
kirbyi—Lac.
Orsodachna—Lac.
atra—Ahrens.
Syneta—Esch.
ferruginea—Germ.
Anomœa—Lac.
laticlavia—Forst.
Babia—Chev.
quadriguttata—Oliv.
Chlamys—Knoch.
foveolata—Knoch.
Bassareus—Hald.
v. pretiosus—Melsh.
lituratus—Fab.
Cryptocephalus—Geoff.
quadrimaculatus—Say.
guttulatus—Oliv.
leucomelas—Suffr.
venustus—Fab.
v. hamatus—Melsh.
v. cinctipennis—Hald.
v. simplex—Hald
mutabilis—Melsh.
Pachybrachys—Chev.
litigiosus—Suffr.
viduatus—Fab.
tridens—Melsh.
cælatus—Lec.
femoratus—Oliv.
Monachus—Chev.
saponatus—Fab.
Diachus—Lec.
levis—Hald.
Xanthonia—Baly.
10notata—Say.
stevensii—Baly.
Fidia—Baly.
viticida—Walsh.
Adoxus—Kirby.
vitis—Linn.
Chrysochus—Chev.
auratus—Fab.
Paria—Lec.
quadrinotata—Say.
aterrima—Oliv.
canella—Fab.
Graphops—Lec.
curtipennis—Melsh.
Colaspis—Fab.
v. flavida—Say.
prætexta—Say.
puncticollis—Say.
Doryphora—Ill.
clivicollis—Kirby.
10 lineata—Say.
Chrysomela—Linn.
suturalis—Fab.
similis—Rogers.
præcelsis—Rogers.
elegans—Oliv.
scalaris—Lec.
multipunctata—Say.
auripennis—Say.
Plagiodera—Redt.
viridis—Melsh.
Gastroidea—Hope.
polygoni—Linn.
Lina—Meg.
lapponica—Linn.
scripta—Fab.
Phyllodecta—Kirby.
vulgatissima—Linn.
Ceratoma—Chev.
caminea—Fab.
Phyllobrotica—Redt.
discoidea—Fab.
Diabrotica—Chev.
12 punctata—Oliv.
vittata—Fab.
longicornis—Say.
Trirhabda—Lec.
v. canadensis—Kirby.
Adimonia—Leach.
externa—Say.
Galeruca—Geoff.
notata—Fab.
Œdionychis—Lat.
gibbitarsis—Say.
vians—Ill.
thoracica—Fab.
petaurista—Fab.
thyamoides—Cr.
Disonycha—Chev.
alternata—Ill.
triangularis—Say.
collaris—Fab.
Haltica—Geoff.
bimarginata—Say.
chalybea—Ill.
ignita—Ill.
Crepidodera—Chev.
helxines—Linn.
cucumeris—Harr.
Orthaltica—Cr.
copalina—Fab.
Systena—Chev.
hudsonias—Forst.
frontalis—Fab.
marginalis—Ill.
Luperaltica—Cr.
fuscula—Lec.
Phyllotreta—Foud.
sinuata—Steph.
vittata—Fab.
bipustulata—Fab.
Mantura—Steph.
floridana—Cr.

Chætocnema—Steph.
cylindrica—Lec.
parcepunctata—Cr.
confinis—Cr.
Dibolia—Chev.
ærea—Melsh.
Microrhopala—Steph.
excavata—Oliv.
Odontota—Chev.
nervosa—Panz.
Stenispa—Baly.
metallica—Fab.
Cassida—Linn.
nigripes.—Oliv.
bivittata—Say.
Coptocycla—Chev.
aurichalcea—Fab.
purpurata—Boh.
clavata—Fab.

BRUCHIDÆ.
Spermophagus—Sch.
robinæ—Sch.
Bruchus—Linn.
pisi—Linn.

TENEBRIONIDÆ.
Nyctobates—Guer.
pennsylvanica—DeG.
Scotobates—Horn.
calcaratus—Fab.
Xylopinus—Lec.
saperdioides—Oliv.
Tenebrio—Linn.
obscurus—Fab.
tenebrioides—Beauv.
Blapstinus—Lat.
metallicus—Fab.
Diædus—Lec.
punctatus—Lec.
Uloma—Lap.
punctulata—Lec.
Diaperis—Geoff.
hydni—Fab.
Hoplocephala—Lap.
bicornis—Oliv.
Platydema—Lap.
excavatum—Say.
ruficorne—Sturm.
Boletotherus—Cand.
bifurcus—Fab.

CISTELIDÆ.
Hymenorus—Muls.
obscurus—Say.

LAGRIIDÆ.
Arthromacra—Kirby.
ænea—Say.
Statira—Lat.
gagatina—Melsh.

MELANDRYIDÆ.
Penthe—Newm.
pimelia—Fab.
Melandrya—Fab.
striata—Say.
Symphora—Lec.
flavicollis—Hald.
Eustrophus—Ill.
bicolor—Say.
Orchesia—Lat.
castanea—Melsh.
gracilis—Melsh.
Canifa—Lec.
plagiata—Melsh.

ŒDEMERIDÆ.
Oxacis—Lec.
cana—Lec.

MORDELLIDÆ.
Mordella—Linn.
scutellaris—Fab.
octopunctata—Fab.
marginata—Melsh.
oculata—Say.
discoidea—Melsh.
Mordellistena—Costa.
lepidula—Lec.
limbalis—Melsh.
ornata—Melsh.
scapularis—Say.
comata—Lec.
semiusta—Lec.
nigricans—Melsh.
unicolor—Lec.
pubescens—Fab.

ANTHICIDÆ.
Stereopalpus—Lap.
mellyi—Lap.
Corphyra—Say.
pulchra—Lec.
lugubris—Say.
Xylophilus—Lat.
fasciatus—Melsh.
Macratria—Newm.
murina—Fab.
Notoxus—Geoff.
monodon—Fab.
anchora—Hentz.
Anthicus—Payk.
formicarius—Laf.
floralis—Linn.
difficilis—Lec.
cervinus—Laf.
spretus—Lec.
pubescens—Lec.

PYROCHROIDÆ.
Pyrochroa—Geoff.
flabellata—Fab.
Dendroides—Lat.
canadensis—Lat.

MELOIDÆ.
Meloe—Linn.
americanus—Leach.
Nemognatha—Ill.
lutea—Lec.
cribricollis—Lec.
Macrobasis—Lec.
unicolor—Kirby.
Epicauta—Redt.
trichrus—Pall.
vittata—Fab.
cinerea—Forst.
pennsylvanica—De G.

RHIPIPHORIDÆ.
Rhipiphorus—Fab.
limbatus—Fab.
Myodites—Lat.
fasciatus—Say.

RHYNCHITIDÆ.
Eugnamptus—Sch.
angustatus—Hbst.
collaris—Fab.
Rhynchites—Hbst.
bicolor—Fab.

ATTELABIDÆ.
Attelabus—Linn.
nigripes—Lec.
rhois—Boh.

OTIORHYNCHIDÆ.
Epicærus—Sch.
imbricatus—Say.
Anametis—Horn.
grisea—Horn.
Nocheles—Horn.
æqualis—Horn.
Phyxelis—Sch.
rigidus—Say.
Otiorhynchus—Germ.
ovatus—Linn.
Cercopeus—Sch.
chrysorrhœus—Say.
Tanymecus—Sch.
confertus—Gyll.
Aphrastus—Sch.
tæniatus—Gyll.

CURCULIONIDÆ.
Sitones—Sch.
tibialis—Hbst.
Apion—Hbst.
obesum—Smith.
estriatum—Smith.
Phytonomus—Sch.
comptus—Say.
Listronotus—Jek.
caudatus—Say.
latiusculus—Boh.
Macrops—Kirby.
sparsus—Say.
Lixus—Fab.
terminalis—Lec.
mucidus—Lec.
musculus—Say.
macer—Lec.
Dorytomus—Steph.
laticollis—Lec.
Grypidius—Sch.
equiseti—Fab.
Barytychius—Jek.
amœnus—Say.
discoideus—Lec.
Smicronyx—Sch.
ovipennis—Lec.
Phyllotrox—Sch.
ferrugineus—Lec.
Onychylis—Lec.
nigrirostris—Boh
Tanysphyrus—Sch.
lemnæ—Fab.
Bagous—Germ.
obliquus—Lec.
restrictus—Lec.
bituberosus—Lec.
Otidocephalus—Chev.
myrmex—Hbst.
Magdalis—Germ.
pandura—Say.
armicollis—Say.
pallida—Say.
Anthonomus—Germ.
quadrigibbus—Say.
profundus—Lec.
suturalis—Lec.
musculus—Say.
corvulus—Lec.
cratægi—Walsh.
mixtus—Lec.
decipiens—Lec.
Orchestes—Ill.
pallicornis—Say.
ephippiatus—Say.
Elleschus—Steph.
ephippiatus—Say.
Piazorhinus—Sch.
scutellaris—Say.
Gymnetron—Sch.
teter—Fab.
Conotrachelus—Sch.
nenuphar—Hbst.
seniculus—Lec.
cratægi—Walsh.
geminatus—Lec.
anaglypticus—Say.
Rhyssematus—Chev.
lineaticollis—Say.
æqualis—Horn.
Tyloderma—Say.
foveolatum—Say.
æreum—Say.
Cryptorhynchus—Ill.
bisignatus—Say.
tristis—Lec.
Copturus—Sch.
quercus—Say.
Mononychus—Germ
vulpeculus—Fab.
Ceutorhynchus—Germ.
rapæ—Gyll.
zimmermanni—Gyll.
Rhinoncus—Sch.
pericarpius—Linn.
pyrrhopus—Lec.
Baris—Germ.
interstitialis—Say.
Pseudobaris—Lec.
farcta—Lec.
Onychobaris—Lec.
pectorosa—Lec.
Aulobaris—Lec.
ibis—Lec.
Centrinus—Sch.
scutellumalbum—Say.
picumnus—Hbst.
perscitus—Hbst.
rectirostris—Lec.
prolixus—Lec.
Balaninus—Germ.
nasicus—Say.
rectus—Say.

CALANDRIDÆ.
Rhodobænus—Lec.
tredecimpunctatus—Ill.
Sphenophorus—Sch.
ochreus—Lec.
costipennis—Horn.
placidus—Say.
parvulus—Gyll.
Calandra—Clairv.
granaria—Linn.

Dryopthorus—Sch.
corticalis—Say.

SCOLYTIDÆ.
Monarthrum—Kirsch.
mali—Fitch.
Pityophthorus—Eich.
minutissimus—Zimm.
Xyleborus—Eich.
celsus—Eich.

Hylesinus—Fab.
aculeatus—Say.

ANTHRIBIDÆ.
Piezocorynus—Sch.
moestus—Lec.
Cratoparis—Sch.
lunatus—Fab.
Brachytarsus—Sch.
plumbeus—Lec.
variegatus—Say.

NOTES ON THE COLEOPTERA OF THE SOUTHWEST.

By H. F. WICKHAM.

COLLECTING AT LIGHT IN NEW MEXICO.—During the seasons of 1887 and 1888 I have made considerable collections in the southwest, and, among other opportunities for observation, have had occasion to collect at the electric lights in Albuquerque. Situated as this place is, in the fertile valley of the Rio Grande, it gives an opportunity for a wide variety of species to exist, though the absence of all forest trees from the neighborhood naturally reduces the number of lignivorous species, especially *Cerambycidæ*, below what we might expect to find. As some of the results of my work at the lights are of interest it may be worth while to give an account of them. The following captures were made between June 29th and July 12th:

Among the *Cicindelidæ* taken were the following species of *Cicindela*—*C. punctulata* (var. *micans*), *C. sperata*, and *C. lepida*. Of these *C. sperata* was by far the most common, appearing in great numbers while the others were represented only by an occasional specimen. *C. lepida* I found only at lights, never observing it during the day. *C. micans* is common during the day in fields around the city, while *C. sperata* is abundant on the banks of the Rio Grande, half a mile or more distant from the lights.

All these species seemed rather bewildered by the strong light, and quite sluggish, though characterized by wonderful activity and alertness by day. I easily took them by hand, by placing myself between them and the light so as to cast a shadow over them.

The case of *C. sperata* seems to me quite strange, as it is a species which runs in the sunlight on hot days and in its natural habitat is in damp places such as exist along the river. In cloudy or cold weather they retire to their holes and remain there until the sun comes out again. How then does it happen that they are attracted from such a long distance by these lights? *C. 16-punctata* which is common along the river with *C. sperata* in the day-time did not appear at the lights. Possibly *C. sperata* is more sensitive to light than *C. 16-punctata*, and is certainly of stronger flight.

The *Carabidæ* were represented by few species but came in considerable numbers. The most numerous was *Nothopus zabroides* though *Agonoderus lineola*, *A. pallipes*, and *Chlænius solitarius* were not rare. *Discoderus* came occasionally as did also *Bembidium*, but both were scarce.

Dytiscidæ appeared as follows: *Laccophilus mexicanus*, *Cœlambus medialis*, *nubilis*, *Thermonectes basilaris* and *Cybister fimbriolatus*. *Hydrophilus triangularis* was extremely common every night.

The only *Staphylinide* found commonly was a large species of *Bledius* which dwells along the river banks. They came to light in great numbers, climbing up the walls of adjacent buildings. *Dermestes marmoratus* came often, and *Anelastes drurii*, the only *Elaterid* seen was not rare.

Among the *Scarabæidæ* the following species appeared: *Ochodæus biarmatus*, *Lachnosterna fusca*, *L. crinita* and *Thyce squamicollis* rare. *Lachnosternan longitarsus*, *Polyphylla hammondi*, *Cyclocephala immaculata*, a species of *Ligyrus*, and *Aphonus clunalis* were more common. As has been mentioned elsewhere by Dr. Horn, the males of *Polyphylla hammondi* are more abundant than the females.

Cerambycidæ seldom came, the only species I saw being *Prionus pocularis* and *Criocephalus asperatus*. *Chrysomelidæ* were very rare. The *Tenebrionidæ* being in great part wingless were also scarce, though I found two or three *Eleodes suturalis* around the base of one pole on which the globe was set. *Hymenorus* was the sole representative of the *Cistelidæ*, *Oxacis bicolor* of the *Œdemeridæ*. Two or three specimens of *Anthicus biguttulus* were taken by a friend at the same light after I had left Albuquerque.

Macrobasis longicollis was attracted quite frequently, and one night I took sixty-three specimens of *M. atrivittata*, a very fine species. Except on this one occasion I never took more than two or three specimens of *atrivittata* in one evening. I was told that *Pyrota mylabrina* came to light in August but being away was unable to verify the assertion.

In connection with the above a note on the common mode of occurrence of these two species of *Macrobasis* may not be out of place. *M. longicollis* occurs in immense numbers on a species of *Solanum*, almost covering the plant in many cases. On being approached they quickly loosen their hold and drop to the ground and make off at a good rate, seldom flying however. The *Solanum* on which it feeds is the food plant of the notorious "Colorado beetle," *Doryphora decemlineata*, which has adapted itself to the climate of every part of our country where the potato is raised. May not our *Macrobasis* prove a serious pest to that useful vegetable if its cultivation should be attempted on a large scale in the valley of the Rio Grande?

The other *Macrobasis*—*atrivittata*—is found in the same places but much less commonly. Both species feed only in the morning and evening, disappearing during the heat of the day.

As far as my experience went, the *Curculionidæ* were not attracted to light, though I have known them to fly into a lighted room at night in Iowa. The best places to capture all the night-flying species were at the globes in front of private establishments, placed only a few feet above the sidewalk, as, though many things could be seen flying around the high poles at the street corners, only the very large ones fell to the ground.

SPHENOPHORUS VOMERINUS—*Lec.*

While collecting on a sand-bar near the Little Colorado river at Holbrook, Arizona, I noticed the remains of a species of *Sphenophorus* in considerable numbers, and wishing to get a good series of living specimens commenced a search to see where they came from. The strip of sand was covered with bunches of short grass, on the roots of which I thought it probable that the larvæ fed, and so commenced scraping away the sand in the hope of finding specimens which had gone down to deposit eggs. I succeeded in getting a few in this way and took a few more under old logs, but still not enough to account for the number of dead specimens I had seen. After looking for some time I gave up the search for them and turned to some fresh cow droppings in the hope of getting some good *Histeridæ* and *Staphylinidæ*.

But when I turned over the first one I found a small colony of *Sphenophorus* underneath, hiding in the damp sand, where the moisture had soaked through from the dung, or resting in holes excavated in the lower surface of the dropping. They occured only in and under fresh droppings, in a living state. Where the dung was dried, only dead examples of *Sphenophorus* were seen. What could have been their object in thus living in manure, when these species are, so far as known, vegetarian? Was it for the sake of the moisture or for warmth? Or may they under certain circumstances become coprophagous in habit? I never knew any of our eastern species to occur under dung, though they are often found under stones and logs. *Epicærus imbricatus* and *Cleonus frontalis* are often found under dry dung in New Mexico.

CHALCOLEPIDIUS WEBBII.—*Lec.*

This fine species, one of the largest and most beautiful of our *Elateridæ*, is rather rare in collections and not often met with in the field. I took it at two localities during my recent trip—two specimens at Peach Springs, Arizona, and about sixty at The Needles just inside the boundary of Southern California. The first one I took on the wing, the next under the bark of a rotten pine log, while the remainder were found in and about a thicket of willows on the banks of the Colorado river. They particularly affect trees that are somewhat bushy in their growth and at times from three to five of them may be seen resting on the same tree, usually near the top, but occasionally quite close to the ground. Any ordinary shake, such as it is possible to give a tree of from three to five inches in diameter will not dislodge them, therefore it is necessary to climb up and pick them off by hand. Great care must be exercised or the beetle will "snap" itself off the limb, and, catching hold of a twig in its fall, take flight. Should it fall to the ground it is almost impossible to find it unless the exact spot is noted, on account of dense undergrowth, and dead leaves.

Both sexes may be found in the trees during the latter half of the day. I have seen them flying as early as 11 o'clock A. M,, and as late as 6 o'clock P. M. Their flight is rather heavy and slow, usually about six to eight feet above the ground. They may easily be captured with a net when flying, providing that they are in a spot where the undergrowth is not too thick to allow of chasing them.

I took the first specimen on the last day of July and continued to find them as late as the 24th of August, when I left that vicinity. I could find no signs of the larvæ anywhere though I searched for them carefully. There is but little decaying wood at The Needles and they may possibly feed on the roots of the willow trees. Notwithstanding the fact that I found a dead male under the bark of a pine, this cannot be the usual fcod-plant of this species, as no pine grows anywhere in the vicinity where *C. webbii* was most abundant I took two specimens of *Mallodon* and one of *Polyphylla cavifrons* in the same thicket.

Vol. I. No. 2.

BULLETIN

FROM THE

LABORATORIES OF NATURAL HISTORY

OF THE

State University of Iowa.

I. ANATOMY OF THE GORGONIDÆ,
By C. C. Nutting, A. M.

II. THE NATIVE FISHES OF IOWA,
By Seth E. Meek, M. S.

PUBLISHED

BY AUTHORITY OF THE REGENTS.

IOWA CITY, IOWA.
November, 1889.

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LABORATORIES OF NATURAL HISTORY

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IOWA CITY, IOWA.
NOVEMBER, 1889.

Secretary Wm. J. Haddock:

We have pleasure in submitting herewith Bulletin No. 2, from the Laboratories of Natural Science, of the State University of Iowa.

Very respectfully,

THE EDITORS.

NOTE.

The present Bulletin contains papers pertaining to Zoölogy only. The second by Prof. Meek is a contribution to the Natural History of the State, and will be followed hereafter by further notes on the same subject by the same author.

Bulletin No. 3, will probably appear in March, 1890, and will contain papers on New Species of Palæozoic Fossils from this State, Saprophytic Fungi, Land and Fresh Water Mollusca, the Coleoptera of the Northwest, the Grasses of Iowa, and on other topics pertinent to the purpose of this publication.

Editors,
S. Calvin,
T. H. McBride,
C. C. Nutting,
B. Shimek,
H. F. Wickham.

CONTRIBUTION TO THE ANATOMY OF GORGONIDÆ.

WITH OBSERVATIONS ON LIVING SPECIMENS.

By C. C. NUTTING.

INTRODUCTORY.

While engaged in the study of the marine fauna in the vicinity of the Island of Eleuthera, British West Indies, the author became interested in the *Gorgonidæ* which abound in that region. A number of notes and drawings made at that time have been supplemented by a more carefnl study of the Anatomy, and to some extent, the Histology of six typical species of the family Gorgonidæ. The present work embodies, therefore, both observations in the field and work in the laboratory. During the studies of these forms I have been struck with the difficulty of obtaining any recent work on the anatomy of Gorgonidæ that is available to the student who has no access to large libraries.

The following brief account is offered in the hope that it will be of service to such students; it is also hoped that some of the facts are new to science. It has the merit, or demerit, of being original from necessity, as no satisfactory account of the anatomy of this seemingly little studied group could be found.

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Hickson, Sidney J.—"The Structure and Relations of Tubipora."

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Kent, Wm. S.—"On the Calcareous Spicula of the Gorgonaceæ."

Kent, Wm. S.—"On two New Genera of Alcyonoid Corals."

Mosely, H. N.—Report on certain Hydroid, Alcyonian and Madreporian Corals produced during the voyage of "H. M. S. Challenger."

Pouchet & Myévre.—"Contribution a l'Anatomie des Alcyonaires."

Verrill, A. E.—Report on the Anthozoa. Bulletin, Mus. Comp. Zoöl., Vol. XI. No. 1.

Definition of Terms Used in Description of Gorgonidæ.

Zoanthodeme: the whole stock or colony.

Calicle: the cell occupied by an individual polyp. The calicle is *included* when it does not decidedly project above general surface of zoanthodeme, and *exserted* when it does decidedly project above general surface.

Papillæ: the protuberances which fringe the sides of the tentacles.

Gullet: the so called "stomach" of the polyps.

Mesenteries: the eight soft vertical partitions which radiate from gullet wall to body wall of polyps.

Mesenterial filaments: the long, convoluted filaments which extend downward from bottom of gullet into general body cavity.

Cœnenchyma: the general substance of the zoanthodeme outside of the calicles and not including the axis cylinder.

Axis cylinder: the central "sclerobasic" core which branches and traverses the several branches of the zoanthodeme.

Water-vascular canals: the passages which ramify throughout the cœnenchyma and are lined with endothelial cells; the canals are usually divisible into *primary* and *secondary* systems.

Spicules: calcareous bodies of various forms deposited throughout the cœnenchyma, and often in the body walls and tentacles of the polyps.

The names given to the various forms of spicules are taken from Kent's article,[1] "On the Calcareous Spicula of the Gorgonaceæ."

The other terms used are either familiar to students or will be explained in the text.

ZOÖLOGICAL POSITION OF GORGONIDÆ.

Sub-Kingdom CŒLENTERATA: animals with radial symmetry; a common gastro-vascular cavity, but no true stomach; a mouth which is used both for ingestion and egestion.

Class ACTINOZOA: cœlenterates with an œsophageal tube or gullet and gastro-vascular cavity divided by vertical mesenteries; no alternation of generation.

Order ALCYONARIA: actinozoans, in which the polyps possess *eight fringed* tentacles.

Family GORGONIDÆ:[2] "Alcyonaria possessing a compound, adherent polypary; provided with a sclerenchyma of a suberose consistence, disposed after the manner of bark around a sclerobasic axis, which axis assumes the form of a simple stem or ramifying branch."

Sub-Family Gorgoninæ: Gorgonidæ whose common sclerobasic axis is for the most part or entirely flexible, and is either of the consistence of horn, or suberose.

1 "On the Calcareous Spicula of the Gorgonaceæ: their Modification of Form, and the Importance of their Characters as a Basis for Generic and Specific Diagnosis." By Wm. Kent, F. Z. S. &c. Monthly Microscopical Journal, February 1, 1870, p. 76.

2 The definition of Gorgonidæ is that of M. Edwards in his "Histoire Naturelle des Corallaires."

BRIAREUM ASBESTINUM.[1]

ZOANTHODEME fleshy, the cœnenchyma being extremely thick; branches comparatively short and clavate, color pink or purple, fading at the tips of branches; height not more than 15 inches in any of the specimens seen.

Calicles included, with a slightly elevated ring around their openings; apertures round, appearing as dark round dots on surface of the zoanthodeme.

Polyps dark brown when fresh, completely retractile. They project farther from the zoanthodeme when fully expanded than those of any other species examined, and present a fair type of alcyonoid polyps. When expanded,[2] they completely conceal the branches and present what appears to be a solid mass of polyps. The tentacles, eight in number, as is the case with all alcyonoid polyps, are very extensile and mobile, waving constantly when expanded, and presenting a picture of grace and activity. The tips of the tentacles were often observed to pass into the mouth as if carrying food. When the polyp expands after retraction the tips of the tentacles appear to issue from the mouth. This appearance is due to the fact that the tentacles when retracted are enclosed in a sort of sack formed by the body wall; the opening of this sack looks like a mouth and from this the tentacles protrude, tips first.

Each tentacle has a small aperture or pore in the distal end and two rows of papillæ along each side. The individual papilla is movable but apparently not retractile. The surface

1 Identified from memory by Dr. J Walter Fewkes.

2 The best results in killing the polyps expanded were obtained by *suddenly plunging* the *zoanthodeme* with *expanded polyps into fresh water heated as hot as can be borne by the hand.*

A decoction of tobacco was used with some success. This method requires more patience than is usually possessed by naturalists whose time is precious. The decoction was slowly dropped from a pipette into the jar containing the expanded coral. At first only a drop at a time at intervals of fifteen or twenty seconds, can be ventured; after a while the process may be gradually hastened. When the polyps seem to be entirely stupefied, fresh water may be introduced by means of a siphon, and the zoanthodeme thoroughly washed; it may then be passed through several grades of alchohol, say 50, 60, 70, 95 per cent.

of the tentacles is covered with epithelial cells bearing cilia. These latter are difficult to observe even in a living specimen, but their presence was proved by the rapid motion of particles in the water near the surface of the tentacles as well as by the fact that individual epithelial cells when detached, rotated and gyrated much as do ciliated epithelial cells from the mouth of a frog or trachea of a dog.

A transverse section of a tentacle (Pl. I, fig. 8,) reveals the fact that it is tubular in structure being lined with columnar endodermal cells much like those lining the gullet cavity of the polyp, although the latter is ectodermal in origin. The covering of ectodermal cells is well shown in the figure, as well as the less compactly aggregated mesodermal cells (c). Three papillæ are also shown in longitudinal section. The papillæ do not appear to contain central prolongations of the tentacular cavity but seem to be mere projections of mesoderm covered with ectoderm.

A single papilla, when examined in a fresh specimen under a $\frac{1}{5}$ objective, presents the appearance shown in fig. 4. The ectodermal cells are well differentiated and appear clear and somewhat quadrate in form. The mesodermal cells (b) on the contrary, are perfectly spherical and filled with a pigment which gives the brown color to the polyp. Fig. 5 shows one of these mesodermal cells much enlarged. These cells seem very loosely aggregated and act much as the cells of the hydra when pressed between the slide and cover, showing a tendency to separate upon the application of very little pressure.

The mesenterial filaments (Pl. I, fig. 6, d) are long convoluted thread-like structures that hang from the lower end of the gullet, near where the mesenteries are attached. They seem to be free inferiorly, and are said to be concerned in some way with digestion.[1]

1. "The secretions of the coiled and twisted filaments (mesenterial filaments) at the edge of the mesenteries must be regarded as aiding in digestion." Zoölogy. Claus and Sedgwick, p. 224.

These organs will be more fully discussed in connection with another species.

The ova are found attached by short pedicels to the inner edge of that portion of the mesenteries projecting below the gullet. These organs are of a brilliant red color in fresh specimens and are covered with vibratile cilia. They develop into free swimming planulæ as is usual among alcyonarians.

The following extract from my note book may be of interest:

"Spanish Wells, Bahamas, July 2, '88. To-day Philip brought more branches of Alcyonarian No. 1[1] and Porites sp? together in a bucket. A large number of small, oblong red bodies[2] which were mobile and ciliated were found on the surface of *both* species, but much more abundant on the former. They were in several instances seen protruding from the mouths of the *Porites*, and one in this position was watched until it *finally disappeared within the polyp*. Was it a case of invasion or of capture? As said before, these red bodies were much more numerous on the surface of the alcyonarian and could also be seen deep within the tissues of the latter. Each planula . . . was attached to the coral by a byssus-like thread."

This observation is, I believe, unique, and I have nothing to offer in explanation, unless it be the suggestion that the planulæ were seeking for secure places for attachment and found nothing more available than the calicles of the Porites.

A transverse section of a branch (Pl. I, fig. 6) shows that the calicles are inserted so that radii from the central axis would traverse their long diameters. There is no great regularity in the arrangement of the polyps on the zoanthodeme. They are simply thickly implanted over the greater part of the branches and thin out toward the base of the zoanthodeme and, also, in the specimen examined, at the ends of the branches.

The ectodermal investment of the zoanthodeme is continu-

1. Briareum asbestinum.
2. Planulæ of Briareum.

ous with that of the polyps. Homologically, the gullet lining is ectodermal being generally considered the equivalent of the ectodermal covering of the proboscis of a Hydroid, the gullet of the polyp being simply an invaginated proboscis, the mouth being then at the bottom of the gullet.

It may be well to mention, however, that in this work the homological proprieties will be dispensed with so far as the mouth is concerned, and the aperture found on the oral surface and between the bases of the tentacles will be regarded as the mouth.[1] The mouth is not round but oval or oblong, appearing indeed, more like a *slit* when the mouth is shut. It is surrounded by a raised, thickened rim or *lip*.[2]

Although probably identical homologically, the ectodermal investment of the polyp and the lining of the stomach are surprisingly different histologically as is shown in Plate I, fig. 7, a and g. The former is composed of simple nucleated cells of quadrate form, and the latter of cells which seem to assume a somewhat follicular shape when in combination. Indeed the appearance is strongly suggestive of the gastric follicles in the stomach of a frog for instance, and would seem to indicate that the gullet is more than a simple "atrium" as it is called by some authors, and acts as a part of the alimentary apparatus.

In none of the many sections examined, could I make out, with any certainty, the aperture leading from the bottom of the gullet into the body cavity. This aperture, as has been said, is homologically the real mouth and was looked for faithfully, but in vain.

It will be seen by referring to Pl. I, fig. 6, that the gullet is a straight tube when the polyp is expanded, and thrown into various convolutions when the polyp is retracted.

A cross section of the polyp on a level with the gullet will show the relation of the body wall, mesenteries, and gullet. As this is practically the same in all the species studied,

1 "La bouche." Pouchet et Myèvre.

2 "Le levre." Pouchet et Myèvre

it will simplify matters to carefully master the diagrammatic figure, Pl. III, fig. 6. The mesenteries are vertical plates connecting the gullet wall with the body wall. They consist essentially of a plate of mesoderm connecting the mesoderm of gullet with that of body. The eight mesenteries enclose eight spaces called inter-mesenterial spaces which open freely into the general body cavity below and are each continuous with the cavity of a tentacle above. It will be seen that each inter-mesenterial chamber is lined with endodermal cells. This endodermal lining extends upward into each tentacle where the cells assume a somewhat columnar shape. (Pl. I, fig. 8, d.)

Returning to Pl. III, fig. 6, we see that the gullet is the only ectodermal structure found in the cross section. This is due to the invagination by which the gullet is formed.

MUSCULAR SYSTEM. By far the most important muscles in the polyp are the retractor muscles which are in the form of thin plates applied to the ventral side of each mesodermal plate of the mesenteries and thus are situated directly under the endodermal covering of the mesenteries. These muscles are attached to the gullet along its entire length, and extend below it into the body cavity where one edge of the muscle plate is free, and the other is attached to the lining of the calicle which offers resistance against which the muscles act in retracting the polyp.

In the expanded polyp, these muscles can be seen showing through on the sides of the mesenteries and extending upward to between the bases of the tentacles, where each muscle divides into two parts which extend along the adjacent sides of two tentacles, between the bases of which they fork. Each of these branches constitutes a *tentacular muscle*. This latter, then, is continuous with the retractor and each retractor divides to form two tentacular muscles which extend along the adjacent sides of two tentacles. There are therefore, sixteen tentacular muscles, two to each tentacle, one on each side. It will also be seen that each tentacle is acted upon by two retractor muscles by which it is pulled down into an intermesenterial chamber during retraction.

Each tentacular muscle bundle is broken up into fibres which are distributed over a great part of the surface of the tentacles and reach even to the tentacular papillæ, although, as has been said, these latter do not seem to retract during life.

It is by no means easy to state clearly the mechanism of retraction and the relation of the various parts during and after the process. By analyzing the different stages of retraction, we may be able to understand these points.

The tentacles are first shortened and at the same time reduced in diameter. The shortening is effected by the main tentacular muscles, while the lateral fibres constrict the tentacle and force out the water. By this means the bulk and length of each tentacle is much reduced.

Next, the retractor muscles pulling from the bottom of the calicle cause the gullet and polyp wall to sink into the calicle. The gullet is thrown into numerous convulutions and the body wall is flexed upon itself at the edge of the calicle. The tentacles curl upon themselves and now occupy a sort of sack formed by the invaginated body wall which by its elasticity binds them together into a firm bundle. At the bottom of this sack, is the mouth. The retracted polyp is shown in fig. 6, Pl. I.

Sphincter muscle. This is a number of muscle bands which are found on the oral surface of the polyp, and in combination form an octagonal figure around its mouth. Their function is to close the latter.

Gullet muscles are horizontal muscle bands found surrounding the outer portion of the gullet wall. They are found beneath the endodermal investment of the gullet. They do not seem to be merely a portion of the retractor muscles which pass into the gullet walls[1], but a separate set altogether.

1. This is the idea presented by Pouchet and Meyèvre. Speaking of the retractor muscles which they call "muscles longitudinaux," they say: "Un certain nombre de fibres s'écartent un peu, viennent s'étaler en éventail sur la face externe de la paroi de l'estomac, dans sa portion supérieure." Contribution a l'Anatomie des Alcyonaires. Pp. 302, 303.

All these muscles are composed of nucleated non-striated muscle fibers.

Where there are undoubted muscle fibers, one naturally looks for nerve-cells or fibers. They have not been seen in any of my sections of this species. There is evidence that they exist, however, aside from histological evidence. For instance, if one touches the tip of a branch of a large zoanthodeme bearing living polyps expanded, he will find that a wave of *retraction* is started from the point touched and proceeds rapidly down that branch to where it joins other branches, when the wave starts *up* these branches, and finally reaches to the polyps the most remote from the starting-point. The stimulus is conveyed from polyp to polyp and each responds by retracting. The stimulus, furthermore, is evidently conveyed through the mass of the cœnenchyma or else through the ectodermal investment common to polyps and zoanthodeme. Which of these is the true medium, could easily be ascertained by "girdling" a live specimen and then seeing whether or not stimuli could be transferred. It seems not unlikely that the cœnenchyma is traversed by fibres which serve as nerves whether they can be histologically classed as nerve tissues or not.

SPICULES. These are of rather small size, purple, pink or white, and vary considerably in shape. Perhaps the most common form is what Wm. S. Kent calls fusiform tuberculate (Pl. I, figs. 15, 18), but arcuate, bi-, tri-, and quadri-partite spicules are met with (figs. 12, 16, 17, 21, 23), as well as such unsymmetrical forms as the one illustrated in fig. 22.

The most striking characteristic of the spicules of this species, and one which I have not found elsewhere, is the fact that each spicule seems to be composed of two halves divided by a plane passing along the longitudinal axis of the spicule. The halves seem to be opposed to each other by flat faces like the halves of a bean. In fig. 14, Pl. I, the plane of juncture is indicated by a longitudinal line, and in fig. 24 it is indicated by a line passing through the long diameter of the cross section of a spicule. This peculiarity of structure seems to be characteristic of this species, as all the spicules which are properly situated on the slide exhibit it.

The spicules are embedded in the fundamental substance throughout the zoanthodeme below the ectodermal investment, and are always enclosed in an apparently structureless membrane which remains after the spicules have been removed by the action of acids. This investing sac,[1] if such it can be called, not only invests the spicule as a whole but also follows the outline of every projection, be it spine, nodule, or tubercle, which may be upon the surface of the spicule, so that after the spicule is dissolved, we have a perfect mold of its minutest external configuration. There has been some discussion as to whether spicules are purely calcareous masses containing no organic matter within the investing sacs above described, or partially calcareous structures containing organic matter in intimate union with the earthy salts through the whole mass of the spicule. Kölliker holds to the former opinion, while Pouchet and Myèvre maintain the latter.[2] Analogy would seem to indicate the former as the correct view. The proofs given by the defenders of the latter view are not satisfactory. They claim that after prolonged action of acid upon the spicules, there remains a substance which they describe as "une masse de substance organique, transparente, à peine granuleuse, gardant d'une façon tres-reconnaissable la forme du spicule."

Such a substance does, in fact, remain even after the most prolonged immersion in strong acid, but whether it is *organic* or not is another question. The fact is that those spicules which are near the surface of the zoanthodeme dissolve out

1 See further discussion of Spicules, in connection with third species described. (Muricea .

2 "Nos observations faites sur les spicules des deux espèces d'Alcyons, sont absolument opposées à cette manière de voir, et confirment au contraire ce qu'avait annoncé Queket en 1854; que dans les spicules, chaque molécule de matière calcaire est dans un état d'intime union avec la base organique."—Contribution a l'Anatomie des Alcyonaires, p. 292.

entirely, while those near the center will not entirely dissolve even where thin sections of the branch are immersed in a strong solution of the acid. There is no apparent difference between spicules situated in different parts of the zoanthodeme and it therefore seems likely that the action of the acid forms a new chemical compound which arrests the further dissolution of the earthy salts, a result having many parallels in chemical action.

It may also be mentioned that in decalcified sections which I have, spicules may be found presenting every degree of dissolution from apparently entire specimens to those which are completely dissolved away leaving no discernible residue.

Fig. 10, Pl. I, is a representation of two cells, highly magnified, in which a deposition of calcareous salts appears to have commenced; hence, I conclude that these are spicules "in embryo" if I may so speak. A careful study of those cells as well as of the *stellate cells* illustrated in fig. 9, Pl. I, had led me to regard it as extremely probable that the former are derived from the latter before I found that the observation had already been made by Kowalevski.[1]

The derivation of the spicules is therefore mesoblastic.

It is interesting in this connection to note

1st. The calcareous spicula of *Sponges* develop in mesodermal cells.

2d. We have seen that the spicules of *Gorgonidæ* have a similar origin.

3d. That the calcareous spicula in the cutis of the *Holothuroidea*[2] take their origin in mesodermal cells.

4th. That the calcareous plates in the *Echinoidea* and *Astroidea* are mesodermal in origin.

5th. That the entire axial calcareous skeleton of all *Verte-*

1 "In *Sympodium coralloides*, Kowalevsky has shown more completely the derivation of the stellate mesoblast cells from the epiblast. He finds that the calcareous spicula develop in these cells as in the mesoblast cells of sponges." —Comparative Embryology. F. M. Balfour. Vol. I. p. 138.

2 Idem., pp. 456, 457.

brata, is derived from the mesoblastic plates and hence is mesoblastic in origin.

We thus find that the calcareous endoskeleton of all the more prominent groups of animals possessing them, are essentially homologous in origin,[1] being all derived from the mesoblast.

This homology is all the more significant when we consider the widely different structures entering into the skeletons of the groups enumerated.

To return to the question of organic matter in intimate union with the earthy salts in the spicules, it is well to remember that while bone contains much organic matter it is derived from many cells; spicules, on the contrary, seem each to be derived from a single cell within which the deposition commences. Therefore we can not consider the composition of the former as a clue to that of the latter as has sometimes been done.

BASAL SUBSTANCE. This is what is called "*substance fondamentale*" by Pouchet and Myèvre and seems to me to be more correctly thus called than by any of the names, such as cœnenchyma, sarcosome, cœnosome, cœnosarc, etc., which have been applied to it by other writers.[2] As used in this paper, the name signifies the substance which forms the *matrix*, as it were, in which the various histological elements are embedded. It is in fact the mesodermal, structureless, hyaline substance constituting a large proportion of the entire mass.

It is the substance in which the spicules are embedded and through which the water-vascular canals penetrate in their various ramifications. It forms the outer [3] layer of the calicle lining and sends forth the apparently structureless mesoder-

1 An apparent exception to this rule is found in the calcareous skeleton of Millepora and Stylasteridæ which is said to be epiblastic. Idem., p. 144.

2 "Nous appelons de ce nom . . la substance particulière an miliéu de laquelle sont placés on sur laquelle s'appuient tous les éléments anatomiques de l'animal. Elle constitue essentiellement le cœnenchyme de M. Edwards." Pouchet et Myèvre. Contribution a l'Anatomie des Alcyonaires. p. 288.

3 Outer, counting from the center of the calicle.

mal plate of each mesentery. It forms that part of the gullet situated between the ectodermal lining and the endodermal investment. It is transparent and, as mentioned before, apparently structureless, having much the appearance of *formed matter* in cartilaginous tissues. It is but little affected by the action of acids, seems firm and elastic in substance, and contains the cells which elaborate the spicules.

The basal substance answers well to the description of "conjunctive substance" of the lower animals given by Kölliker, who describes conjunctive substances as those pertaining to the tissues which exist between the internal [1] and external epithelium and which are neither muscles nor nerves.[2]

Stellate mesodermal cells. Pl. I, fig. 9. These are the cells directly concerned in the formation of spicules. They bear a general resemblance in form to the *polar cells* found in the gray matter of the spinal cord of vertebrates. The prolongations at the poles seem, in certain cases, to anastomose with those from other cells. I have been unable to entirely satisfy myself as to whether one or several of these cells, contribute to the formation of an individual spicule.

WATER-VASCULAR SYSTEM. This consists of a great number of canals of varicus sizes which ramify throughout the zoanthodeme and serve to place the various polyps in communication and to convey to each individual of the community its share of the common stock of food, which is thus evenly distributed throughout the zoanthodeme.

Primary Canals. These are the large vessels which are directly continuous with the body cavity of the polyps. They are hence lined with endodermal cells. In most species of Gorgonias, these canals form a series of parallel vessels surrounding the axis cylinder, the individual canals being much larger than those which will hereafter be described as *secondary* canals. In this species, however, a cross section of a branch (Pl. I, fig. 6) will reveal the fact that the primary canals

1 More properly endoderm and ectoderm.

2 Icones Histologicæ, p. 93.

are not grouped around the aggregation of spicules which constitute the axis cylinder, but are somewhat evenly distributed throughout the cœnenchyma, thus forming a large series of canals running parallel to the axis of the branch. This arrangement seems to approach that of the Alcyonidæ, with this important difference that the canals in the latter contain continuations of the mesenteries of the polyps, traversing their whole length.[1]

The primary canals contain an external[2] investment of basal substance (mesodermal), and an internal lining of endothelium[3] (endodermal). These endothelial cells are quadrate in form, and an examination of a living specimen will show that they are ciliated. The ciliated cells are the cause of the rapid flow of the water through the water-vascular system. They thus serve the purpose of a heart, although it must be understood that this is an analogical, and by no means a homological resemblance.

The primary canals send off numerous branches which traverse the cœnenchyma in every direction, anastomosing freely. These branches seem also to be lined with endothelial cells and often serve to connect the polyps directly with the main canals.

Secondary Water-vascular Canals. These may be termed the capillaries of the water-vascular system. Indeed the more one studies these vessels the more he is struck with their close resemblance to the real capillaries of vertebrated animals. These vessels are usually minute in size, and are found throughout the cœnenchyma of this species. They occur rather sparingly in the region of the spicular axis in the centre of each branch, and are more profusely distributed

1. Ces cloisons alternent avec les tentacules, les cavités qu'elles limitent se continuent donc supériéurement dans ceux-lá. Inférieurement elles s'ouvrent toutes dans la cavité générale du polype, qui plonge jusque dans la profondeur du zoanthodéme. Pouchet et Myèvre. Contribution a l'Anatomie des Alcyonaires, p. 287.

2. External from axis of canal.

3. See Pl. I, fig. 11.

throughout the region lying between this axis and the surface. In some places they are met with in such profusion as to suggest real plexuses. They connect with the primary canals, wind in a tortuous course among and around the spicules, anastomose freely, and serve the purpose of true capillaries in facilitating the contact of the water-vascular fluid with the living, active cells of the zoanthodeme. The secondary canals are probably without cilia, the water being forced through them by the constant action of the ciliated endothelial cells of the primary canals.

Histologically, these canals present good reasons for considering them homologically capillaries. The figures of capillaries in Gray's Anatomy on page 83, would answer fairly for a representation of the secondary water-vascular canals. The same delicate, transparent tube that is seen in the figure will be found in the coral, and similar nuclei scattered over the surface of the tube. The nuclei, however, are larger and more numerous in the coral than represented in the figure. It is interesting, moreover, to note that these two structures—the secondary water-vascular canals, and the capillaries of the higher animals—are both mesodermal in origin, a fact that still further strengthens the evidence in favor of real homology.

In concluding the description of this species, it may be instructive to give a tabulated statement of the origin of the various parts described.

Ectodermal—The epithelial investment of the zoanthodeme and of the individual polyps; the lining of the gullet.

Mesodermal—The "basal substance" forming the middle plate of each mesentery; the portion of the gullet between the investing endoderm and the lining ectoderm; that portion of the body wall and tentacles of each polyp which is found immediately beneath the ectoderm; the "matrix" of the zoanthodeme; and the wall of each calicle beneath the endoderm; the spicules; stellate mesodermal cells; secondary water-vascular canals; the muscles of the individual polyps.

Endodermal—The lining of the tentacular canal and of each intermesenterial chamber; the lining of the gastro-vascular space, or of interior of calicle; the lining of the primary water-vascular canals.

PLEXAURELLA DICHOTOMA.[1]

ZOANTHODEME branching dichotomously, sometimes growing to a height of three or four feet. The branches grow vertically and parallel with each other, giving a peculiarly stately appearance to the larger zoanthodemes.

Branches smooth and round, sometimes clavate but not so decidedly so as in *Briareum* and traversed by an axis cylinder of peculiar structure. They are more flexible than in *Briareum* the color being often very nearly that of buckskin, varying from gray to a light brown. The calicles are completely included, their orifices being elongated so as to present the appearance of a short slit rather than a pore as in most Gorgonias. These slits look like small gashes cut haphazard all over the surface of the zoanthodeme, their long axes lying at every possible angle with each other. There is no swelling around the edges of the calicular openings. These openings become oval and finally round as the polyps protrude themselves, and reassume their slit-like appearance as they close over the retreating polyps. The calicles are so inserted into the branches that their longitudinal axes are slightly inclined upwards, so that the mouth of each calicle is somewhat higher than its base. The individual calicle is more elongated than in *Briareum*.

POLYPS completely retractile. When fully expanded they cover the tips, as well as the rest of the branches, as closely as they can crowd. They are very sensitive to any disturbance, the polyps over a large zoanthodeme quickly re-

1 Identified by the author at the Smithsonian Institution. The generic name *Plexaurella* was proposed by Kölliker for a certain section of the old genus *Plexaura*.

tracting when a single branch is touched. The individual polyp is darker in color than the branches. It does not protrude so far from the general surface as in *Briareum*.

The tentacles are very short and blunt, and the tentacular papillæ are reduced to mere warty protuberances, each of which is mobile and contractile. The surfaces of tentacles and papillæ are covered with vibratile cilia.

An examination of Pl. II, fig. 2, will show the appearance of a polyp viewed from above. It will be seen that these tentacles can hardly be of much service in conveying food to the mouth except by means of cilia. In the figure the mesenteries and body wall appear as light markings showing through the oral surface of the polyp.

A side view of an expanded polyp will reveal deep furrows or longitudinal plaitings in the body wall extending down from the points of juncture of the adjacent tentacles. It seems likely that the polyp in retracting, throws the body wall into a series of longitudinal folds and thus lessens its "calibre," as it were.

In retraction, the polyps do not appear to withdraw so far within the calicle as in *Briareum*.

The gullet does not occupy so great a portion of the calicular space as in most other species examined. Its histological characters could not be satisfactorily ascertained. It is a nearly straight tube when the polyp is expanded and is thrown into convolutions when retracted.

The mesenteries are long and their attachments to the calicle occupy meridional lines on the internal surface of the latter. They are much longer in proportion to the size of the polyps and diameter of calicles than those of any other species examined. The histological features of the mesenteries and their attached muscles were better shown in sections of this species than in any other. Fig. 6, Pl. II, is a representation of a portion of a mesentery with the corresponding part of one of the retractor muscles. The muscle is seen to be a plate (a) of parallel muscle fibres, each fibre containing nuclei irregularly distributed along its length. Beneath the muscle is seen the mesodermal plate of the mesentery. This is composed of round cells with large nuclei. On the side of this plate opposite the muscle is a layer of endothelium composed of quadrate cells with small nuclei. We have here a demonstration of most of the points regarding the histological elements of the mesenteries illustrated diagrammatically in fig. 6, Pl. II. The mesodermal plate is seen to be covered on one side by endothelium, and on the other by a muscle plate constituting one of the retractor muscles.

The gastric filaments are attached, as in other species, to the bottom of the gullet where the latter is joined by the retractor muscles. These filaments hang down in many convolutions to the bottom of the calicle. I did not get sections of this species which were favorable for the study of these organs.

The ova were very abundant. They are attached to the inner edge of the mesenteries and seem to be about equally distributed along these organs from a short distance below the bottom of the gullet to the bottom of the calicle. The ova are borne on slender pedicels which seem to spring from the mesodermal plates of the mesenteries.[1]

As is the case in most Cœlenterates, there are no well differentiated ovaries, their function being performed by certain mesoblastic tissues.

The ova are found in groups or bunches as is shown in fig. 5, Pl. II, and several ova may be attached to one pedicel, or perhaps it would be better to say that one pedicel may branch one or more times so as to bear several ova.

These clusters of ova sometimes almost fill the calicle below the gullet, and present a beautiful appearance in sections stained with carmine. In some instances, clusters attached to adjacent mesenteries meet and apparently coalesce to some

1 "Amongst the Actinozoa, the ova are usually developed between the epiblast and the hypoblast in walls of the gastric mesenteries." Comparative Embryology. Balfour, p. 21.

extent, or those attached to opposite mesenteries may meet in the center of the calicle.

The ova, in the specimens examined, seem to have undergone segmentation. No germinal vescicle or dot could be seen, but a well defined peripheral layer of cells was distinguishable. It appears that the segmentation is regular and the stage figured seems to be that of a solid morula which has become differentiated into epiblast and hypoblast by a process of delamination, as is usually the case among ALCYONIDÆ according to Balfour.[1]

Fig. 4, Pl. II, represents a structure found in this species which I am at a loss to interpret correctly; c, represents the point where the retractor muscle, a, joins the bottom of the gullet; b, is a mass of deeply stained tissue in which the outlines of globular bodies can be indistinctly discerned. Scattered through the mass are a number of intensely black dots, the number of which seems to correspond to the number of globular bodies before mentioned.[2] Whether this structure is simply a part of a mesenterial filament or a mass of young ova, I could not determine. The black dots are more intensely black than any nuclei or germinal dots that I have ever before seen. The position of the structure is that usually occupied by ova, as it is situated along the free inner edge of the retractor muscle.

I will add that this structure appears in several sections which I have of the species under consideration, and so is probably not abnormal to the species.

CŒNENCHYMA. Under this head will be described all those structures found outside of the calicles and inside of the general ectodermal investment of the zoanthodeme, with the exception of the axis cylinder.[3]

1 "In the ALCYONIDÆ the segmentation appears always to lead to the formation of a solid morula, which becomes a planula by delamination." Comparative Embryology, p. 138.

2 This is true only in the section figured and not of several others examined.

3 See definition of terms, p. 98.

Spicules. These are all colorless and present some decidedly characteristic forms. They tend to assume bi-, tri- and quadri-partite forms, Pl. II, figs. 14, 13, 15, but perhaps the most strikingly characteristic is the papilio-form spicule (fig. 14), which is more abundant than any other one form.

The spicules are eminently tuberculate. When they are tri- or quadri-partite they appear to be composed of three or four simple spicules with their bases fitted together so that their juncture presents a cruciform mark as seen in figs. 11 and 15.[1] They seldom exhibit any marked departure from a bilateral symmetry as is the case in *Muricea* and *Eunicea*. These tri- and quadri-partite spicules usually present another well marked characteristic in the shape of large tubercles implanted on the surfaces of each part near its base. These quadrate tubercles thus occupy the angles joined by the cross which marks the juncture of the parts. Simple fusiform and double conic spicules are also met with in this species (Pl. II, figs. 12, 16).

Upon focusing down to the center of a large spicule a concentric lamellate structure is seen with dark lines radiating from the center. These latter I am unable to interpret. Fig. 17 very fairly represents the appearance indicated.

The spicules of this species are evenly and profusely distributed throughout the mass of the cœnenchyma (Pl. II, fig. 3). They are quite regular in size and do not seem to present any tangible difference in different parts of the zoanthodeme. The amount of calcareous matter is decidedly greater in this than in the preceding species, although *P. dichotoma* is much more flexible than *B. asbestinum*.

Basal Substance. This is much less in relative quantity than in *Briareum asbestinum* owing to the preponderance of spicules in the cœnenchyma. As its structure is apparently

1 "Les spicules . . . formés par la réunion de quartre petits cones obtus, juxtaposés par leur base. Le point de réunion laisse deviner des plans de séparation que se manifestent á la lumiére transmise par deux lignes obscures se croisant á angle droit." Contribution a l'Anatomie des Alcyonaires. Pouchet and Myévre (p. 292).

the same in all GORGONIDÆ, it requires no further mention here.

WATER-VASCULAR SYSTEM. This is of the typical Gorgonian character and differs in some respects from that found in *Briarcum.* It is practically the same in all genera possessing a more or less horny axis cylinder.

The Primary Water-vascular canals are a system of parallel tubes grouped regularly around the axis cylinder (See Pl. II, fig. 3, e, e, e). There are eight of these canals shown in a cross section of a branch. They traverse the whole length of each branch in the zoanthodeme from its origin to near the point where the axis cylinder terminates at or near the bottom of one of the terminal calicles. An examination of one of these canals in sections of a fresh specimen will disclose an oval opening having the smaller end of the oval nearest the axis cylinder. The lining of these canals is endothelial and the cells of which it is composed are furnished with large active cilia which are constantly at work pumping water through the canals and their various ramifications. The action of the cilia is continued for some time if the sections are kept in seawater, and the view under the microscope presents a scene of great activity, reminding one of the working of the cilia attached to the gill tentacles of a clam. The current of water thus produced is strong and constant.

There is no direct or immediate connection between the body cavities of the individual polyps, except, perhaps, the terminal ones and these canals. That is, the calicles do not open directly into the canals and there is always a considerable mass of cœnenchyma crowded with spicules between the two. This connection, however, is more or less indirectly effected by means of the

Secondary Water-vascular canals which traverse the cœnenchyma in great numbers, tap the primary canals at irregular but frequent intervals throughout the length of the latter, and wind in tortuous courses among the spicules, anastomosing freely and opening into the gastro-vascular cavities of the polyps. The lining (endodermal) of the calicles is continuous with that of the secondary water-vascular canals, and the latter with that of the primary canals, so that both systems are lined with endothelium.

The circulation through the canals is further aided by the cilia that are profusely distributed over the surfaces of the organs within the general body cavity of the polyps. Examination of the fresh specimens reveals the fact that the calicular lining, the gastric or mesenterial filaments, and even the surfaces of the ova and planulæ, are all densely ciliated and produce active movements of the water within the calicles. In connection with this the fact that the external surfaces of the tentacles are also ciliated, is of interest, showing as it does the efficient manner in which every part, external and internal, of the polyps is constantly bathed in currents of fresh sea-water. Nothing could be more complete and thorough than the means by which this is effected.

Capillaries. By this term I designate the ultimate ramifications of the water-vascular system. These are minute tubes formed by mesodermal cells which penetrate through every part of the zoanthodeme except the axis cylinder. They present the appearance of transparent vessels with walls dotted with nuclei, and are even more tortuous in their course than the secondary canals with which they communicate freely.

It is somewhat difficult to homologize satisfactorily the water-vascular system here described with that of *Briareum*. Perhaps as satisfactory a statement as any would be as follows:

1st. *Briareum* has no homologue of the primary canals of *Plexaurella*.

2d. The canals which I have called *primary* in *Briareum*, are homologically equivalent to the *secondary* canals of *Plexaurella*.

3d. The secondary canals of *Briareum* are equivalent to the capillaries of *Plexaurella*.

In the study of this species I have been profoundly impressed with the completeness of the mechanism by which every living part is constantly bathed in a current of water bearing the various materials utilized by the polyp and other parts of the zoanthodeme in the various life processes. When we consider the large amount of lime, for instance, which must be collected from the water to form the great mass of spicules with which the zoanthodeme is fairly packed, the necessity for this wonderful water-vascular system is evident.

AXIS CYLINDER. This structure, so characteristic of the GORGONIDÆ, presents some features of peculiar interest in this species. It may be described as the organ of support of the zoanthodeme and its several branches. It is an axial framework which sustains the whole fabric and expanding at the base, forms the principal surface of attachment to the rocks or bottom. By its flexibility it permits considerable movement of the branches, and any one who has seen these zoanthodemes gracefully waving in the undulations of the water, will at once be struck by the applicability of the old name *Zoöphyte*. The resemblance of the naked axis cylinder with its spreading base and gracefully curving branches and woody appearance, extending even, as it does in this species, to a simulation of the *grain of wood*, is so striking, even startling, that little blame is to be attached to those early naturalists who claimed that the polyps of these Zoöphytes had simply spread over and encrusted the dead branches of some plant.

The axis cylinder of *P. dichotoma* is composed of two distinct parts (Pl. II, fig. 7), an inner horny core or medullary portion (b) and an outer semi-calcareous cylinder (a). The former is simply a solid core of homogeneous matter which appears much like the basal substance of the cœnenchyma. It is somewhat translucent and appears, when examined under the microscope, to be built up, as it were, of superimposed lamellæ which are quite thin and present markings like wrinkles on their surfaces. To use a somewhat homely simile, the central part of the axis cylinder looks like a pile of very thin gun-wads or a *rouleau*.

The cylinder of semi-calcareous matter which invests the core is composed of two very distinct elements, 1st, calcareous matter deposited in the form of vermiform bodies, and 2d, a fibrous, corneous matrix in which what I have called the vermiform bodies are embedded. The relative proportion of these two elements varies greatly with the size of the entire axis cylinder, the calcareous bodies increasing with the diameter of the axis and greatly preponderating over the matrix in the region of the stolon or root-stalk of the zoanthodeme. In this latter region the axis is almost as hard as flint, harder than the corallum of ordinary so-called "hard corals."

Fig. 9, Pl. II, represents a transverse section of the axis cylinder as it appears under a ¾ inch objective; a, is the horny core or medulla; b, b, b, are cross sections of the vermiform bodies; c, is the core of a branch from the main axis cut a short distance above its origin.

Fig. 8, Pl. II, represents a longitudinal section of a part of a vermiform body and its investing matrix. The calcareous body shows evidence of having been built up by superimposed deposits in the same manner as the core of the cylinder. It seems to be nearly or entirely composed of calcareous matter. The matrix (fig. 9, a) is plainly fibrous in structure, the fibers being parallel to the long axis of the vermiform body.

A transverse section of the vermiform body, highly magnified (fig. 10), shows evidence of having been deposited at successive stages from the inner[1] to the outer side. The striations give the appearance of *stratification*, the inner strata being deposited first and the outer last.

In the fresh specimen a transverse section of the axis will reveal a stellate outline to the cut surface of the semi-calcareous outer cylinder (see fig. 3, f), the points of the star being eight in number and situated between the inner sides of the primary water-vascular canals.

1 The inner side is the one nearest the horny core of the axis. It is the lower side in the figure.

Mode of formation of the axis cylinder. I have been unable to find the opinion of recent authorities on this matter. Professor Huxley says, "It is in these *Octocoralla* that the form of skeleton which is termed *sclerobase*, which is formed by cornification or calcification of the axial connective tissue of the zoanthodeme, occurs."[1]

Balfour, on the contrary, says, "In the Actinozoa an epiblastic skeleton is exceptional, and according to most authorities absent. Quite recently however Koch has found that the axial branched skeleton of most of the GORGONIDÆ, viz: the *Gorgoninæ* and *Isidinæ*, is separated from the cœnosarc by an epithelium, which he believes to be epiblastic, and to which no doubt the axial skeleton owns its origin."[2]

Colton, in his *Practical Zoölogy*, p. 175, says, "This horny axis is excreted by the walls of these tubes." The tubes here spoken of are the primary water-vascular canals.

We have here a sufficient variety of opinions among authors to show the difficulty of the subject. It seems to me quite probable that each of the above opinions is incorrect, as I have reason to believe that the axis cylinder is *endodermal in origin.* My reasons for this conclusion will be given at length in connection with a description of *Muricea* on page 132.

In regard to the species at present under consideration, I think it probable that the horny core or medulla is homologous with the horny axis cylinder of typical Gorgonias, and hence is endodermal in origin, and that at least the vermiform bodies of the semi-calcareous cylinder are *mesodermal* in origin.

If we take a small piece of the end of a branch of this species and carefully expose the axis cylinder to its very tip, we shall find that the vermiform bodies disappear altogether some distance below the tip. At the very end there is a soft, translucent knob, shaped somewhat like the end of an ordinary tool handle. This seems to be identical in structure with the tip of the axis in ordinary Gorgonias. By commencing at this

1 "The Anatomy of Invertebrated Animals," p. 143.

2 Comparative Embryology, Vol. I, p. 149.

tip and carefully examining the axis as its recedes from this point, we can get a presumably fair idea of the process of development in its successive stages in time, as this point is the newest or youngest part of the structure under consideration. For some little distance back from the terminal knob the axis seems entirely homogeneous and presents an even surface. Still further back slight wrinkles or longitudinal furrows appear on the surface. These deepen, become more pronounced and increase in number as we trace them backward, and soon we see that there are small deposits of lime in the bottoms of these furrows, appearing as wavy white lines on the dark brown surface of the homogeneous horny core. These deposits increase in size as we go still further backward until we recognize the well defined vermiform calcareous bodies heretofore described.

In other species I have demonstrated to my own satisfaction at least, that the horny core is invested by a layer of *endothelial cells* which presumably secrete the core. As these vermiform bodies seem to be deposited *outside* of this axis and its investment, I conclude that they are *mesodermal* in origin. The fact that the deposit proceeds from the bottom, or inside of these furrows outward in successive strata, as appears likely from examination of fig. 10, Pl. II, is in accord with this theory. A still more significant consideration is the fact that the *mesoderm* is the universally acknowledged seat of enormous deposits of lime in the form of calcareous spicules. The profound homology indicated on page 108, is another *a priori* reason for expecting that the calcareous vermiform bodies are mesodermal in origin.

The calcareous nature of these bodies was demonstrated by their being dissolved out of the fibrous matrix by the action of acids.

MURICEA[1] SP.

ZOANTHODEME profusely branching, the branches again

1 Identified from Kent's description in "On Calcareous Spicula of Gorgonaceæ," p. 84.

dividing pinnately. The entire zoöphyte may be as much as three feet in height and contain hundreds of branches. The pinnate method of branching is sometimes obscured or interrupted by single branches arising on the stem between the bases of opposite pinnæ and growing at right angles to the plane of the latter.

Color of zoanthodeme, a dark dull red, the polyp being brown. Spicules show through from the surface.

The individual branches are round, slender, and often swollen slightly toward the ends, calicles forming small warty prominences of slight elevation. They seem to be rather evenly distributed on the branches called pinnæ, and less densely on the main branches.

The entire zoanthodeme is extremely flexible and waves gracefully with the slightest disturbance of the water.

POLYPS completely retractile, small and decidedly "thick set" or "squat" in appearance when contrasted with those previously described. When expanded, the body has its greatest diameter a short distance above the surface of the zoanthodeme. From this point there is a gentle curve of the profile toward the center as it ascends, until the least diameter is reached just below the bases of the tentacles.

One of the most conspicuous external features of the expanded polyp is the great prominence of the longitudinal ridges and intervening depressions corresponding to the mesenteries and intermesenterial chambers within the body. In some cases the spicules immediately beneath the ectoderm of the zoanthodeme, are seen to invade the polyp walls themselves.

The tentacles resemble in general contour those of *Plexaurella dichotoma*, but are of course absolutely much smaller (see fig. 3, Pl. III). The mouth seems large in proportion to the size of the polyp and is much elongated, a character showing a tendency toward bilateral symmetry.

The gullet is very short and has few convolutions. It is almost entirely hidden by the tentacles when the polyp is retracted, even when the latter is seen in profile (Pl. III, fig. 5) it is much wider than deep.

The mesenteries are small and inconspicuous. They extend from the gullet directly to the calicle walls and attach themselves higher up on these walls than in other species described. They do not seem to extend below this level, hence the lower part of the gastro-vascular space is empty with the exception of an occasional ovum.

The retractor muscles occupy their usual position with reference to the mesenteries. They are small and weak. In this connection it may be well to mention the significant fact that the polyps although able to retract entirely within the calicles, seem to do so slowly and with great difficulty. A zoanthodeme can be plunged into weak alcohol and the polyps killed before they can or will retract, a proceeding that could by no means be successfully accomplished in the case of either of the preceding species. Perhaps these weak retractor muscles are the cause of the inability to retract on the part of the polyps. It would be convenient for the naturalist if other species were affected in a like manner.

The mesenterial filaments are reduced to a minimum. All that can be seen of these structures is an occasional ill-defined mass attached to the mesenteries which can hardly be distinguished from ova. Indeed they may be ova in a very early stage of development. If this is the case the mesenterial filaments are entirely wanting in this species.

The ova are few and these few seem addicted to occupying peculiar positions, for, although they are seen attached in the normal manner to the mesenteries, they are also found on the bottom of calicles a considerable distance below the mesenteries (Pl. III, fig. 5, j), or even in the water-vascular canals which open into the calicles from below. I have been unable to find any pedicels by which these ova are attached as is the case in other species.

CŒNENCHYMA not so thick in proportion to size of axis as in other species described with exception of *Rhipidigorgia*.

The Basal substance offers no peculiar characteristics. It is relatively greater in amount than in *Plexaurella.* The stellate mesodermal cells can not certainly be distinguished, and their function as the point of origin of spicules, is probably taken by some of the quadrate cells, so thickly distributed throughout the mesoderm. Basal substance is always found between the primary water-vascular canals and the axis cylinder.

Spicules rather small and less numerous than in *Briareum asbestinum* and *Plexaurella dichotoma.* They present in a striking degree the features which Kent regards as characteristic of the genus *Muricea.*[1] The peculiarity referred to is shown in figs. 12, 13, 16, 17, Pl. III, where the long blunt spines are seen to be aggregated on one side of the spicule and often are confined to one end. The spines appear to be tubercles greatly elongated with their long axes parallel and implanted on the surface of the spicule so as to form a more or less acute angle with its long axis. The spines seem to lean toward the end of the spicule about which they are clustered.

While the above may be said to be the characteristic form of spicule for this species, a number of others may be found. Many, for instance, are of the fusiform tuberculate (fig. 14), fusiform echinate (figs. 10, 11), or arcuate tuberculate (fig. 19) types. In some cases the spicules appear to be quadri-partite (fig. 18) as in *Plexaurella.* The lack of symmetry is a peculiarity shared only by *Rhipidigorgia flabellum* among the species examined, and the long spines were found nowhere else and therefore seem characteristic.

In color these spicules are a deep purple-red sometimes varying to pink.

In that part of the cœnenchyma immediately surrounding the axis cylinder, the spicules are placed with their long axes

1 "The dominant form of spicula in this genus is coarse echinate unsymmetrical fusiform, having spines or tubercles developed to a much greater extent on one side than on the other." Monthly Microscopical Journal, Feb. 1, 1870, p. 84, and Plate XLI.

parallel to that of the axis cylinder. Throughout the remainder of the cœnenchyma the spicules may occupy almost any position, being placed with their axes at all angles with each other. As before stated the spicules are plainly visible through the ectodermal investment of the zoanthodeme.

Dr. L. W. Andrews, of the State University of Iowa, has very kindly made an examination of the spicules, at my request, in order to ascertain something of their chemical nature. This examination has resulted in some surprising discoveries which are as unexpected as interesting. So far as I have been able to ascertain no competent chemist has heretofore investigated this subject.

The points ascertained were as follows:

1st. The pellicle investing each spicule and covering each prominence on its surface, is an exceedingly thin investment of *silica* or a *silicate*.

Upon placing a few spicules on a slide and applying acetic acid and examining under a microscope, bubbles of gas caused by the dissolution of the calcium carbonate, will be seen issuing from the spicules. These bubbles do not arise from all parts of the spicule but seem to issue from a few definite spots or even from one. Evidently the acid can not act on the surface but must find apertures where the surface is broken. Having found such a point of access, the acid vigorously attacks the calcium carbonate in the interior.

If now a drop of dilute hydrochloric acid be placed on the spicules, an increased energy is added to the evolution of gas. If an individual spicule is carefully watched under a microscope, the acid will be seen to *eat out* the interior of the spicule commencing immediately under the pellicle, the outlines of which now begin to appear following the outline of every tubercle in faint shadowy lines. The interior of the spicule now presents a central dark mass surrounded by a perfectly clear space around which can be seen the delicate outline of the pellicle. This central core is gradually consumed by the acid, with the evolution of bubbles of gas, from the periphery to the center, growing smaller and smaller, until the last vestige disappears with the last bubble of gas, and we see simply the shadowy outlines of the perfectly transparent pellicle, which retains every detail of the original form of the spicule, but will shortly collapse and be nothing but a filmy fragment of silica of extreme tenuity.

This pellicle withstands both boiling in potash and treatment with strong hydrochloric acid. Its chemical properties and appearances under the polariscope show that it is composed either of silica or of some silicate. Dr. Andrews regards it as more likely to be the former.

It is hard to conceive of the entreme tenuity of the pellicle. It is with difficulty that its outlines can be made out with the microscope and its actual weight is so little that the combined weight of all the pellicles investing 1087 m. g. of spicules was not capable of affecting the balances of the scales used in analysis.

2d. The amount of organic matter in the interior of the spicules is not appreciable. This is in accord with the opinion of Kölliker and opposed to that of Pouchet and Myèvre.

Thinking that the spicules cleared by boiling in caustic potash might be unsatisfactory in attempting a solution of this point, I carefully dissected some spicules out of an alcoholic specimen of *Eunicea tourneforti* and then treated them with acid as described above. They were attacked by the acid at definite points, the whole interior was disintegrated and completely disappeared leaving nothing but the pellicle, as was the case with spicules which had been cleaned in potash. Not a trace of any residue could be seen under the microscope inside the siliceous pellicle spoken of.

3d. Calcium carbonate constitutes nearly all of the interior of the spicule. Rough tests show that at least 98 per cent. of the entire spicule is composed of this substance.

4th. Next to calcium carbonate, calcium sulphate enters most largely into the constitution of the spicules.

After treating the spicules with acid, as above described, and allowing the acid to evaporate, it was found that beautiful stellate crystals were deposited on the slide. Upon analysis these crystals proved to be those of calcium sulphate.

In order to avoid any possibility of error on this point, Dr. Andrews kindly made a careful quantitative analysis of the spicules of *Plexaurella dichotoma* for calcium sulphate. These spicules were cleaned by boiling in a platinum capsule, in a solution of pure sodium hydrate prepared from metal entirely free from sulphate. The analysis was then made with the following result:

In 1087 m. g. of the spicules, there was 12.4 m. g. of calcium sulphate, or 1.14 per cent. We find then that these spicules are made up of at least three substances — calcium carbonate, calcium sulphate, and silica or some silicate.

Tests were also made for *fluorine* in spicules of *Muricea*, but no trace of this substance could be found.

It is interesting to know that the color of *fluor spar* (fluoride of calcium) which is so much like that of these spicules is now known to be organic in its nature, being produced by bitumen.[1]

The presence of the siliceous pellicle around the spicule is of peculiar systematic interest. In the sponges, which are now regarded by many authorities as belonging to the CŒLENTERATA, both siliceous and calcareous spicules exist. In the GORGONIDÆ, which seems properly to be regarded as one of the highest groups of the CŒLENTERATA, we find that both siliceous and calcareous substances unite in forming each spicule.

WATER-VASCULAR SYSTEM. The various canals in this species are not so easily grouped as in preceding forms, as they seem to intergrade completely in size.

The Primary canals are not constant in number and differ greatly in size. In cross sections of a branch it is not easy to

1 The purple color of the spicules of many Gorgonias is rapidly dispelled by heat and more slowly by some mounting media such as dammar. It is not superficial but is found thoughout the spicule being evenly distributed like the color of stained glass and no pigment granules can be seen.

distinguish empty calicles from primary canals. The large space in the upper part of fig. 4, Pl. III, for instance, is probably a longitudinal section of a calicle, and the two large spaces below may be sections cut toward one side of the calicle. How this may come about can be readily seen by a reference to fig. 5, Pl. III, which is part of a longitudinal section of a branch. If a section were cut at right angles to the plane of the paper and the axis cylinder, so that the section would traverse the large opening between the calicle on the right and the primary canal (f, f), the line of demarkation between calicular cavity and canal would not be apparent in the section. The connection between the two is so broad in this species that some of the calicles appear to be almost bottomless so far as single sections will show.

However much these canals may differ in size they are all grouped around the axis cylinder and are strictly homologous with the primary water-vascular canals as described in *Plexaurella dichotoma*. They are lined with a well defined endothelial layer which is plainly seen to be continuous with the endothelial calicular lining (fig. 5, d, d). The individual cells of this lining are quadrate in form and have large granular nuclei (fig. 8, d). Observations were not made upon living specimens to ascertain whether these cells were furnished with cilia or not, neither can cilia be discerned in sections of alcoholic specimens. It is reasonable to suppose, however, that they exist, having been demonstrated in many allied forms.

When the endothelial lining is viewed from above, and not in section, it presents a surface much like that of mucous membrane from the higher vertebrates.

The Secondary Water-vascular canals offer no characters by which they may be distinguished from those of other species already described. Their number, however, is less than in *Briareum.* The cells with which they are lined differ in no important particular from those of the primary canals. Being simply continuations of the latter, the lining of these canals is of course endothelial. The gastro-vascular cavity of the polyps, as has been said, opens in many cases directly into the primary canals. Often, however, the connection between the two is effected by means of secondary canals.

The Capillaries are well exhibited in this species. Under a low power of the microscope they appear as rows of granules and are doubtless the homologues of the "petits conduits" described by Pouchet and Myèvre, and admirably illustrated in Pl. IV, fig. 1, of their work.[1] A higher magnifying power reveals the fact that these cells constitute conjointly very fine, transparent tubes which ramify throughout the cœnenchyma and tap the secondary, and perhaps the primary canals, at numerous points.

In the region between the primary canals and the investment of the axis cylinder, these capillaries are particularly numerous, and appear to be generally parallel to each other and to the axis cylinder. In a transverse section of a branch, the capillaries around the axis will be seen in cross section. The walls in alcoholic specimens seem to be collapsed so that no central space can be detected. In this inner part of the cœnenchyma nearest the axis, the peculiar abundance of capillaries is significant, when we consider the great amount of physiological activity probably involved in the secretion of the axis cylinder. In some cases the capillaries can be traced from their origin in the walls of primary canals to the investment of the axis cylinder.

In parts of the cœnenchyma remote from the axis, the capillaries penetrate and anastomose in every direction. They seem quite numerous near the exterior ectodermal investment.

AXIS CYLINDER. In this species the axis cylinder seems to be composed almost entirely of horny matter without the semi-calcareous cylinder found in *Plexaurella dichotoma*. The entire axis in the present species is probably homologous with the horny core or medullary portion of the axis of *P. dichotoma*. It presents the same appearance of having been built

1 Contribution a l'Anatomie des Alcyonaires, Published in "Journal de l'Anatomie et de la Physiologie." No. de mai, 1870.

up of superimposed lamellæ of structureless horny plates (Pl. III, fig. 5, a).

As this species seems a favorable one for demonstrating the origin of the axis cylinder, this subject will now be taken up and the reasons given for the opinion expressed on page 122, to the effect that it is endodermal.

If the tip of a branch of this coral be embedded in celloidin and transverse sections be made across it, it will be found that the bottom of one of the calicles situated near the tip, not necessarily the terminal calicle, will embrace the extreme tip of the axis cylinder of the branch, or else several calicles will open below into a common chamber which contains the tip of the axis. The former case is illustrated semi-diagrammatically in Pl. III, fig. 7. This chamber, whether it is the continuation of a single calicle or common to several calicles, *is lined by a continuation of the endothelium of the calicle*, and this endothelial lining of the calicle envelops the growing tip of the axis cylinder and extends downward as an endodermal investment of the axis cylinder, as illustrated in Pl. III, fig. 7.

This endodermal investment is doubtless the one referred to by Balfour as having been discovered by Koch.[1] Koch, however, believed it to be *epiblastic* in origin, while all the evidence which I have secured from examination of numerous sections, goes to show that it is hypoblastic or endodermal in origin. This investment, moreover, is not furnished by the walls of the water-vascular canals as is the opinion of Colton, there being a considerable layer of mesodermal tissue between the canals and axial investment.

In fig. 5, Pl. III, which represents a longitudinal section of the axis cylinder and the structures on one side of it, we see first the horny core (a) with its superimposed lamellæ, then the fibrous sheath (e) which seems to be of the same nature as the core, but is not lamellate, then the endodermal investment of the axis (b) which is a continuation of b, fig. 7, then comes a layer of mesoderm, (c, c) with its characteristic spic-

1 See page 126 of this Bulletin.

ules, capillaries, etc., and then the endothelial lining of one of the primary water-vascular canals. This lining of the primary canal is seen to be continuous with that of the calicle of the polyp on the right. Hence it appears that the endodermal investment of the axis cylinder and the endodermal lining of the primary canals are homologous but not identical. It seems that the calicular lining of certain polyps extends downward to form the endodermal investment of the axis cylinder, and the calicular lining of other polyps is continuous with the endodermal lining of the primary canals.

The fibrous portion of the axis (fig. 5, e) is not seen near the growing tip of the axis (fig. 7) but is gradually intercalated between the core and the endothelial investment as the branch grows older. It forms the hard "woody" outside part of the axis, preponderating over the core as the axis grows larger, until it forms nearly the whole of the stolon by which the zoanthodeme is attached or rooted.

In fig. 8, Pl. III, we have a greatly magnified view of a cross section of a portion of a branch which may make still more evident the relation of the parts near the tip of a branch: a, is the peripheral edge of the horny core; b, is a portion of the investing endodermal layer of the axis. The individual cells are seen to be somewhat columnar in shape and are considerably larger than those constituting the lining of the water-vascular canals; c, is a portion of the mesodermal basal substance which is seen to be between the investment of the axis, and the cells, d, forming the endothelial lining of the water-vascular canals. These latter cells are quadrate with large nuclei and are considerably smaller than those constituting the investment of the axis.

The extreme tip of the axis is an apparently homogeneous translucent mass of gelatinous consistency. It is embraced, as it were, by the layer of endothelial cells which seem to me to be in all probability the active agents in the secretion of the axis. When a superficial view of these cells can be obtained, they are seen to present a very close resemblance to certain secreting cells, e. g. those of mucous membranes found in vertebrated animals.

Fig. 6, Pl. III, gives a diagrammatic view of a cross section of a polyp, showing the distribution of the products of the different germinal layers the ectoderm, mesoderm, and endoderm, as explained on page 104.

EUNICEA MURICATA.[1]

ZOANTHODEME branching, arborescent, branches without any marked tendency to lie in one plane and more spreading than in *Muricea*. The zoanthodeme may reach a height of as much as three feet. It is of a light brownish or buffy brown color, has a corneous flexible axis and thick cœnenchyma.

Calicles exserted, having very much the general arrangement of those of branching Madrepores (Pl. IV, fig. 1). Indeed the zoanthodeme at large resembles that of *Madrepora alcicornis*, for instance, and I at first mistook fresh specimens of this species for a Madrepore[2] and found out my mistake when I discovered that they were flexible.

The calicles are set thickly over the surface of the branches and are obliquely inserted so that their mouths are higher than their bases (Pl. IV, fig. 6). The mouths of the calicles are bilabiate in a general way, but one lip is usually entire or nearly so, while the other is divided into several lobes. The longitudinal axis of the calicle mouth is, of course, between the lips, and the asymmetrical lips are capable of being closed tightly over the retracted polyp. The lower lip is usually the entire one and is ventral in relation to the polyp. It will thus be seen that while the lips are asymmetrical in relation to each other, they are really indicative of a tendency toward bilaterality on the part of the polyps.

1 Identified from description in Milne Edward's "Histoire Naturelle des Coralliaires," which came to hand while the preceding pages were in press. This identification is also confirmed by the description in Kent's work, "On the Calcareous Spicula of the Gorgonaciæ," p. 86.

2 Dana in his "Zoöphytes" calls a closely related species *Gorgonia madrepora*.

This arrangement, by which two movable lips of an exserted calicle close over the retreating polyp, is one which I have seen nowhere else among GORGONIDÆ.

POLYPS completely retractile. The expanded polyps of this species were not observed. The color is darker than that of the zoanthodeme.

Tentacles long with large papillæ. In retraction, the tentacles are coiled much as in *Briareum* (Pl. V, fig. 4). Commencing at the base each tentacle extends upward, then curves inward and downward until it reaches the oral surface of the polyp, when it bends outward toward its own base and then upward again, the tip being between two other portions of the tentacle to which it belongs.

The papillæ seem to be rather less numerous than in *Briareum*, and larger in proportion to the size of the tentacle (Pl. V, fig. 4, d, d).

The *gullet* is large and much convoluted. Pl. VI, fig. 1, k, shows the convolutions, there being six in the gullet of the specimen figured. The convolutions are more numerous than in any other species studied. Indeed, the gullet is larger in proportion to the size of the polyp. Its histological characters were well defined and offered some features of interest.

The superior histological results are probably due to the fact that separate polyps were removed from the zoanthodeme and embedded and cut by the celloidin method. In this case also it was possible to use alum carmine for staining which often yields better results[1] than borax carmine which was used in all other cases.

A transverse section across the gullet (Pl. V, fig. 2) shows the mesodermal part of the gullet in an unshaded ring, from which radiate the mesenteries, demonstrating the relation of mesenteries to gullet. A longitudinal section of one of the convolutions of the gullet is shown in Pl. V, fig. 3. The interior or ectodermal surface resembles some of the mucous surfaces of the stomach of higher animals. The cells in this region

1 Alum carmine brings out nuclei better than borax carmine.

are transparent and large, with a decided tendency to assume a columnar form. Next to these, we find mesodermal cells with large nuclei (fig. 3, d, d), and on the exterior surface endothelial cells with smaller nuclei.

In this section were found a number of large pear-shaped cells (fig. 3, c, c, c) which resemble *nerve cells*—more particularly the cells of Purkinje found in the cerebellum of many vertebrates. The figure correctly represents the appearance of these cells.

Nerve cells were found around the gullet of an alcyonoid polyp—*Voringia mirabilis*—by Danielssen which are described as follows:

"On the uppermost part of the inner surface of the gullet . . . . there is found on the ventral side, below, or outside of the epithelial layer and between it and the connective tissue layer, adherent, as it were, to the first named, a group of oblong cells containing an extremely large nucleus, with its nucleus body surrounded by a rich protoplasmic substance.

"From this prolonged part, that faces the epithelium, a prolongation springs, which, however, disappears again between the epithelial cells. The other more rounded extremity of the nerve cell does not appear to send out any prolongation. I must consider these large cells as pertaining to the nerve apparatus, and as being unipolar ganglial cells."[1]

The cells which I have figured in Pl. V, fig. 3, c, c, answer to this description in every particular so far as can be made out with the objectives at my disposal; hence I conclude that they are probably nerve cells.

I have been unable to find any mention of nerve cells having been found in GORGONIDÆ by other investigators, although the high degree of specialization in the muscular tissues would lead one to expect to find nerves.

Muscular system. This is more highly specialized than in

1 Norwegian North Atlantic Expedition, 1876–1878. Zoölogy, Alcyonida. By D. C. Danielssen, p. 7 and Plate I, fig. 31.

the other species studied, owing probably to the mobility of the calicle lips.

The retractors are very large and long (Pl. VI, fig. 1, j, j) and are by far the most powerful that I have found in the GORGONIDÆ. In a transverse section of the gullet and mesenteries (Pl. V, fig. 2), these muscles are seen to consist of several layers of fibers. In some sections that I have, the muscles appear to be made up of a number of muscle plates, each composed of many fibres which run parallel to each other and are attached by the edges to the mesentery.

There is another set of muscles in polyps of this species which may serve both to aid in the protraction of the polyps and to close the calicle lips. These muscles seem to be direct continuations of a portion of each retractor which extends from between the bases of the tentacles to the edge of the calicular lip.

There are then eight of these muscles which, for convenience, I shall call *opercular* muscles, the name being suggested by the function which the calicular lips perform.

These opercular muscles are seen in Pl. VI, fig. 1, i, i, and also in Pl. IV, fig. 5 where they are not lettered. It is probable that the polyp in retracting closes the calicle by simply pulling the calicular lips down after it by means of these muscles. It can be easily seen by reference to Pl. III, fig. 2, that the contraction of these muscles when the polyp is fully retracted would raise it toward the calicle mouth and give it a start, as it were, in protraction.

The opercular muscles must not be confounded with the polyp wall which forms a sort of sack in which the tentacles are bundled together when the polyp is retracted, as described in *Briareum*. This wall is formed by the endothelial calicular lining and the ectodermal investment of the zoanthodeme, with probably a mesodermal layer between, meeting at the edge of the calicle mouth and together passing over the *outside* of the retracted tentacles, and encircling their bases. When the polyp is expanded this structure constitutes the polyp wall.

It is indicated in Pl. IV, fig. 5, as a shaded line below end of reference line, a. These shaded lines should be a little nearer the bases of the tentacles.

The tentacular muscles are also extensions of a portion of each retractor as described in *Briareum*.

The polyps in this species are capable of retracting farther within the calicle than in any other studied.

Gastric filaments. In the living specimens, these appear as white, excessively convoluted, and densely ciliated threads, forming a conspicuous object when part of the calicle wall is dissected away. As their name implies they are thought to be concerned in digestion. They appear to be four in number, but they are so contorted and easily broken in alcoholic specimens that it is difficult to count them. Pl. V, fig. 4, represents a longitudinal section of a polyp. The gastric filament (h, h) is seen to be attached to the lower end of the gullet and to extend in a tortuous course down to where the bottom of the calicle should be. Toward the lower end of its course, it appears to break up into a number of branches which have horseshoe-shaped terminations.

Three of these branches with their terminations are shown in Pl. V, fig. 11. It will be seen that each of these horseshoe-shaped terminations has its concavity lined with somewhat columnar cells backed by large nucleated cells, an arrangement somewhat similar to that of the gullet lining. Perhaps these horseshoe-shaped structures may be the organs which secrete digestive fluids; but if we were to judge solely by appearances, the gullet lining, Pl. V, fig. 3, seems to present an appearance more like that of a gastric surface. I am aware, however, that authorities do not consider the gullet as digestive in function.

The ova are very numerous in sections secured from this species. They were found in various stages of development from exceedingly small ova to those which had apparently reached the planula stage. Pl. V, figs. 5, 6, 7, 8, 9, 10, 12, show various ova of this species. In fresh specimens they are white and richly ciliated. They retain the germinal vesicle even after they have reached a considerable size and apparently have undergone complete segmentation, the dot and vesicle being superficial in position.

The ova are found as usual attached to the mesenteries, but are generally quite low down toward the bottom of the calicle, and not up near the gullet as is the case in *Plexaurella dichotoma*. Fig. 7, shows an ovum with three germinal dots and fig. 9, one in which the protoplasmic mass has shrunk away from the vitelline membrane. Fig. 12, shows an ovum which has developed an epiblast and hypoblast, but the germinal vesicle and dot can still be seen.

The pedicels by which the ova are attached to the mesenteries are shorter, as a rule, than those of *Plexaurella dichotoma*.

CŒNENCHYMA. Under this head may be mentioned a peculiar property of this species which I have noticed in no other. If a fresh zoanthodeme is allowed to die in sea-water, the water will soon be colored a deep brownish black. Whether this color is due to some chemical combination or not I do not know. There is certainly no great amount of black pigment in the zoanthodeme. There is, however, a great deal of purple coloring matter in the mass of spicules surrounding the axis cylinder, and if any action of the salt-water in connection with the decomposition of the zoanthodeme could release this color and change it to black, there appears to be a sufficient amount to produce the effect described.

Spicules. These are exceedingly beautiful in this species and are of two well marked forms.

1st. Small echinato-clavate spicules represented in Pl. VII, figs. 2, 5, 10, 20, 22, 25. These form a dense mass immediately under the ectoderm of the zoanthodeme, being closely interlocked by means of the peculiar plates and processes which extend from their basal ends. This "cortical layer," as Kent calls it, invests the entire cœnenchyma and the exserted calicles, reaching even over the surface of the calicular lips. Here, however, they are more thinly distributed in order to permit of the motion of the calicular lips. These spicules are all white, or rather colorless.

2d. Larger tuberculate fusiform spicules which are of two well marked sizes, according to the position which they occupy. The large ones are handsome, symmetrical or arcuate and are among the largest, or rather longest, spicules encountered.[1] They may be either colorless, in which case they occupy a position in the cœnenchyma immediately under the "cortical layer" spoken of above, or of a rich purple color, in which case they are near the axis cylinder. The colorless ones are found in the cœnenchyma of the calicle walls, standing parallel to each other and surrounding the calicle, to which they thus contribute an effective support.[2] Other large colorless spicules are found in various positions underlying the cortical layer in all parts of the branches. Beneath these are a few large purple spicules, the purple color becoming more intense as we pass toward the center of the branch. Around the axis cylinder, there is a thick mass of intensely purple spicules which are generally much smaller than the others of the same shape.[3] They are placed, as a rule, with their long axes parallel to the axis cylinder.

Many of the spicules of this species appear to contain a central cavity, sometimes of considerable extent.

The tubercles on the surfaces of the large spicules, are often quite complicated in form, as is illustrated in fig. 27, Pl. VII. They appear to consist of a short thick shaft or pedicel upon which is mounted an expanded head consisting of several irregular projections arranged around a central disk. These tubercles, or rather the shafts spoken of, appear to contain axial cavities.

1 In some instances they are as much as 2 m m. long.

2 See Pl. IV, fig. 5, f, f.

3 See Pl. IV, fig. 2, b.

The typical spicules of this species are the symmetrical tuberculate fusiform and the echinato-clavate. The other forms figured may be regarded as only occasional.

The basal substance offers no features of particular interest, being the same transparent homogeneous mass heretofore described. There appear to be no typical stellate mesodermal cells, and I was unable to discover the cells in which the spicules have their origin. The only cells found in the mesoderm of the cœnenchyma are quadrate in form having large nuclei.

WATER-VASCULAR SYSTEM. *The Primary canals* are arranged around the axis cylinder in much the same manner as those of *Plexaurella dichotoma*, but are not so constant in number, although the typical number seems to be 16, double as many as are found in *P. dichotoma*, as is represented in Pl. VI, fig. 2.

In fresh specimens these canals appear to be further removed from the axis cylinder than in other species, and thus nearer the bases of the polyps. They were seen to be richly ciliated, the cilia causing rapid currents of water to pass through the canals.

The Secondary Water-vascular canals are large, numerous, and conspicuous.[1] They are given off as branches from the main canals, and ramify throughout the cœnenchyma. They are often seen to form a direct communication between the calicles and primary canals. They penetrate the calicle walls and ramify between the spicules.

The Capillaries resemble in structure those of the species already described. They appear to be particularly numerous immediately under the ectodermal investment of the branches, where they penetrate in great numbers through the minute spaces between the cortical layer of spicules. They are also numerous near the inside of the calicle wall, as if to supply the polyp wall.

AXIS CYLINDER. This offers no important points of difference from that of *Muricea*. There are no vermiform bodies.

1 See Pl. V, fig. 1.

The investing endothelium can be plainly seen under the dissecting microscope. The exact relation of the tip of the axis to the adjacent polyps was not discovered.

Taken all in all, this species seems to me to be the highest in rank of those studied, although I have not indicated this in the position given it in this paper. The exserted calicles, mobile calicular lips, well defined cortical layers of spicules, size and complexity of gullet, specialization of muscular system, and perfection of water-vascular system, all point to this conclusion. It may be that still greater significance should be attached to the fact that in this species alone have I been able to find the peculiar cells which I regard as ganglion cells.

EUNICEA TOURNEFORTI [1] M. E.

ZOANTHODEME branching, the branches having a strong tendency to occupy the same plane. This species does not seem to attain a very great height, at least I have never seen a specimen over twelve or fifteen inches high. The branches are spreading at the base curving outward from a common trunk which bears the stolon, then shooting straight upward parallel to each other and, as has been indicated, all in nearly the same plane. The branches never anastomose, nor do they seem to have a tendency to divide indefinitely as is the case in *Muricea*.

There is a rigidity about the branches that is in marked contrast to those heretofore considered, with the exception, per-

1 Identified from memory by Dr. J. Walter Fewkes. It agrees perfectly with the description of this species in M. Edward's "Histoire Naturelle des Coralliaires." It seems to me however that it differs so widely from *E. muricata* that it should be placed in a separate Genus. Among the most prominent differences are the following: *E. muricata* has retractile polyps with radial symmetry; tentacles without spicules, spicules of two distinct types—comparatively slender tuberculate and echinato-clavate; *E. tourneforti* has non retractile bilaterally symmetrical polyps, tentacles armed with spicules, spicules of three distinct types—the largest being remarkably massive tuberculate and the smallest a cortical layer of spicules without any constant form whatever. These differences appear to be greater than those commonly recognized as specific characters, and therefore of generic rank.

haps, of *Briareum*. The branches are round, and about the size of those of the preceding species.

The color is a dark brown, considerably darker than those heretofore described. Some specimens that I saw, however, were of a light greyish color, but in every other respect they appear to be identical with *Eunicea tourneforti* to which I refer them.

Calicles, exserted, thickly implanted over the surface of the zoanthodeme (Pl. VIII, fig. 1). Each calicle bends somewhat abruptly upward a little beyond the middle, so that part of its exterior wall is vertical and the calicle opens upward (Pl. VIII, fig. 2). The opening of the calicle is not furnished with movable lips as in the preceding species, and is probably never closed, although, of course, it may be filled by the body of the polyp. The top of the calicle is lobed, the lobes corresponding in a general way to the spaces between the tentacles of the polyps. One lobe, usually the outer one is greatly enlarged so that it forms a prominent projection extending upward, affording a useful protection to the polyp.

Very young polyps in this and the preceding species of *Eunicea*, have no distinct calicles but make their appearance on the surface of a branch between the older calicles. It appears that the calicle grows *pari passu* with the young polyp, as was to be expected.

It is interesting in this connection to notice that the new polyps in *Tubipora* appear at first without any trace of the tube so characteristic of this coral, taking their origin from the platforms around the mouths of older polyps, and build up their tubes of agglomerated spicules as they grow.[1]

POLYPS non-retractile, or at least only partially retractile, not being able to withdraw entirely within the zoanthodeme. When fully expanded they stand considerably above the calicles, even above the greatly enlarged calicular lobe. When retracted, or perhaps more properly contracted, they occupy about the position figured in Pl. VIII, fig. 2. The level of the

1 Duncan—"On the Structure and Relations of Tubipora."

top of this polyp will be seen to be below that of the outer calicular lobe. All that the polyps of this species seem to be able to accomplish in the way of retraction is to draw the gullet within the calicle, fold the tips of the tentacles over the mouth and hide behind the outer lobe of the calicle. (See figs. 2 and 7, Pl. VIII.)

As might be expected these polyps, being exposed to greater dangers than those of preceding species on account of being unable to seek the protection of the interior of the calicles, are provided with a means of protection not heretofore encountered in the species described. The tentacles and body walls are provided with an external armor of small spicules and are thus enabled to hold their own in competition with completely retractile forms.

So far as I can ascertain it is a general rule among Alcyonaria, or at least *Alcyonidæ* and *Gorgonidæ*, that the polyps are provided with spicules in direct ratio to their inability to retract within their calicles.

The color of the polyps is a light grey, conspicuously lighter than the general color of zoanthodeme.

The tentacles are short and tapering, the papillæ not so numerous as usual, being reduced to from 5 to 8 on each side of each tentacle near its tip (Pl. VIII, fig. 5). These papillæ are hardly more than knobs and are doubtless much restricted in their movements, if they are mobile, by the spicules which encrust both tentacles and papillæ.

In the figure giving oral view of folded tentacles, Pl. VIII, fig. 3, it will be seen that they are so disposed that the tips of three only are unprotected, the remaining five being neatly tucked away out of sight and presumably out of danger.

In living specimens of this species there is far less motion of the tentacles than in any of the others studied. I also failed to find any indication that the ectodermal investment of the tentacles was ciliated.

The gullet appears to have a larger cavity and fewer convolutions than in other polyps of similar size. This is doubtless due to the fact that the polyp in *E. tourneforti* can not retract so far as the others, hence the gullet is thrown into a less number of folds and the cavity is less obscured by the convolutions.

The gullet partakes of the general curve of the calicle and its contents, as illustrated in fig. 7, Pl. VIII, which represents a longitudinal section of a calicle and polyp. The section is supposed to bisect the enlarged outer lobe of the calicle.

The mesenteries, owing to the peculiar bend in the calicle referred to, are of unequal lengths, those on the ventral side of the polyp being longer than those on the dorsal side. An examination of Pl. VIII, fig. 7, will make this plain. The left hand side of the figure is the ventral side and it will readily be seen that the mesenteries which follow the convexity of the curve of the gullet will be longer than those on the other side. The polyps of this species therefore depart more from a true radial symmetry and approach more nearly a true bilateral symmetry than any others studied.

Indeed, I know of no other polyp among the class Actinozoa that, in an adult state, has its radial symmetry so greatly impaired. The bend in the gullet is so great that a section may cut through some of the gullet convolutions and also make a cross section of the entire gullet of the same polyp thus making a partially longitudinal and partially transverse section of the same polyp. This fact must be borne in mind in order to interpret a section such as is figured in Pl. VIII, fig. 6. The section passes through the upper polyp in the manner just described.

The mesenteries are also somewhat out of their usual position so that in the same section we have longitudinal and transverse sections of mesenteries as is shown in the two right hand polyps in the section figured, Pl. VIII, fig. 6. In the same figure the section cuts across the tentacles of a polyp at l, which do not seem to be connected with the rest of the section. This is their proper position, however, the calicle to which they belong having its base below the level of the section.

The Muscular System is also thrown out of symmetry by the upward bend of the calicle and polyp. The ventral retractor muscles are of course, longer than the dorsal. The retractors are all fairly well developed although the polyps are not strictly retractile. The tentacular muscles are not easy to make out owing to the incrusting layer of spicules on the tentacles. They seem to be arranged much as in *Briareum asbestinum.*

The mesenterial filaments do not differ in any essential particular from those of the preceding species.

Ova were not found in any of the specimens examined. This is the only species in which ova were wanting.

CŒNENCHYMA of about the same thickness as that of the preceding species, a much greater portion, however, being occupied by the

Spicules. These are of at least three distinct kinds:

1st. Very large massive tuberculate spicules. They are by far the heaviest and bulkiest which I have found. They do not agree with any of those figured or described by Kent,[1] and do not at all conform to those which he regards as characteristic of the genus Eunicea.[2] They are often as long as the longest spicules of the preceding species and much thicker, their bulk being many times greater than that of any others studied by me. They are covered with a dense mass of tubercles of various shapes which grade sometimes into spines. They are so thick as to be practically opaque, thus differing from those of other species, all of which are sufficiently thin to permit the transmission of light to a considerable extent. An examination of Pl. IX will help the reader to understand the main features of these remarkable spicules. They are always colorless, appearing white when viewed by direct light.

In the zoanthodeme they occupy the greater part of the cœnenchyma and are usually placed with their long axes parallel to that of the axis cylinder. They are found between

1 "On the Calcareous Spicula of the Gorgonaceæ, etc." Wm. S. Kent.

2 Idem. Pl. XIII, and p. 86.

the primary water-vascular canals and the ectodermal investment of the zoanthodeme.

In cross section these spicules show very plainly a concentric laminate arrangement of the calcareous matter, which seemingly indicates an exogenous mode of growth. The appearance is much like that of the lines of growth in a transverse section of wood. Radiating lines also appear originating at what seems to be an axial cavity and sometimes forking as they pass toward the periphery.

2d. Much smaller fusiform tuberculate spicules like those of *Briareum*. These are purple in color and occupy a definite space around the axis cylinder, and between this and the primary water-vascular canals. They are embedded in a soft mesodermal sheath which surrounds the axis outside of its endodermal investment, and are arranged with their long axes parallel with the axis cylinder. The mesodermal sheath spoken of does not appear to be firmly attached in alcoholic specimens, to either the axis or primary canals. It can easily be separated from both and removed for examination, when it appears as a soft almost gelatinous mass of basal substance in which are embedded a great number of pink or purple spicules lying side by side so closely as almost to fill the mesodermal sheath.

This latter is peculiar in its apparent lack of intimate connection with associated structures, and in this respect presents a character not observed in any other species.

In cross sections many of these spicules exhibit a round axial cavity.

Similar tuberculate fusiform spicules which differ from those around the axis chiefly in being colorless, are found thickly implanted in the walls and tentacles of the polyps. As they ascend the polyp walls they maintain a nearly uniform size, being about as large as the spicules in the mesodermal sheath around the axis cylinder. As they mount upward in the walls of the tentacles they rapidly diminish in size until they become quite minute near the tips of the tentacles. They even extend into the tentacular papillæ where they become extremely minute and lose their tubercles, appearing as simple irregular rod-like bodies. All the spicules in the tentacles occupy a definite portion of the mesoderm so that in a cross section of a tentacle they are seen to occupy a zone immediately inside of the ectoderm. (See Pl. VII, fig. 6, l.)

In the center of each of the small tentacular spicules a well defined dot may be seen, and these dots appear to be precisely like the nuclei of the stellate mesodermal cells soon to be described.

3d. A cortical layer of small irregular spicules found immediately under the ectodermal investment of the zoanthodeme and tentacles. Many of these spicules look like grains of sand under the microscope. They are calcareous, however, and not siliceous, and so are true spicules although they have no regularity of form whatever. They are usually about as long as broad and may have several rounded protuberances projecting from the main body. They form a compact mass embedded in the mesoderm immediately below the ectoderm of the entire zoanthodeme including the polyps. They become smaller toward the tips of the tentacles where they are indistinguishable from spicules of the second type.

Taken as a whole, the spicules of this species offer a greater diversity of size and form than those of any other species of GORGONIDÆ discussed in this paper. They present the largest and most densely tuberculate, as well as the smallest and simplest types. Moreover, this is the only species in which I have found three perfectly distinct types of spicules occupying equally well defined positions in the zoanthodeme.

Basal substance is proportionately limited in quantity owing to the great number of large spicules. In it are seen somewhat sparsely distributed *stellate mesodermal cells*. These are more clearly recognizable than in any other species studied except *Briareum asbestinum*. Upon a cursory examination under the microscope, nothing but the scattered, sharply defined nuclei are seen. Upon closer inspection with a favorable light, the faint outlines of the cell can be made out and also prolongations like the "poles" of ganglion cells. In some of these cells the protoplasmic contents can be seen and the poles appear to contain granular protoplasm. The poles of one cell do not appear to anastomose with those of others. Perhaps the cells are too remote for the connection to be easily traced even if it exists.

These stellate cells do not exhibit any tendency to form linear series as is the case in *Briareum asbestinum*. In some cases they seem to form the point of origin of spicules and, as has been stated, the minute spicules in the tentacles of the polyps contain nuclei-like dots which are indistinguishable optically from the nuclei of the stellate cells of the mesoblast.

WATER-VASCULAR SYSTEM. *The Primary canals* do not appear to be at all constant in number, twelve being about the average, and vary greatly in size. The number evidently increases as the branch grows larger. In sections near the tip only four or five primary canals are seen, while further down from ten to fourteen are found. (See Pl. VIII, fig. 6.)

The Secondary canals in this species offer no characters not heretofore described.

The Capillaries are by no means so numerous as in other species, being largely confined to the region between the primary canals and axis, and that immediately under the ectodermal investment of the zoanthodeme, where they wind around among the cortical layer of spicules.

The nuclei in the walls of the capillaries do not appear to be so numerous as usual.

THE AXIS CYLINDER is practically the same as in the last. The fact of its being surrounded by an easily separable sheath of mesoblast containing vertically arranged spicules, is interesting as an approach to the structure found in *Plexaurella dichotoma* in which the horny axis is surrounded by a sheath in which are embedded a number of calcareous deposits in the form of what I have called "vermiform bodies."

In both *P. dichotoma* and *E. tourneforti* we have a deposition of calcareous salts in a sheath which is more or less adherent to the horny axis. The difference between them is in the *form* in which these salts are deposited. In *P. dichotoma* the deposition is in the form of the vermiform bodies and in *E. tourneforti* it is in the form of spicules.

The ending of the axis cylinder in this species furnishes a typical illustration of the theory which I have advanced as to the endodermal origin of the axis.

In Pl. VIII, fig. 9, we have a sketch made from a dissection now in my possession, of the tip of the axis. It is a correct representation so far as the relation of parts around the axis termination is concerned, the body of the polyp and external outlines of the calicle being diagrammatic.

The axis ends in a rounded boss, behind which is a raised ring at which the mesodermal sheath of spicules ends. The longitudinal lines indicate the flutings made on this soft sheath by the impressions of the primary water-vascular canals.

The tip of the axis is seen to project upward until it is *actually within the calicular cavity of the terminal polyp.*

The endodermal lining of the calicle embraces the terminal boss of the axis and these endodermal cells seem almost certainly to be the ones from which the horny axis is secreted.

I have been unable to ascertain with certainty the significance of the raised ring below the base. It seems probable that it was once the boss and is destined to be flattened out until it constitutes one of the lamellæ of which the axis is composed.

These lamellæ are similar to those found in *Muricea* for instance, and illustrated in Pl. III, fig. 5, a.

If my supposition is correct we can easily account for this laminated appearance by regarding each lamina as having been a boss of soft, almost gelatinous tissue which has been flattened upon the preceding one by the pressure arising from the formation of a new boss above it. This will also account for the fact that the laminæ are thicker near the tip of the axis than further down.

It may be well to add that cross sections of the branch near the tip reveal an investment of the axis which is composed of cells closely resembling those forming the endodermal lining of the calicle; and this investment is separated by considerable mesodermal tissue from the water-vascular canals, as was the case in *Muricea*.

RHIPIDIGORGIA FLABELLUM. *LINN.*[1]

ZOANTHODEME profusely branching; the branches disposed in one plane and giving off numerous branchlets which anastomose wherever they meet. This peculiarity results in the flabellate zoanthodeme suggested by the specific name, as well as by the popular name of *sea-fan*. The anastomosing of the branchlets is carried out to the extent of producing a reticulate structure. (See Pl. X, fig. 1). Ordinarily the main stalks divide into several large branches which may be traced to the periphery of the zoanthodeme as seen in the figure. Sometimes, however, the large branches break up, soon after leaving the main stalk, into numerous anastomosing branchlets which form an approximately uniform reticulation in which the large branches are obliterated. The vertical branches, however, are generally longer than the horizontal. The greatest diameter of the branches is at right angles to the plane of the zoanthodeme.

The two surfaces of the fan differ in certain particulars. The polyps are much more thickly implanted on one side than on the other,[2] and the side on which there are fewer polyps bears a number of short branchlets which are somewhat clavate, curve outward and upward and occupy planes at right angles to the general surface of the zoanthodome.

Sometimes a smaller fan with its branches and reticulations may spring from the main one to which it is attached by one straight edge, its plane being at right angles to the parent fan.

1 Identified from memory by Dr. J. Walter Fewkes.

2 This is usually but not always the case.

The stolon or root stalk is expanded to form a surface by which the zoanthodeme is attached to the bottom or some stationary object.

Color a golden yellow, uniform throughout. Specimens which have been kept for sixteen months in strong alcohol have not perceptibly faded.

Size smaller than that of the red sea-fan which it very closely resembles in structure. The largest specimens which I have seen were not more than two feet in height, while the red form sometimes reaches a height of nearly four feet. The yellow form seems to prefer sandy bottom, while the red is more often found attached to coral rocks and dead coral.

Calicles included, almost globular. (See Pl. X, figs. 5 and 6).

POLYPS dark brown in color, completely retractile, although they often die partially expanded as illustrated in Pl. X, fig. 3. They seem to be quite sluggish, in which respect they resemble those of *Muricea*. The polyps are most numerous on the flat sides of the branches, i. e., the sides within the meshes of the net work at right angles to the general plane of the zoanthodeme. There are also many polyps on the side of the fan which does not bear the numerous curved branchlets.

The tentacles are moderately long, contain few or no spicules, and are furnished with long and prominent papillæ which are larger in proportion to the size of the polyp than those of any other species examined,[1] and present a picture of gracefulness when viewed alive under the microscope.

In retraction the tentacles fold inward and downward and are snugly packed away in the sack formed by the invaginated body wall much as is the case in *Briareum*. The ultimate flexure near the tip is inward and upward so that the tips of the tentacles in the retracted polyp are clustered together immediately above the mouth and point upward. It will thus be seen that each tentacle assumes an S-shaped position when retracted, while those of *Briareum* are *coiled*.

1 The reader must not be misled by fig. 3, Pl. X, which represents a polyp only partially expanded and has the tentacles still incurved.

The *gullet* is shallow, with one to three extensive lateral convolutions. It very closely resembles that of *Briareum*. In both cases the shallowness of the gullet seems to be a necessary consequence of the shallowness of the calicles.

MUSCULAR SYSTEM. *The retractor muscles* are strong and conspicuous. (See Pl. X, fig. 6, g, g). They extend along each mesentery from near the bases of the tentacles to near the bottom of the calicles. The usual *tentacular* muscles are present.

Besides those muscles that have been described in previous species, there appears to be a sort of sphincter muscle which closes the invaginated body wall over the retracted polyp. It will be remembered that in retraction the body wall is flexed upon itself at the edge of the calicular opening so as to form a sack above the gullet, in which the tentacles are folded. The upper end or mouth of this sack would be nearly as large as the calicular opening were it not for this muscle which acts as a purse-string to close the mouth of the sack.

It is interesting to note the contrivances by which the soft parts of the polyps are protected in the several species studied.

In *Briareum asbestinum* the polyp sinks deep within the calicle and the elasticity of the cœnenchyma permits a partial closing of the calicular opening, which leaves a small round pore.

In *Plexaurella dichotoma* the polyp does not sink so deeply into the calicle, but the orifice is closed by the elasticity of the cœnenchyma in such a way as to leave a slit-like aperture.

In *Eunicea muricata* the calicular lips have an opercular action, closing over the retracting polyp much as the lid of the nest of the *trap-door spider* closes over the animal.

In *Eunicea tourneforti* the polyp does not retract, but the tentacles and oral surface are armed with spicules which make them almost as hard as the general surface of the zoanthodeme.

In *Rhipidigorgia flabellum* and probably also in *Muricea*, the calicular openings are wide and the orifice seems to be closed by the peculiar sphincter-like muscle in the walls of the polyps.

Mesenterial filaments could not certainly be distinguished in this species. I think it probable that they are wanting in both *R. flabellum* and the species of *Muricea* studied. If they aid in the process of digestion, as thought by some writers, they do not seem to be essential to that process in GORGONIDÆ, as they are sometimes either entirely wanting, or so rudimentary as probably to be of little utility.

The ova are large and abundant in the species examined. They seem to rest directly on the calicular walls and not to be borne on pedicels as is usually the case.

In some sections that I have the ova appear to be embedded in a mass of cells from the endodermal lining of the calicle; and in others the ova are not in the calicles at all, but are situated in water-vascular canals which lead from the calicles.

Some of the ova in specimens of this species have almost reached the planula stage of development. I have wondered how these planulae escape from the zoanthodeme. It does not seem likely that they could pass out through the aperture at the bottom of the gullet and thence through the mouth as in the hard corals.

In the specimen of *Briareum asbestinum* referred to on page 102, the planulæ could be seen from the outside "deep within" the tissues of the cœnenchyma, which is slightly transparent in this species. They could also be seen in places just under the ectodermal investment of the zoanthodeme, as if they were in some way burrowing out. Might they not find their way to points near the surface by following the water-vascular canals and then break through the ectoderm at those points?

CŒNENCHYMA moderately thick and crowded with cells. In this species and in *Muricea sp.* the cœnenchyma presents an appearance of greater vascularity and more active life-processes than in the others. It contains a greater proportion of living tissues. I should judge that the two species mentioned were also of more rapid and vigorous growth.

The spicules are much smaller than in any other species studied. Their size, compared with the others, may be judged by comparing fig. 8, Pl. X, with the spicules figured on other plates, all of which were drawn to the same scale. The remaining spicules on this plate are much more highly magnified in order to show their characteristics. They are remarkably uniform in size, or, at least in length, and also in color, being of the same bright yellow as the zoanthodeme to which they, of course, impart their color.

The most characteristic shape is the one illustrated in figs. 10, 13, Pl. X, and called "scaphoid" by W. S. Kent. They are unsymmetrical and consist of a somewhat arcuate heavy shaft with four series of compound tubercles surrounding it on its concave and two adjoining sides, leaving the convex side bare. When viewed from the front these scaphoid spicules present the appearance shown in figs. 9 and 11. This species bears many resemblances to *Muricea*, and among them not the least interesting is the fact that they both possess unsymmetrical spicules, although the patterns are quite different.

Another form of spicule found in *R. flabellum* is the "dumb-bell" illustrated in fig. 14, Pl. X, and called by Kent the "Leptogorgian type."

Kent thinks that there is a correspondence between the size of spicules and the thickness of the cœnenchyma in GORGONACEÆ.[1] This theory is not entirely borne out by the examination of the six species considered in this paper. *Briareum asbestinum* has decidedly the thickest cœnenchyma, and *Plexaurella* dichotoma has the next thickest. As regards the size of spicules, they rank 4th and 3d respectively. The largest spicules found were in *Eunicea tourneforti* and the next largest in *Eunicea muricata*. These rank 4th and 3d respectively as regards thickness of cœnenchyma. So we find that the rule does not apply in four out of the six species

1 "On the Calcareous Spicula of the Gorgonaceæ," p. 89.

studied. It is worth while to note, however, that the largest spicules are found in the species having *exserted calicles.* Perhaps a general rule might be stated as follows:

The largest spicules are found in species having exserted calicles, and the smallest spicules are found in the species having included calicles and a thin cœnenchyma.

Basal substance. The cœnenchyma is so full of spicules and cells that there is very little of the basal substance to be seen. The mesodermal cells seem to be oval or quadrate in form, few, if any, typical "stellate mesodermal cells" being visible in my sections of this species.

WATER-VASCULAR SYSTEM. *The Primary canals* are not well differentiated from the secondary. On account of homological considerations, however, I shall consider those canals which immediately surround the axis as primary canals. These vary greatly in size and section (Pl. X, fig. 5), and also in number, which, however, is less than in previous species. The calicles often open directly into primary canals as in *Muricea.* The endothelial lining of both primary and secondary canals seems to be unusually thick as if composed of several layers of cells.

The Secondary Water-vascular canals are not particularly numerous. They often serve to connect calicles with the primary canals, and sometimes go directly from one primary canal to another (figs. 5 and 6, Pl. X). There is less regularity in the arrangement and distribution of both classes in this than in the other species studied.

The Capillaries are exceedingly numerous and are almost equally distributed throughout the cœnenchyma. There seems to be a correspondence between the size of spicules and the relative number of secondary canals and capillaries. Species having large spicules have very numerous secondary canals and comparatively few capillaries; while those having small spicules have few secondary canals and many capillaries. This doubtless is brought about mechanically. Large spicules have large spaces between them and consequently there is room for secondary canals; while minute spicules have little room between them and the interspace can only be penetrated by minute vessels, i. e., capillaries. This relation is true in different parts of the same zoanthodeme in which different sizes of spicules are found.

AXIS CYLINDER. This is peculiar in having a relatively small axial core (Pl. X, fig. 6, b), and a large apparently structureless horny or chitinous investing cylinder. The former presents the laminated structure which in many species constitutes almost the entire axis cylinder, with which it is probably homologous. The latter seems to be the homologue of the structureless horny sheath which forms a thin investment of the axis in other species. It appears likely that the axial core is produced by the growing tip as described on page 132, and that the investing sheath is secreted by the layer of endodermal cells immediately external to it. This layer of cells is shown in fig. 5, c. The mesodermal cells are columnar in shape and larger than those in a corresponding position[1] in other species.

The tip of the axis penetrates well within the body cavity of the terminal calicle, hence reaches nearly to the surface at the end of the branch.

It is difficult to see how the frequent anastomoses between different branches is accomplished. It may be that the axial core, being very small, is produced with great rapidity and forms the primary connection, and that the mass of the axis is afterward produced by the endothelial investment in such quantities as quickly to make a firm connection.

ABSENCE OF NEMATOCYSTS IN GORGONIDÆ.

In none of the species described in the preceding pages have I been able to find any nematocysts, or thread cells. A careful scrutiny both of fresh and alcoholic specimens failed to reveal a single one of these peculiar structures although the writer was particularly anxious to find them if they existed.

1 That is surrounding the axis when it has attained its normal diameter, *not* near the tip.

Among the ALCYONIDÆ it would seem that the nematocysts are very generally wanting.

In the magnificent monographs of the *Alcyonarians* of the North Atlantic, by Danielssen, in which the details of structure are worked out and figured with great minuteness, not a single nematocyst is mentioned or figured. The same is true of the companion work on "Alcyonider, Gorgonider og Pennatulider" of the Norwegian fauna by Koren and Danielssen.

Mosely failed to find nematocysts in the species of *Sarcophyton* described in the Challenger Report,[1] but found them in *Heliopora cærulea*.[2]

Milne Edwards[3] mentions the occurrence of nematocysts among Actinians and Madreporians, and figures them as found in *Adamsia effæta* and *Cladocora cespitosa*. He neither mentions nor figures them in connection with any of the Alcyonarians.

Verrill in his "Report on the Anthozoa,"[4] collected by the Blake Expeditions, neither mentions nor figures any nematocysts although some of the Alcyonarians are worked out in detail.

Pouchet and Myèvre, however, speak of nematocysts being found in ALCYONIDÆ, at least in some species, e. g., *Alcyonium digitatum*.

In regard to the PENNATULIDÆ, I have little information, but can not find any mention of nematocysts in any of the works at my command.

In the GORGONIDÆ they do not exist in the six species which form the subject of the present work, neither were they found in several other species examined, nor can I find any mention of their presence by others who have worked on this group.

In Sidney J. Hickson's work on "The Structure and Rela-

1 Vol. II, p. 119.

2 Idem, p. 111.

3 "Histoire Naturelle des Coralliaires, Vol. I, p. 20, Plates A 3 and A 4.

4 Bulletin Mus. Comp. Zoöl. Vol. XI, No. 1.

tions of TUBIPORA" in which many details of structure are given, there is no mention nor figure of nematocysts.

Hence it seems likely that these thread cells are by no means a constant feature of ALCYONARIA, being wanting in certain groups, e. g., Gorgonidæ, and rare in others, e. g., Alcyonidæ. Taking the ALCYONARIA as a whole, nematocysts seem to be more frequently absent than present, hence their use as a diagnostic feature is unfortunate, as is also the use of a nomenclature implying their presence.

That this use and nomenclature is largely adopted, the following will show:

In the preface to Gegenbaur's Comparative Anatomy, E. Ray Lankester divides the "Grade" CŒLENTERA into two "Phyla," namely, PORIFERA and NEMATOPHORA.[1] The former includes, of course, the Sponges and the latter Cœlenterates including the Alcyonoids.

The same writer gives the same classification with the same misleading use, of the name "*Nematophora*" in the article "Hydrozoa" in the Encyclopædia Britannica.

Under the head of "Zoölogy" in the same encyclopædia, is given an "example of the most recent genealogical classification." E. Ray Lancaster again makes the same use of the name "*Nematophora*" as applied to the "Phylum" of Cœlentera excepting the Sponges.

Gegenbaur, in the body of his work on Comparative Anatomy, includes all the Cœlenterates except SPONGIÆ under the ACALEPHÆ,[2] and says, "The urticating capsules (nemocysts) are special differentiations of the epithelial elements which are found in all the ACALEPHÆ, although they are not confined to them."[3]

Claus and Sedgwick include the PORIFERA among the CŒLENTERA and divide the latter into two sub-groups; one of

1 "Elements of Comparative Anatomy" by Carl Gegenbaur, p. XVI (preface).

2 "Elements of Comparative Anatomy," p. 90.

3 Idem, p. 103.

which includes the Sponges, characterized, among other things by the absence of nematocysts, and the other "CNIDARIA," characterized as follows: "*Cœlenterata with consistent tissues not pierced by a system of pores; the osculum is replaced by a mouth; with thread cells in the epithelial tissues.*" This is in italics and constitutes the formal characterization of the sub-group.

Under the sub-group thus characterized, they place the Order Alcyonaria, composed of the four families ALCYONIDÆ, PENNATULIDÆ, GORGONIDÆ and TUBIPORIDÆ.

The above examples are sufficient to show the extent to which nematocysts are used as diagnostic characters of great importance and the manner in which this fact is embodied in our nomenclature.

It seems to me that the presence or absence of these organs is not sufficiently constant to afford characters of even Family value, and hence should be entirely discarded in defining Orders, Classes or "Phyla," and that the misleading impressions conveyed by such names as "*Nematophora*" and "*Cnidaria*" should be no longer perpetuated by the use of those terms as above employed.

In conclusion, the writer desires to express his obligation, to Messrs. Martin, Wagner & Co., of Baltimore, for aid in securing transportation to and from the Island of Eleuthera; to Capt. Charles Flowers, for kind and most efficient assistance rendered on the Island; to Dr. J. Walter Fewkes, for identification of specimens, and for other valuable information; to Mr. John L. Ridgway, of the U. S. Geol. Survey, Washington, D. C., for most acceptable aid in the matter of engraving and printing the plates accompanying this article; to Mrs. C. C. Nutting, for faithful and painstaking aid in the field, and through the entire work.

THE NATIVE FISHES OF IOWA.

By SETH E. MEEK, M.S.

In the following paper is given a list of the native fishes of Iowa, with an analytical key by which they may be distinguished. A few notes are added concerning the habits, the economic value, and geographical distribution of each species.

A fish is a cold-blooded vertebrate, living in the water, and breathing by means of gills. The exoskeleton is developed as scales or bony plates. The limbs, if present, are developed as fins. On the median line of the body is usually one or more fins consisting of spines and cartilaginous rays, usually joined by a membrane. The fins on the median line of the back are the dorsal fins. The one on the median line of the belly is the anal fin. The fins homologous with the arms or the fore legs of other animals are the pectoral fins, those homologous with the hind legs are the ventral fins. Usually along the side extending from the shoulder to the caudal fin (tail fin) is the lateral line. At each side of the head are the gill openings, these are covered by the gill covers, which are composed of several pieces. The upper piece is the opercle, below this and forward is the sub-opercle. The edge bordering the cheek is the pre-opercle, this is sometimes serrated on its edge. The thin membrane below the sub-opercle is the branchiostegal membrane, its cartilaginous supports are the branchiostegal rays.

The gills are supported on cartilaginous arches. On the inner side of the first gill arch are the gill rakers.

The scales are cycloid when smooth on their posterior border, ctenoid when toothed or spiny.

The classification of fishes is based chiefly on osteological characters, but in the present paper only such characters are used as will enable one to identify the species known at present from the waters of Iowa. With the above explanations of these few characters we will begin the list of species, adding explanations of other characters as occasion may require.

A Skull imperfectly developed. Mouth sub-circular, and without true jaws. (The Lampreys).

Family 1. **PETROMYZONTIDÆ.**—THE LAMPREYS.

Nostrils single on top of the head. Gill openings, 7 on each side of the head. Skeleton cartilaginous. The mouth fringed and adapted for sucking. Body eel-shaped and with no paired fins. Parasites on larger fishes.

a Maxillary (supra-oral) tooth forming a crescent-shaped plate with a cusp at either end, and sometimes with a median cusp. Discal teeth few.

Genus 1. AMMOCŒTES.—*Dumeril.*

1. AMMOCŒTES BRANCHIALIS.—*L.*—Brook Lamprey.

In the spring animals of this species ascend small streams for the purpose of spawning. They build their nests on the gravelly bottom of clear, swift streams by excavating cavities in the gravel from two to three inches in depth, and with a diameter of from 1½ to 2 times the length of the animal. The eggs are deposited in the bottom of these nests and left to hatch.

The time of spawning in this locality is from about April 15th to April 20th, (1889). If the Lamprey be taken at other times of the year it is only when attached to some unlucky fish. This species seldom exceeds a length of 6½ inches, and is of no economic importance. Found in Europe and known, at present, in this country only from Ithaca, N. Y., central and southern Indiana, southern Wisconsin and Cedar Rapids, Iowa.

aa Maxillary tooth composed of two or three cusps placed close together. Discal teeth numerous and in concentric series.

Genus 2. PETROMYZON (*Artedi*).—*L.*

2. PETROMYZON CONCOLOR.—*Kirtland.*—Silvery Lamprey.

Petromyzon castaneus, Jordan, Man. Vert., 1887.

The habits of this species are similar to those of the preceding. It attacks soft rayed fishes more often than the spiny rayed fishes. Occasionally it is taken attached to *Lepidosteus.* The dentition is variable. The maxillary tooth has from two to three cusps, and the mandibulary from 6 to 12 cusps. In some specimens some of the discal teeth are bicuspid, in others all the discal teeth are simple.

This species attains a length of 10 inches, and is of no economic importance. It ranges from Lake Erie to the Mississippi valley, Minnesota, Kansas and Louisiana.

The Lampreys are not really fishes, but they are usually classified with them. Their affinities are perhaps as much with the *Batrachia* as with the fishes. They undergo a metamorphosis as do the *Batrachia.* In the larval state they are white, worm-like, toothless, and with rudimentary eyes. During the larval state they live buried in the sand on the banks of the stream just below the water's edge.

AA Skull well developed, nostrils paired, mouth not sub-circular and with true jaws. (The true fishes.)

B Tail evidently heterocercal. (The backbone running up into the upper lobe of the tail.)

C Body almost entirely naked. Snout prolonged into a long flat blade which overhangs the broad terminal mouth. No barbels.

Family 2. **POLYODONTIDÆ.**—THE PADDLE-FISHES.

Spiracles present. Air bladder cellular and lung-like. One branchiostegal ray. Opercle rudimentary, its skin produced in a long flap. Dorsal rays 55. Anal rays 57.

Genus 3. POLYODON.—*Lacépède.*

3. POLYODON SPATHULA.—*Walbaum.*—Spoon-bill. Paddle-fish.

This remarkable fish inhabits the Mississippi valley only. It attains a length of 6 feet, is found more frequently in the fall and then in bayous. It is not highly valued as a food fish.

CC Body with 5 series of bony shields. Mouth inferior, toothless, and preceded by four barbels. Air bladder large and not cellular.

Family 3. **ACIPENSERIDÆ.**—THE STURGEONS.

b Spiracles (openings on the head to the gill openings) not present. Snout broad, somewhat depressed. Tail depressed and completely mailed. Rays about 25.

Genus 4. SCAPHIRHYNCHUS.—*Heckel.*

4. SCAPHIRHYNCHUS PLATYRHYNCHUS.—*Rafinesque.*—Shovel-nosed Sturgeon.

Not very abundant in this state, and found only in the larger streams. It attains a length of 5 feet, but is worthless as a food fish.

bb Spiracles present, snout subconic. Tail not depressed nor mailed. Dorsal rays about 42. Anal, 25.

Genus 5. ACIPENSER (*Artedi*).—*L.*

5. ACIPENSER RUBICUNDUS.—*LeSueur.*—Lake Sturgeon. Rock Sturgeon.

Not very abundant, taken in larger numbers in the Mississippi in the spring. It reaches a length of 6 feet, and is an important food fish.

CCC Body covered with rhombic enameled scales. Jaws long, the upper projecting. Vertebræ with ball and socket joint as in reptiles. Air bladder cellular. Vertical fins with round dark spots.

Family 4. **LEPIDOSTIIDÆ.**—THE GAR-PIKES.

Genus 6. LEPIDOSTEUS.—*Lacépède.*

c Jaws long and slender, more than twice the length of the rest of the head. Length of the snout, 15 to 20 times its least width.

6. LEPIDOSTEUS OSSEUS.—*L.*—Common Gar-pike. Long-nosed Gar. Bill-fish.

Very common in all the larger streams in the state, especially in the spring. Length reaching 5 feet; of no value as food for man or for other fishes. Found from the Carolinas to the Great Lakes and Mexico.

cc Jaw shorter and broader, its length less than twice the length of the rest of the head. Its length 5 to 6 times its least width.

7. LEPIDOSTEUS PLATYSTOMUS.—*Rafinesque.*—Short-nosed Gar-pike.

This species is similar to the preceding, but smaller, and less abundant in Iowa. It inhabits the Mississippi valley, and is of no value whatever.

CCCC Body covered with cycloid scales. A broad triangular plate between the branches of the lower jaw. Air bladder cellular, and used in respiration. A lanceolate appendage under each gill cover.

Family 5. **AMIIDÆ.**—THE BOW-FINS.

Genus 7. AMIA.—*L.*

8. AMIA CALVA.—*L.*—Bow-fin. Mud-fish. Dog-fish. "John A. Grindle."

This species inhabits sluggish waters, lakes and bayous. It is seldom taken in our river currents. If kept moist it will live longer out of water than any of our cat-fishes. The male has a large black spot at base of caudal fin above. It reaches a length of 2½ feet, takes the hook readily, but is worthless for food. Its relations to earlier forms make it of much interest to zoologists. Dakota to Texas and east.

BB Tail not evidently heterocercal. Air bladder never cellular and lung-like.

D Body naked. Head with 8 barbels. Two dorsal fins, the posterior adipose. The anterior rays of first dorsal and pectoral fins developed as a strong spine.

Family 6. **SILURIDÆ.**—THE CAT-FISHES.

d Adipose fin with its posterior margin free.

e Pre-maxillary band of teeth (teeth of upper jaw) without lateral backward process.

f Supra-occipital and second inter-spinal bones so meeting as to form a continuous bony bridge from head to first dorsal spine.

Genus 8. ICTALURUS.—*Rafinesque.*

Tail forked, species of a silvery color.

g Anal fin very long, its rays 32 to 35 in number; base of anal fin one-third the length of the body.

9. ICTALURUS FURCATUS.—*Cuv. and Val.*—Chuckle-headed Cat.

This species is found in the larger streams of this state. It is apparently very scarce. It reaches a length of 2½ feet, and is highly valued as a food fish, and not always distinguished from the next. Mississippi valley.

gg Anal fin shorter, its rays 24 to 30; base of anal fin one-third to one-fourth the length of body.

10. ICTALURUS PUNCTATUS.—*Rafinesque.*—Channel Cat, White Cat.

This species grows somewhat larger than the preceding, which it resembles. It is the best food fish in the family. Rather common in Iowa. Montana to Mexico and east to Georgia and Vermont.

ff Supra-occipital and second inter-spinal bones not meeting. The bony bridge from snout to first dorsal not continuous.

Genus 9. AMEIURUS.—*Rafinesque.*

h Caudal fin forked. Anal rays 25 to 35. Species of large size.

11. AMEIURUS NIGRICANS.—*LeSueur.*—Great Cat-fish. Mississippi Cat.

This is the largest of the cat-fishes. It has been known to reach a weight of 150 pounds. At present one is seldom taken half that weight. It is scarcer now than usual in the Mississippi river. Mississippi valley, great lakes to Florida and Texas.

hh Caudal fin not forked. Species of small size.

i Anal fin of 24 to 27 rays.

12. AMEIURUS NATALIS.—*LeSueur.*—Yellow Cat.

This species is not very abundant in the state. In collections I have examined from Iowa, but one specimen was seen; it was taken in Indian creek.

This species inhabits sluggish streams and still bodies of water. It, with the following species of this genus, is too small to be a food fish of importance. Great lakes to Virginia and Texas. Apparently scarce in Iowa.

ii Anal rays 20 to 22. The rays and membrane about the same color.

13. AMEIURUS NEBULOSUS.—*LeSueur.*—Common Bull-head. Horned Pout.

Common in sluggish streams and ponds in Iowa. Length about 12 inches. Rather too small for food, but is often eaten. Wisconsin, Iowa and Texas to Virginia and northeast.

iii Anal rays 18 to 20. The rays pale, the membrane dark.

14. AMEIURUS MELAS.—*Rafinesque.*

This species is far more abundant in Iowa than either of the two preceding forms. Length about 12 inches. New York to Iowa and Kansas.

ee Pre-maxillary band of teeth with lateral backward process on each side. Lower jaw projecting. Anal rays 12 to 15. Head broad and much depressed.

Genus 10. LEPTOPS.—*Rafinesque.*

15. LEPTOPS OLIVARIS.—*Rafinesque.*—Mud Cat. Flat-head Cat. Russian Cat. Gou Jon.

This species is found only in larger streams. It is next larger to *A. nigricans.* It reaches a weight of 75 pounds, but one is seldom taken at present half that weight. One of our best food fishes. Iowa to Ohio and southwest.

dd Adipose fin adnate to the back, and more or less joined to the caudal fin.

Genus 11. NOTURUS.—*Rafinesque.*

j Pre-maxillary band of teeth with lateral backward processes. Pectoral spine retrorse-serrate in front, roughish behind. Anal rays 16.

16. NOTURUS FLAVUS.—*Rafinesque.*—Stone Cat.

This species appears quite common in the state. Like the other species of the genus, it inhabits sluggish waters, and is usually found among logs and in weedy and stony places. The wound produced by the pectoral spine is very painful. This is supposed to be due to the presence of a poison gland at base of spine.

The species seldom attains a length of twelve inches, and is too small to be of economic importance.

jj Pre-maxillary band of teeth without backward lateral processes.

k Pectoral spine retrorse-serrate in front, with about 6 small teeth behind. Anal rays 14 to 17.

17. NOTURUS EXILIS.—*Nelson.*

This species seldom reaches a length of 4 or 5 inches, Scarce and of no value. Wisconsin, Iowa and Kansas.

kk Pectoral spine entire, grooved behind. Adipose fin continuous with the caudal. One or more narrow black lateral streaks. Anal rays 15 or 16.

18. NOTURUS GYRINUS.—*Mitchill.*

More common in this state than the two preceding species. Length about 5 inches. Hudson river to Minnesota, Iowa and south.

DD Body covered with scales, or nearly so.

E Ventral fins, if present, abdominal.

F Scales cycloid. Dorsal and anal fins without spines.

G Head without scales. Mouth toothless. Gill membranes united to the isthmus (the narrow part of the body between the gill membranes).

H Pharyngeal bones (bones behind the gills at anterior end of the œsophagus) falciform, and armed with numerous teeth in one row. Dorsal rays more than 10.

Family 7. **CATOSTOMIDÆ.**—THE SUCKERS.

l Dorsal fin elongate, its rays more than 25. Air bladder in two parts.

m Body oblong-ovate, its depth ⅓ to ½ the length of the body (length measured from tip of the snout to the base of the caudal fin).

Genus 12. ICTIOBUS.—*Rafinesque.*—The Buffalo Fishes.

The species of the Buffalo fishes have never been well defined. I have examined a large number in the Muscatine market and recognize the following species:

n Mouth large, terminal and protractile forwards. The lips thin and scarcely plicate (sucker like).

19. ICTIOBUS CYPRINELLA.—*Cuv. and Val.*

This species is known as the common Buffalo fish, or Big mouthed Buffalo. It reaches a weight of 20 to 40 pounds. It is seldom taken in the Mississippi, but is abundant in the bayous. A food fish of moderate value. Mississippi valley.

nn Mouth smaller and sub-inferior, usually overhung by the blunt snout. The upper jaw protractile downward.

o Lower pharyngeal bones strong. Species dusky, not silvery.

p Lips rather thin; body not much elevated, nearly elliptical in form.

20. ICTIOBUS URUS.—*Agassiz.*

The Razor-backed Buffalo is not as abundant as the former. Found in the river and also in bayous. It reaches nearly the size of the former, and is of about the same value for food. Mississippi valley.

pp Lips very thick, sucker-like. Body more elevated.

21. ICTIOBUS BUBALUS.—*Rafinesque.*

This species is known as the Small-mouthed Buffalo. It is more abundant in the river channels, and is more abundant in the market than other Buffalo fishes. It is easily distinguished from the former two species by its very thick lips. Mississippi valley.

oo Lower pharyngeals thin and weak. Color pale and silvery.

22. ICTIOBUS VELIFER.—*Rafinesque.*

This species is known by the name of Quill-back and Carp-sucker. It is by far the most abundant of the Buffalo fishes in this state. I have found it in abundance in the Des Moines, Skunk, Iowa and Cedar rivers, while the others are, in the collections examined by me, only from the Mississippi river and Squaw creek. Of little value for food because of small size and the numerous small bones. Mississippi valley.

mm Body elongate, its length about 4½ times its width. Snout long, pointed. Mouth small. Dorsal rays 30.

Genus 13. CYCLEPTUS.—*Rafinesque.*

23. CYCLEPTUS ELONGATUS.—*LeSueur.*—Black-horse. Missouri Sucker. Gourd-seed Sucker.

This species inhabits only the larger streams. It is not very abundant. It reaches a length of 2½ feet, and is the best food fish in the family. Mississippi valley.

ll Dorsal fin short, its rays 12 to 16.

q Air bladder in two parts.

r Lips thick, papillose. Scales in the lateral line 50 to 70. Fontanelle present.

Genus 14. CATOSTOMUS.—*LeSueur.*

s Scales on anterior part of the body crowded forward. 65 to 70 scales in the lateral line. Color nearly plain.

24. CATOSTOMUS TERES. — *Mitchill.* — Common Sucker. White Sucker.

This is the commonest Sucker. It reaches a length of 18 inches, and is a poor food fish. Montana to Canada and south.

ss Scales not crowded anteriorly. 48 to 55 in the lateral line. The back with dark black blotches.

25. CATOSTOMUS NIGRICANS.—*LeSueur.*—Hog Sucker. Hog Mullet. Stone Toter.

This Sucker is common in streams and lakes. It grows somewhat larger than the preceeding and is nearly worthless as a food fish. Western New York to Iowa, Kansas and Alabama.

rr Lips thin, plicate. Scales, 40 to 50 in the lateral line.

t Lateral line wanting. Sides in the young with a dark lateral band. Scales in lateral line 40.

Genus 15. ERIMYZON.—*Jordan.*

26. ERYMYZON SUCETTA.—*Lacépède.*—Chub Sucker. Sweet Sucker.

This species appears to be quite scarce in this state. It never grows large enough to become of any importance. Dakota east to Massachusetts and south.

tt Lateral line nearly complete. A dark spot on each scale, forming lateral stripes on the body. About 45 scales in the lateral line.

Genus 16. MINYTREMA.—*Jordan.*

27. MINYTREMA MELANOPS.—*Rafinesque.*—Striped Sucker.

Very scarce, known in this state from Squaw creek, Ames, and the Mississippi river. A food fish of little importance. Great lakes, Iowa to South Carolina and Texas.

qq Air bladder in three parts. Lips plicate. Fontanelle present. Color plain. Scales in the lateral line about 45; scales not crowded anteriorly.

Genus 17. MOXOSTOMA.—*Rafinesque.*

28. MOXOSTOMA DUQUESNEI. — *LeSueur.*— Common Red-horse. White Sucker. Mullet.

This species is quite common in this state. It reaches a length of 2 feet and is a food fish of some importance.

[TO BE CONTINUED.]

*** For further information concerning the fishes of Iowa, I would refer the student to Dr. Jordan's "Manual of the Vertebrates of the Eastern United States" (A. C. McClurg & Co., Chicago), which work has been closely followed in the preparation of the present paper.

EXPLANATION OF PLATE I.

BRIAREUM ASBESTINUM.[1] *PALL.*

FIG. 1. *Young zoanthodeme, reduced one-half.*

FIG. 2. *Expanded polyp greatly enlarged:* a, surface of zoanthodeme; b, b, b, mesenteries showing through from interior; c, c, expanded tentacles; d, d, d, tentacular papillæ.

FIG. 3. *Tentacle taken fresh from living polyp and pressed under a cover glass:* a, a, a, tentacular papillæ; b, b, globular mesodermal cells.

FIG. 4. *Tentacular papilla from fresh tentacle:* a, a, ciliated ectodermal cells; b, b, globular mesodermal cells; c, c, cilia.

FIG. 5. *Single globular mesodermal cell:* a, cell wall; b, granular pigment; c, nucleus.

FIG. 6. *Segment of a transverse section of branch of zoanthodeme:* a, a, a, ectoderm, covering zoanthodeme and polyps; b, b, endoderm lining calicles; c, c, retractor muscles of polyps; d, d, convoluted mesenterial filaments; e, e, ova attached to mesenterial muscles; f, gullet of polyp; g, g, expanded tentacles of polyp; h, h, tentacular papillæ; i, i, i, water-vascular canals in cross section; j, j, j, spicules embedded in cœnenchyma.

FIG. 7. *Cross-section of polyp near base of tentacles:* a, endodermal lining of calicle; b, ectodermal investment of tentacle; c, endodermal lining of tentacle; d, d, mesenteries; e, e, retractor muscles attached to mesenteries; f, f, spaces (intermesenterial); g, endodermal lining of gullet.

FIG. 8. *Transverse section of tentacle:* a, ectodermal cells; b, line indicating muscle layer; c, globular mesodermal cells; d, columnar endodermal cells lining tentacle and surrounding tentacular cavity.

FIG. 9. *Stellate "connective tissue" cells of cœnenchyma:* a, anastomosing processes; b, granular protoplasm; c, nucleus.

FIG. 10. *Other cells supposed to contain forming spicules.*

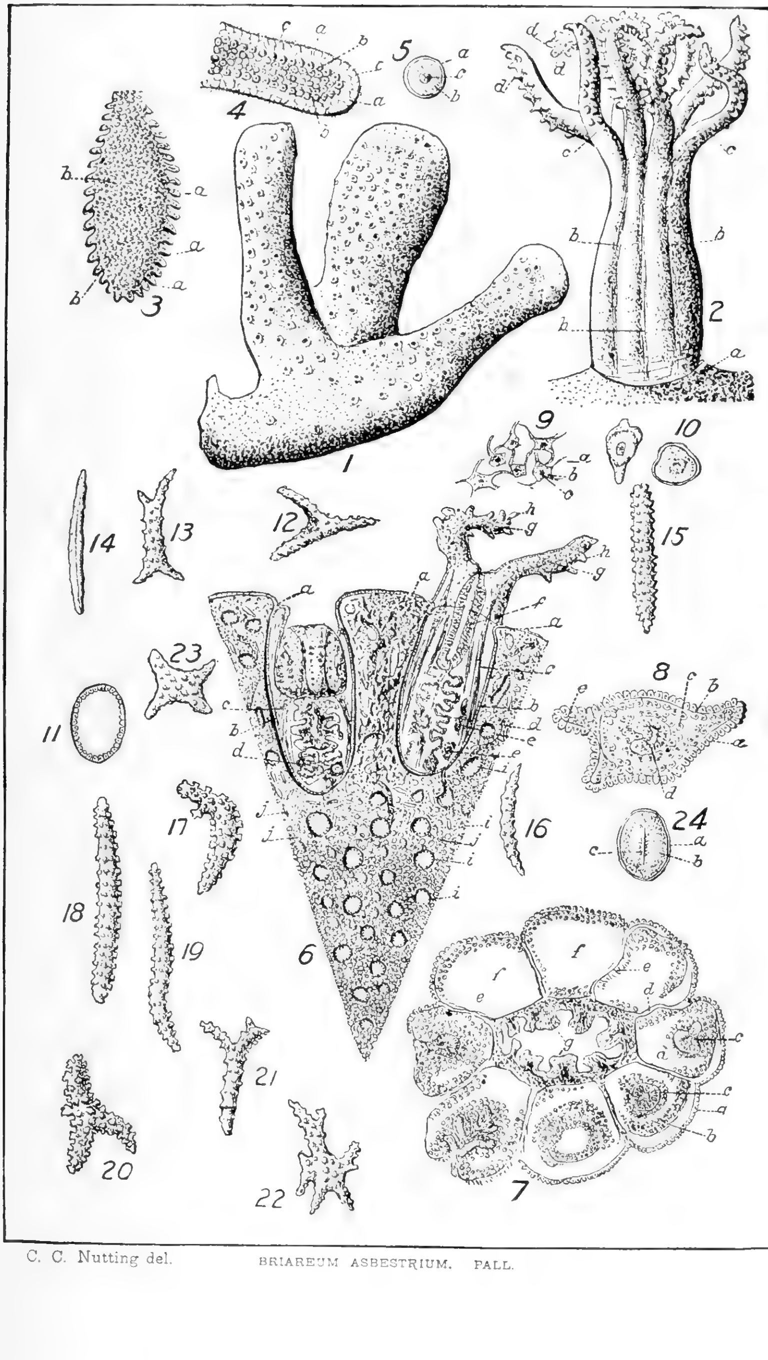
FIG. 11. *Lining of water-vascular canal showing endothelial cells.*

FIGS. 12–23. *Characteristic spicules.*[2]

FIG. 24. *Transverse section of spicule softened by acid, highly magnified:* a, pellicle; b, calcareous salts; c, line of separation between apposed halves.

1 This name is incorrectly spelled "Asbestrium" on the plate.

2 All spicules on these Plates are drawn to the same scale except those on Plate X.



C. C. Nutting del. BRIAREUM ASBESTRIUM. PALL.

EXPLANATION OF PLATE II.

PLEXAURELLA DICHOTOMA.

FIG. 1. *Small zoanthodeme, reduced one-half.*

FIG. 2. *Living and expanded polyp as it appears from above:* a. a. a, tentacles; b, b, body wall showing through as a light circle; c, c, mesenteries showing through as light lines radiating from œsophagus to body wall; d, mouth; e, e, e, tentacular papillæ.

FIG. 3. *Cross-section of branch of zoanthodeme:* a, a, expanded polyp; b, b, b, b, retracted polyps; c, empty calicle; d, d, cœnenchyma in which spicules are embedded; e, e, e, e, eight primary water-vascular canals; f, semi-calcareous portion of axis cylinder; g, corneous portion of axis cylinder, h, h, ova attached to mesenteries.

FIG. 4. *Supposed young ova attached to mesentery:* a, muscle retractor attached to mesentery; b, small black dot supposed to be germinal vesicle of young ova; c, point of attachment to lower edge of œsophagus.

FIG. 5. *Cluster of ova showing attachment:* a, lining of calicle; b, mesentery in cross section; c, c, c, epiblast; d, d, d, hypoblast; e, e, pedicels.

FIG. 6. *Portion of mesentery below gullet showing histological structure:* a, layer of nucleated muscle fibers; b, mesodermal cells; c, layer of endodermal cells.

FIG. 7. *Portion of axis cylinder:* a, semi-calcareous portion showing the undulatory course of vermiform bodies; b, corneous central part of axis.

FIG. 8. *A single vermiform body from semi-calcareous part of axis cylinder:* a, fibrous sheath or investment; b, central calcareous deposit showing superimposed lamellæ.

FIG. 9. *Transverse section of axis cylinder, greatly magnified:* a, corneous part or core; b, section of vermiform bodies; c, section of young branch from axis.

FIG. 10. *Section of single vermiform body (more highly magnified):* a, sheath; b, central calcareous deposit with indications of laminated structure.

FIGS. 11, 15. *Quadri-partite tuberculate spicules.*

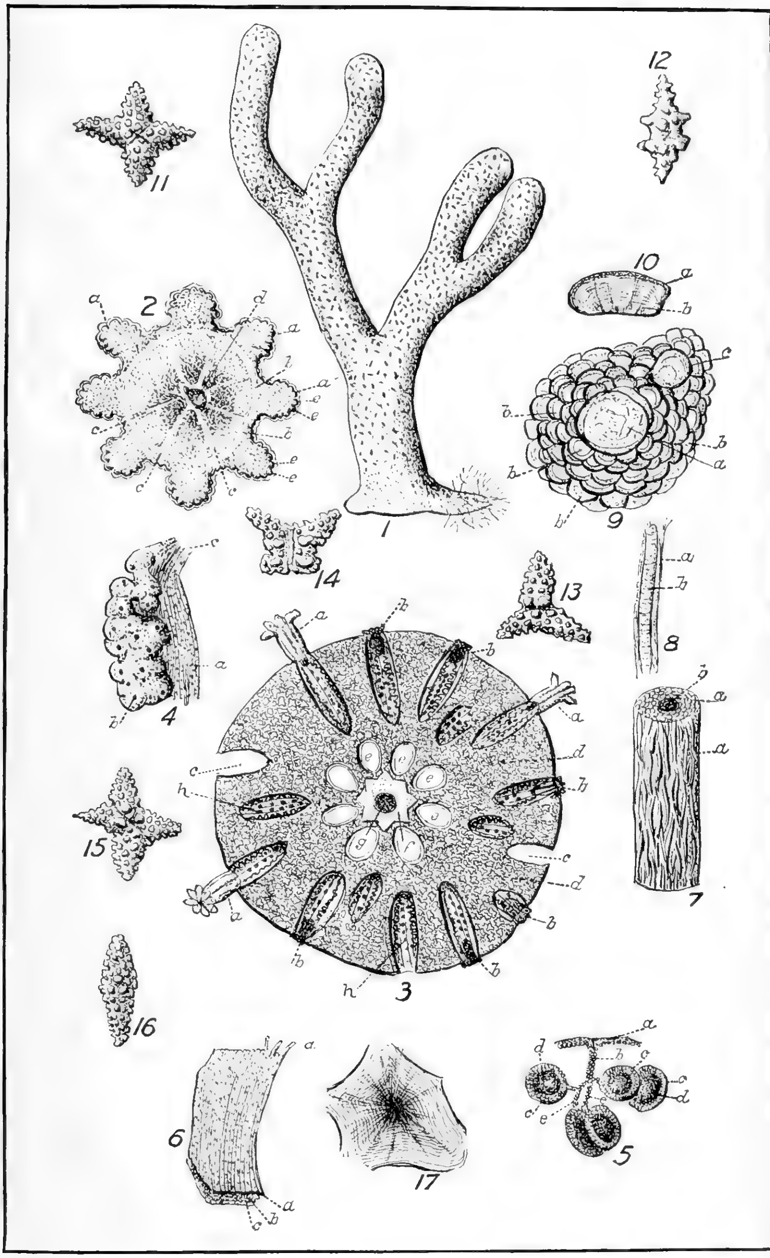
FIG. 12. *Simple or double-conic spicule.*

FIG. 13. *Tri-partite tuberculate spicule.*

FIG. 14. *Papillioform tuberculate spicule.*

FIG. 16. *Terete tuberculate spicule.*

FIG. 17. *Cross-section of partly decalcified spicule showing concentric lamellate structure.*



C. C. Nutting del. PLEXAURELLA DICHOTOMA

EXPLANATION OF PLATE III.

MURICEA—SP.

FIG. 1. *Small zoanthodeme showing pinnate manner of branching, and expanded polyps.*

FIG. 2. *Living and expanded polyp, magnified:* a, surface of branch with spicules showing through the ectoderm; b, expanded tentacle of polyp; c, mesentery showing as a ridge.

FIG. 3. *Oral view of living and expanded polyp:* a, a, tentacles; b, b, mesenteries; c, mouth.

FIG. 4. *Transverse section of branch near tip, magnified:* a, axis cylinder; b, endodermal investment of axis; c, mesodermal cœnenchyma surrounding b; d, d, endodermal lining of primary water-vascular canals; e, epithelium covering zoanthodeme; f, f, f, retracted polyps; g, g, primary canals; h, h, mesenteries; i, ovum.

FIG. 5. *Longitudinal section of axis and one side of branch:* a, axis cylinder showing superimposed lamellæ; b, endodermal investment of axis; c, cœnenchyma containing spicules; d, d, d, endothelial lining of water-vascular canals—on the right, this is shown to be continuous with lining of calicles; e, fibrous sheath of axis; f, f, longitudinal section of primary canal, showing its connection with calicle; g, retracted polyp; h, epithelium; i, i, retractor muscles; j, ovum; k, k, k, granular rows of cells in cœnenchyma; l, l, l, spicules.

FIG. 6. *Transverse section of polyp (diagrammatic) to illustrate relation of ectoderm, endoderm, and mesoderm:* a, a, a, mesoderm comprising central plates of mesenteries, middle layer of body wall, and the portion of gullet between the external and internal surfaces; b, b, b, endodermal lining of all the inter-mesenterial chambers; c, c, c, muscle layer comprising retractor muscles and situated on the ventral surface of the mesodermal plate of each mesentery; d, ectodermal lining of gullet formed by inversion from oral surface.

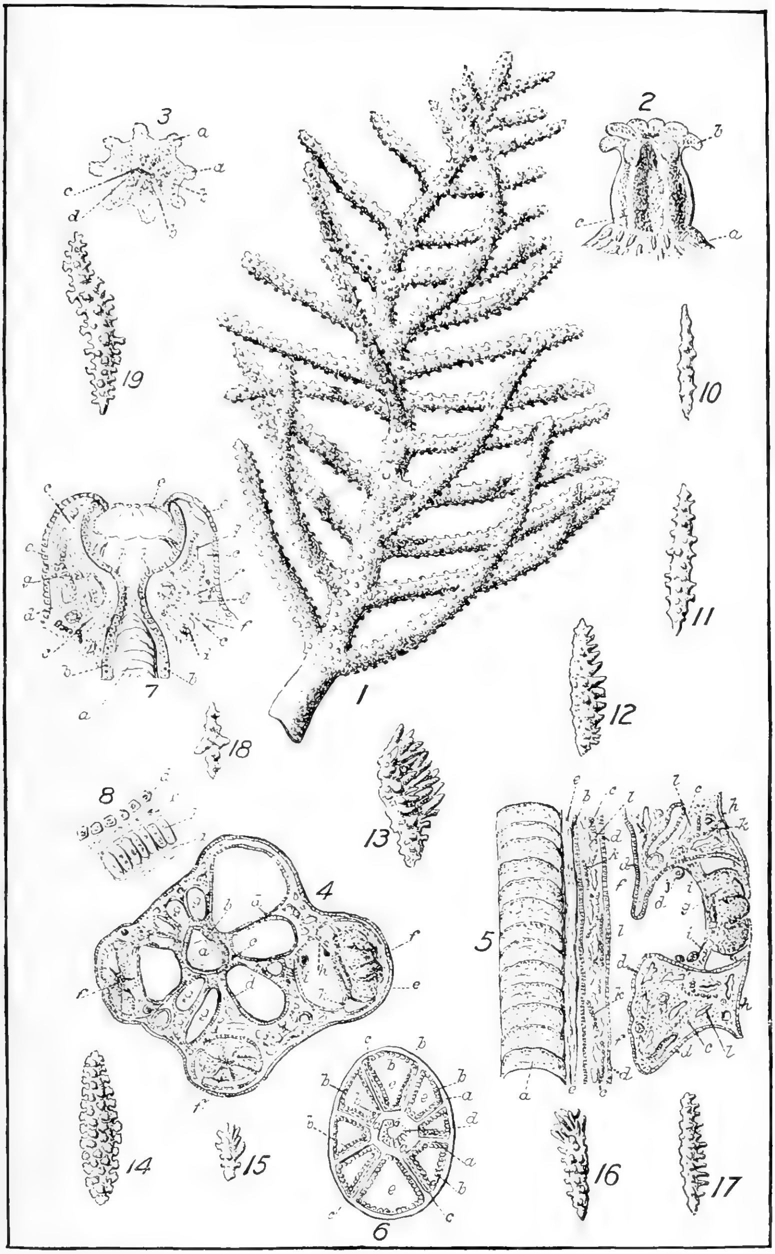
FIG. 7. *Longitudinal section of tip of branch, to illustrate formation of end of axis cylinder:* a, axis cylinder; b, b, its endodermal investment continuous with lining of terminal polyp; c, c, cœnenchyma; d, d, d, small canals; e, epithelium; f, f, spicules; g, g. granular rows of cells.

FIG. 8. *Portion of a cross section of a branch near tip, to show relation of parts to axis:* a, periphery of axis; b, columnar cells of investment of axis; c, cœnenchyma between investment and d; d, quadrate endodermal cells forming lining of primary canal.

FIGS. 10, 11, 14, 19. *Regular tuberculate spicules.*

FIGS. 12, 13, 15, 16, 17. *Unsymmetrical echinate spicules.*

FIG. 18. *Quadri-partite spicule.*



C. C. Nutting del. MURICEA. SP.

EXPLANATION OF PLATE IV.

EUNICEA MURICATA.[1] GROSS ANATOMY.

FIG. 1. *Tip of branch showing arrangement of calicles, enlarged.*

FIG. 2. *Gross cross-section of living branch, enlarged:* a, axis cylinder; b, investing mass of small purple spicules; c, main water-vascular canals; d, mesoderm containing small spicules; e, e, e, large spicules supporting calicles; f, f, exterior layer of small interlocking spicules; g, g, g, g, retracted tentacles of polyps; h, h, h, mesenteries; i, i, convoluted gullet wall; j, j, mesenterial filaments; k, k, k, ova; l, l, "lid" of calicle.

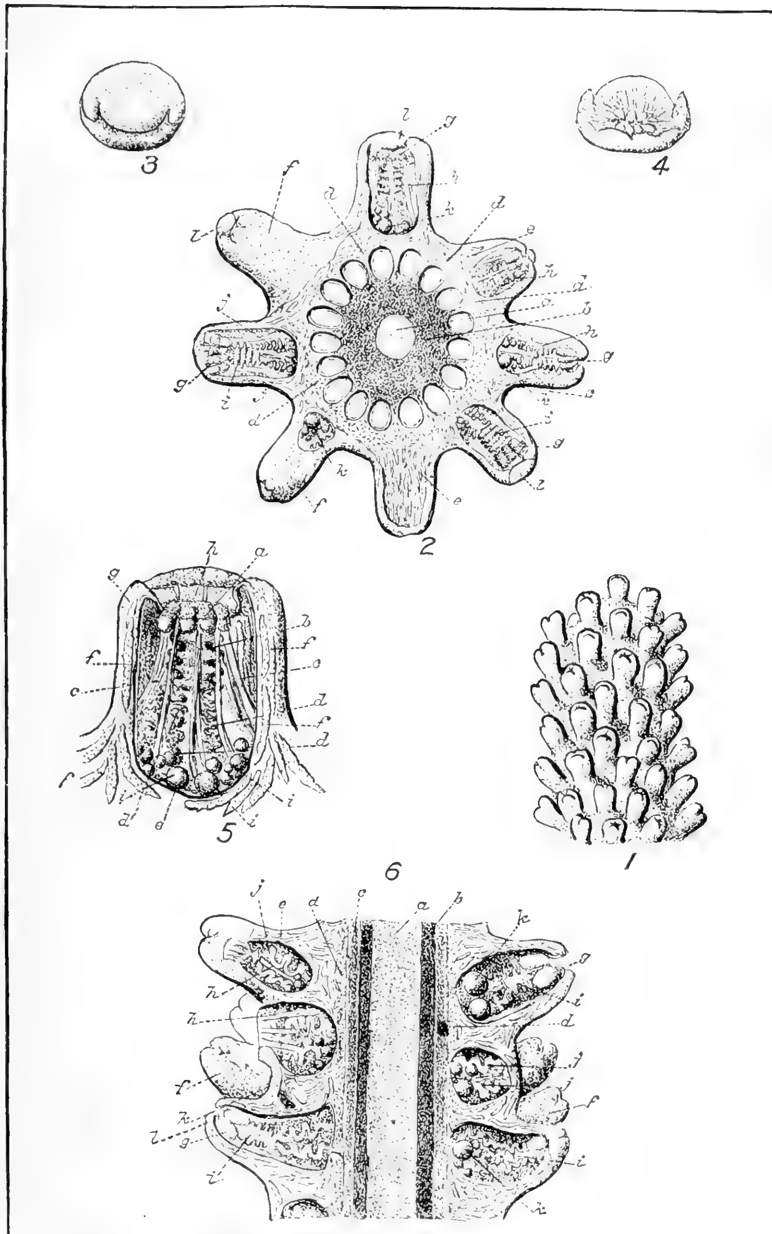
FIG. 3. *Top of calicle with "lid" closed.*

FIG. 4. *Top of calicle with "lid" open.*

FIG. 5. *A calicle with side removed to show contents:* a, retracted tentacle; b, convoluted gullet wall; c, c, retractor muscles; d, mesenterial filament; e, lining of calicle; f, f, large supporting spicules; g, small interlocking spicules; h, epidermis extending over polyp; i, i, i, ova.

FIG. 6. *Gross longitudinal section of fresh branch.* Lettering as in fig. 2.

1 This species was identified after the Plates were sent to the engraver.



C. C. Nutting del.

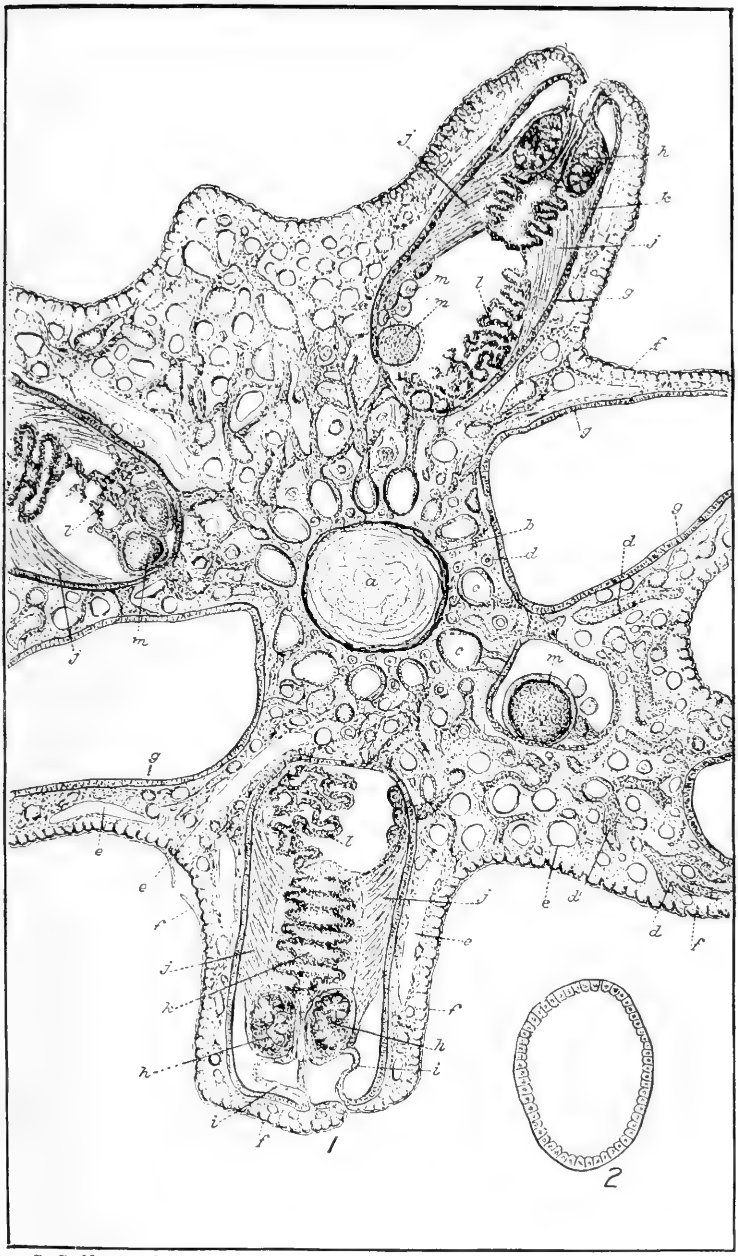
EUNICEA. SP.
Gross Anatomy.

EXPLANATION OF PLATE V.

EUNICEA MURICATA.

FIG. 1. *Transverse section (greatly enlarged) of branch preserved in alcohol:* a, axis cylinder; b, its sheath; c, c, primary water-vascular canals; d, secondary water-vascular canals; e, e, e, e, spaces from which spicules have been dissolved; f, f, f, f, f, epidermis; g, g, g, endodermal lining of calicles; h, h, h, retracted tentacles of polyps; i, i, opercular muscles; j, j, j, j, retractor muscles; k, k, convoluted gullet; l, l, l, mesenterial filaments; m, m, m, m, ova.

FIG. 2. *Transverse section of primary water-vascular canal showing lining of endodermal or endothelial cells.*



C. C Nutting del

EUNICEA SP.

Cross Section of Branch

EXPLANATION OF PLATE VI.

EUNICEA MURICATA. HISTOLOGY.

FIG. 1. *Transverse section of polyp across retracted tentacles:* a, a, a, body wall; b, b, b, mesenteries; c, c, papillæ of tentacles; e, e, e, ectodermal investment of tentacles.

FIG. 2. *Transverse section across gullet of polyp:* a, a, a, mesodermal plates of mesenteries; b, b, b, muscle fibres of retractor muscles; c, ectodermal lining of gullet; d, d, muscles of gullet wall; e, e, cavity of gullet.

FIG. 3. *Section through convoluted wall of gullet, greatly magnified:* a, endodermal cells; b, b, columnar ectodermal cells lining gullet; c, c, large polar cells supposed to be nerve cells; d, d, mesodermal cells with large nuclei.

FIG. 4. *Longitudinal section of polyp:* a, a, a, retractor muscles; b, b, b, tentacular muscles; c, c, c, retracted tentacles; d, d, tentacular papillæ; e, e, convolutions of gullet; f, f, gullet wall; g, gullet cavity; h, h, mesenterial filaments; i, i, ova.

FIG. 5. *Large ovum, segmented:* a, vitelline membrane; b, segmented mass.

FIG. 6. *Ovum, unsegmented:* a, vitelline membrane; b, granular protoplasm; c, germinal vesicle; d, germinal dot; e, nucleated cells surrounding ovum.

FIG. 7. *Group of ova, the largest of which has three germinal dots.* Letters as in fig. 6.

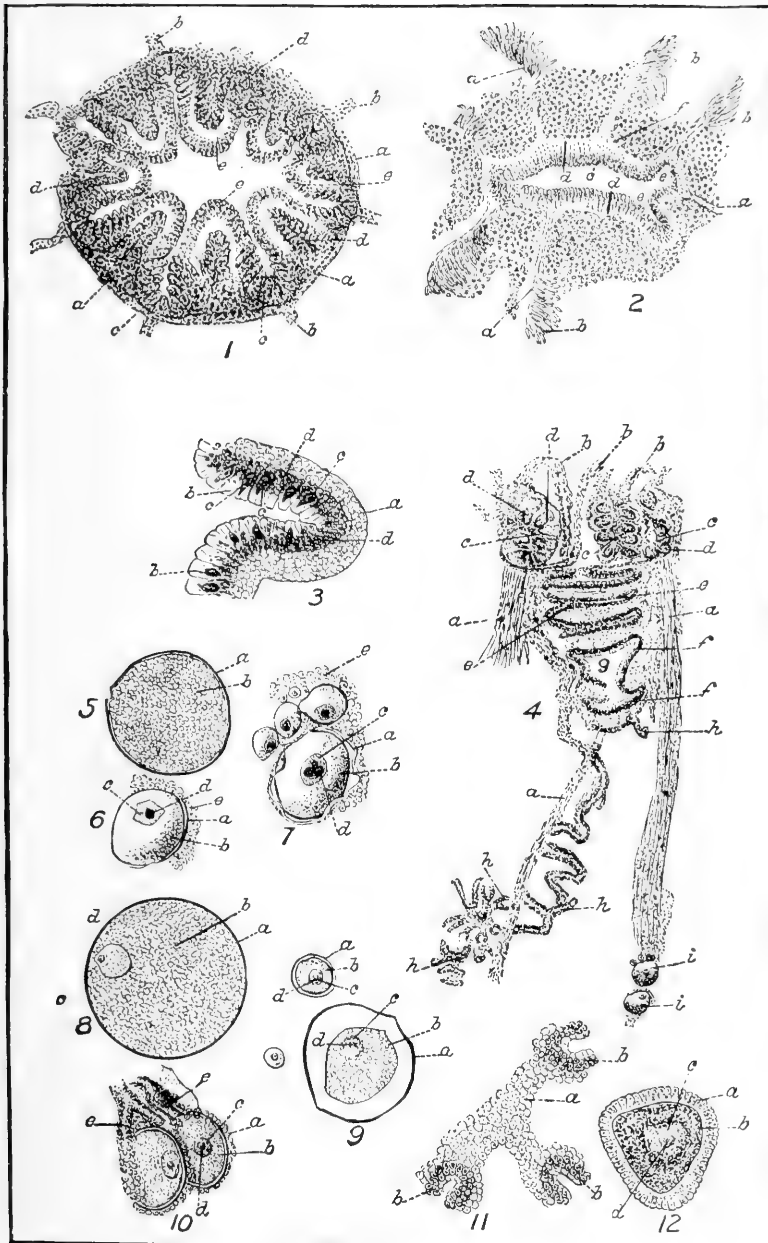
FIG. 8. *Ovum.* Letters as in fig. 6.

FIG. 9. *Ovum in which the protoplasmic mass has shrunk away from the vitelline membrane*

FIG. 10. *Two ova attached to pedicels,* e, e. Other letters as in fig. 6.

FIG. 11. *Part of mesenterial filament highly magnified:* a, cells having small nuclei, forming mass of filament; b, b, cells having large nuclei, forming horse-shoe-shaped projections.

FIG. 12. *Advanced ovum or young planula:* a, ectoderm or epiblast; b, endoderm or hypoblast; c, germinal vesicle; d, germinal dot.



C. C. Nutting del.

EUNICEA. SP.

Histology

EXPLANATION OF PLATE VII.

EUNICEA MURICATA. SPICULES.

FIGS. 1, 3, 6, 13, 14, 18, 19. *Symmetrical tuberculate fusiform.*

FIGS. 2, 5, 10, 20, 22, 25. *Echinato-clavate.*

FIGS. 4, 7, 12, 24, 28. *Attenuato-echinate.*

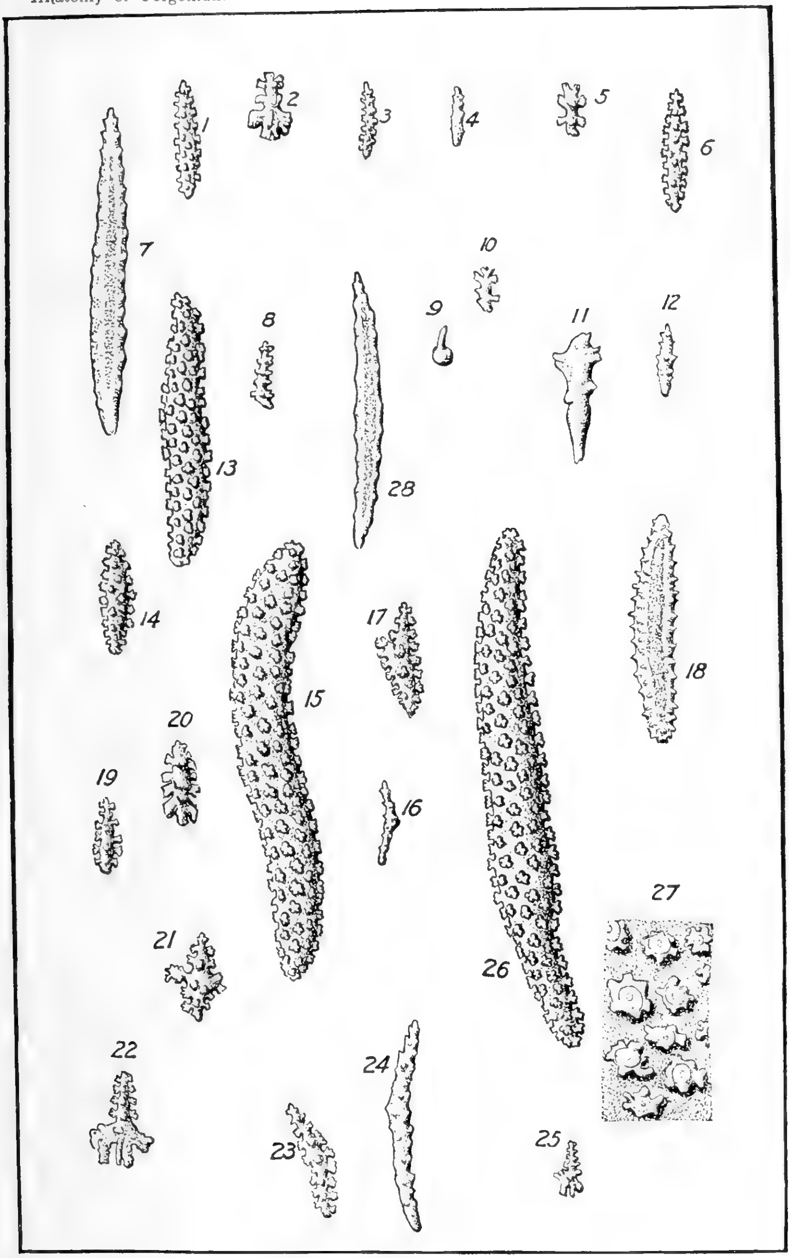
FIGS. 15, 26, 23. *Arcuate tuberculate fusiform.*

FIGS. 8, 9, 11, 16. *Irregular.*

FIG. 17. *Bi-partite tuberculate.*

FIG. 21. *Quadri-partite tuberculate.*

FIG. 27. *Surface of tuberculate spicule highly magnified, showing axial cavities of tubercles.*



C. C. Nutting del.

EUNICEA. SP.
Spicules.

EXPLANATION OF PLATE VIII.

EUNICEA TOURNEFORTI. *M. E.*

FIG. 1. *Portion of branch enlarged:* a, a, exserted calicles; b, b, b, expanded polyps; c, c, side view of calicles.

FIG. 2. *Profile view of single calicle with expanded polyp:* a, major lobe of calicle; b, polyp.

FIG. 3. *View of oral surface of polyp with flexed tentacles.*

FIG. 4. *View of oral surface of young polyp.*

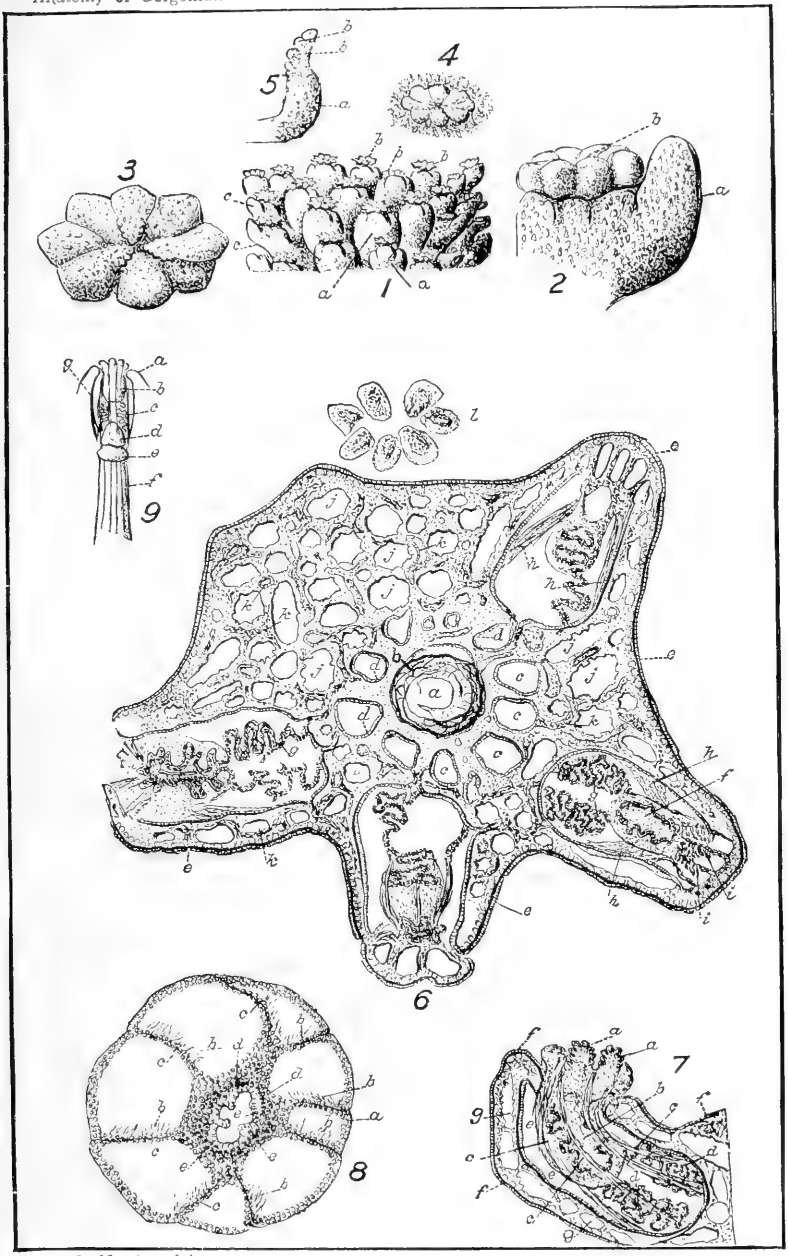
FIG. 5. *Profile view of tentacle:* a, tentacle; b, tentacular papillæ.

FIG. 6. *Transverse section of branch, magnified:* a, axis cylinder; b, edges of superimposed lamellæ; c, c, c, primary water-vascular canals; d, d, d, endodermal lining of water-vascular canals; e, e, e, ectoderm; f, gullet of polyp; g, g, mesenterial filaments; h, h, h, h, retractor muscles; i, i, mesenteries and retractors; j, j, j, spaces left by spicules which have been dissolved out; k, k, k, secondary water-vascular canals; l, tentacle of polyp.

FIG. 7. *Longitudinal section of calicle and polyp to show curvature:* a, a, tentacles; b, gullet; c, c, c, mesenteries and retractor muscles; d, d, mesenterial filaments; e, e, endodermal lining of calicle; f, f, epidermis; g, g, spaces occupied by spicules.

FIG. 8. *Transverse section of polyp through gullet:* a, a, a, body wall; b, b, b, b, retractor muscles; c, c, c, c, mesenteries; d, d, mesodermal portion of gullet wall; e, ectodermal lining of gullet.

FIG. 9. *Termination of axis cylinder:* a, terminal calicle; b, terminal polyp; c, mesenterial filaments; d, terminal boss of axis; e, ring below boss; f, ridges forming flutings around axis, in which the interior part of primary canals fit.



C. C. Nutting del. EUNICEA TOURNEFORTI. M. E.

EXPLANATION OF PLATE IX.

EUNICEA TOURNEFORTI. SPICULES.

FIG. 1. *Regular massive tuberculate.*

FIG. 2. *Arcuate massive tuberculate.*

FIG. 3. *Regular echinato-tuberculate.*

FIG. 4. *Arcuato-tuberculate.*

FIG. 5. *Quadri-partite tuberculate.*

FIG. 6. *Very large massive arcuato-tuberculate.*

FIG. 7. *Arcuato-echinate.*

FIG. 8. *Tuberculato-fusiform.*

FIG. 9. *Small echinato-clavate.*

FIG. 10. *Arcuato-tuberculate showing tendency to become bi-partite.*

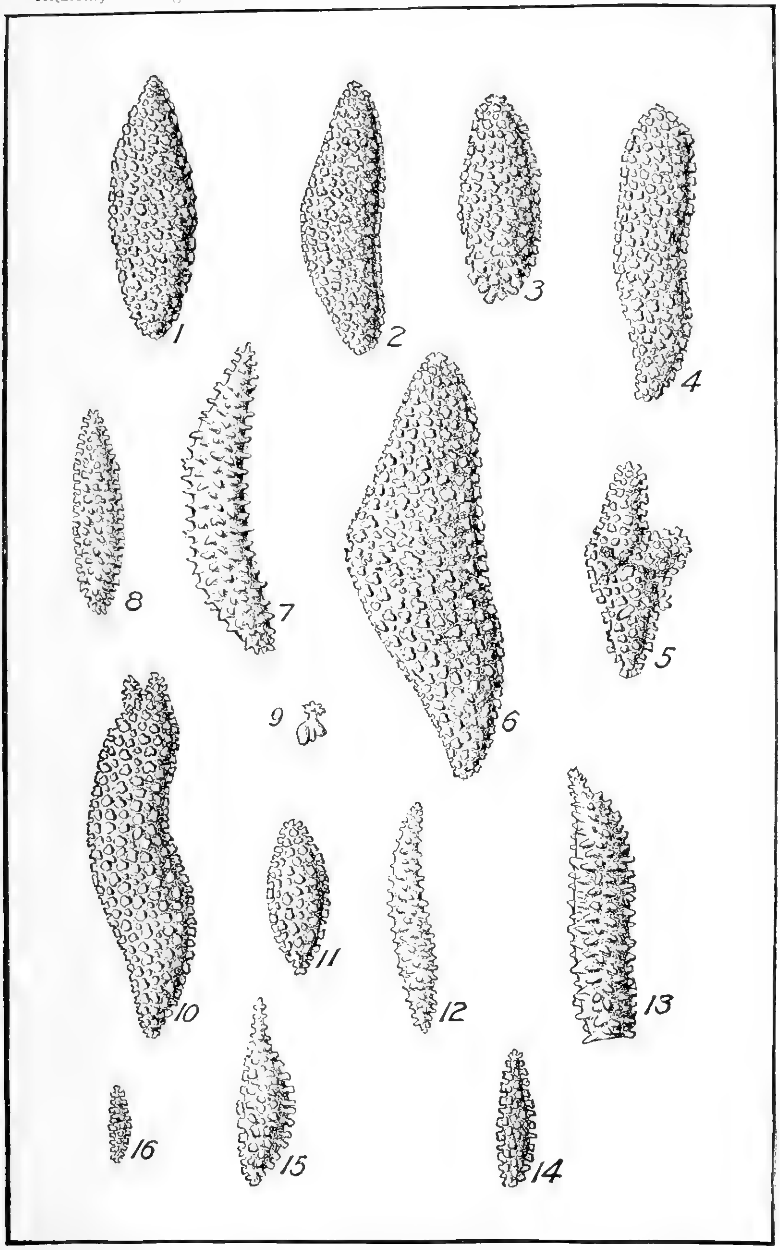
FIG. 11. *Regular tereto-tuberculate.*

FIG. 12. *Arcuato-echinate.*

FIG. 13. *Unsymmetrical echinate.*

FIGS. 14, 16. *Small tuberculato-fusiform.*

FIG. 15. *Irregular pointed tuberculate.*



C. C. Nutting del

EUNICEA TOURNEFORTI. M. E

Spicules.

EXPLANATION OF PLATE X.

RHIPIDIGORGIA FLABELLUM. *LINN.*

FIG. 1. *Small zoanthodeme with polyps expanded, reduced one-half.*

FIG. 2. *Portion of the same enlarged to show arrangement of polyps.*

FIG. 3. *Expanded polyp, enlarged.*

FIG. 4. *View of polyp from above showing folded tentacles.*

FIG. 5. *Transverse section of branch:* a, a, central pith of axis cylinder; b, corneous part of axis cylinder; c, endodermal investment of axis cylinder; d, endodermal lining of calicle, continuous with e; e, e, endodermal lining of water-vascular canals; f, f, spicules embedded in cœnenchyma; g, g, retractor muscles; h, gullet of polyp; i, i, expanded tentacles; j, mesentery; k, ovum.

FIG. 6. *Longitudinal section of branch:* a, corneous portion of axis cylinder; b, central pith of axis cylinder; c, endodermal investment of axis; d, e, endodermal lining of calicle; f, f, spicules embedded in cœnenchyma; g, g, g, g, retractor muscles of polyps; h, stomach of polyp; i, retracted tentacle; j, j, mesenteries; k, k, k, ova.

FIG. 7. *Transverse section of branch near tip showing end of axis cylinder:* a, a, axis cylinder; b, side of same; c, lining of calicle; d, d, d, mesenteries.

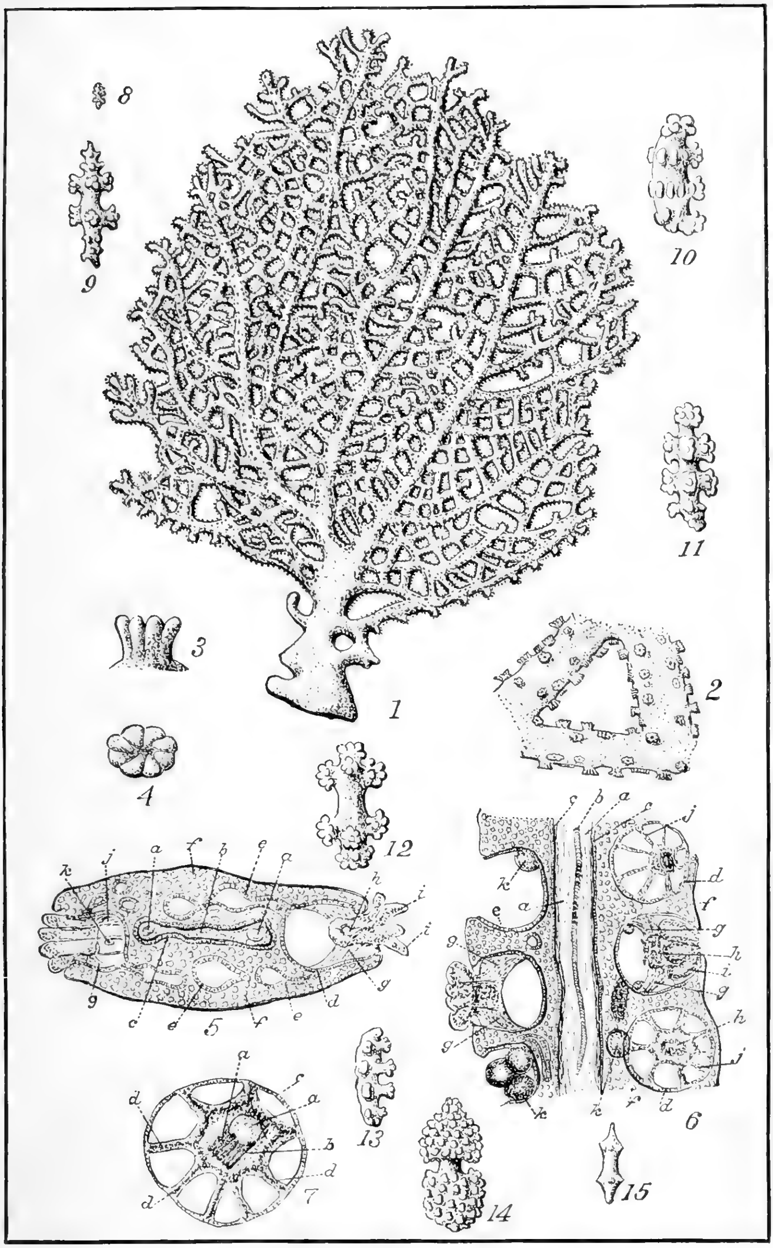
FIG. 8. *Spicule drawn to same scale as those on other Plates. The remaining spicules are much more highly magnified.*

FIGS. 9, 11, 12. *Regular tuberculate fusiform spicules.*

FIGS. 10, 13. *Scaphoid spicules.*

FIG. 14. *Dumb-bell-shaped spicule.*

FIG. 15. *Young spicule.*



C. C. Nutting del RHIPIDIGORGIA FLABELLUM. LINN.

VOL. I. NOS. 3–4.

BULLETIN

FROM THE

LABORATORIES OF NATURAL HISTORY

OF THE

STATE UNIVERSITY OF IOWA.

PUBLISHED

BY AUTHORITY OF THE REGENTS.

IOWA CITY, IOWA.

JUNE, 1890.

Vol. I. Nos. 3-4.

BULLETIN

FROM THE

LABORATORIES OF NATURAL HISTORY

OF THE

State University of Iowa.

PUBLISHED

BY AUTHORITY OF THE REGENTS.

IOWA CITY, IOWA.
June, 1890.

Secretary Wm. J. Haddock:

We submit herewith Nos. 3 and 4 of Vol. I., Bulletins from the Laboratories of Natural History.

THE EDITORS.

PREFATORY NOTE.

The present Bulletin is a double number, 3 and 4, and completes Volume I. The paper by Prof. Shimek will be completed in the first number of Vol. II., expected to appear in December. The monograph on the Pselaphidæ brings to conclusion in this number the genus Bryaxis; the remaining genera with illustrations will appear later. It is hoped also to continue the paleontological and botanical papers as occasion may offer.

Editors,
S. CALVIN,
T. H. MCBRIDE,
C. C. NUTTING,
B. SHIMEK,
H. F. WICKHAM.

SOME NEW SPECIES OF PALÆOZOIC FOSSILS.

S. CALVIN.

In this paper are given descriptions of a few of the new species of invertebrate fossils that, for some time, have been awaiting suitable recognition in the collections of the writer. The quarries and natural rock exposures of Iowa are rich in forms illustrating the earlier geologic faunas. The conditions under which these old faunas lived were, in this region, unusually favorable to the expansion of certain groups, and hence there is a large number of species peculiar to the region. Of these species a considerable proportion remains undescribed, and it will be the purpose of the paleontological papers contributed to the BULLETIN to bring these hitherto unrecognized forms to general notice. The papers will of necessity be fragmentary. The exacting duties of a chair of instruction leave little opportunity for original study, or for the elaboration of conclusions. Moreover, the means at my command for publication and illustration make it a present necessity to issue papers that are individually but scraps and fragments.

We may reasonably hope that the study of the fossil faunas of a region where life was so profuse and the conditions so favorable for the preservation of individual forms, will throw light on the interesting problems of the introduction and succession of organic types. The splendid results achieved by Messrs. Wachsmuth and Springer in the study of our local crinoids are an example of what may be expected when other organic groups are studied with equal intelligence, leisure and enthusiasm. Ordinary private means, or the means that can be spared from the income of a collegiate institution, are as inadequate as the fragments of leisure at the disposal of men doing full work in other directions, to secure in reasonable time any very satisfactory outcome of investigation. In the absence of a Natural History Survey, supported and encouraged by the state, it is our purpose to make such progress as may be possible, even though the final summing up of results is likely to be long delayed.

In this paper two distinct types of Straparolli are illustrated — one, represented by a species from the Devonian, and another, represented by two species from the Upper Silurian. As recently emphasized by Keyes,[1] the shells of this group present such complete intergradation as to obliterate the distinctions between the proposed genera, *Straparollus*, *Euomphalus*, and *Phanerotinus* or *Eccyliomphalus*, and therefore in this paper the generic name *Straparollus* is employed for both types.

TEREBRATULA, LLHWYD.

TEREBRATULA (CRYPTONELLA) IOWENSIS, N. S.

PLATE III., FIGS. 4 a, b.

Shell large, ovate, widest at or below the middle, adult specimens very convex, greatest convexity a short distance in front of the umbo; front margin regularly rounded, truncate or slightly sinuate. Dorsal valve convex, curving gradually in all directions from a point situated at a variable distance behind the middle of the valve. Ventral valve, like dorsal, sloping from a point behind the middle line, the curvature increasing most rapidly toward the beak; beak only moderately incurved, perforated by a relatively small foramen; cardinolateral slopes rounding gradually, without the usual subangular ridge toward the deltidial plate; deltidial plate wide, its sides meeting beneath the foramen in an obtuse angle; mus-

1 Keyes, *Lower Carbonic Gasteropoda from Burlington, Iowa*, Proceedings Academy of Natural Sciences of Philadelphia, 1889, p. 291; and *Certain Forms of Straparollus from Southeastern Iowa*, American Geologist, Vol. V., April, 1890, p. 194.

cular scars of ventral valve elongated and bounded by sharp ridges that leave three grooves extending beyond the middle of the shell in the exfoliated cast, middle groove deeper than the other two, and extending in some instances almost to the front margin; sometimes the middle groove widens from the beak to about the middle of the valve, then narrows abruptly and is continued toward the front as a slender furrow. Muscular markings on dorsal valve very variable; in general, the scars were long and separated by a narrow carina. The other details, however, are far from being constant. Dental laminæ forming two short septa in umbonal cavity of ventral valve, nearly parallel or slightly diverging where their lower margins join the shell, but curving at their upper margins so as to conform nearly in direction to the lateral margins of the deltidial plate. Surface smooth, marked only by obscure lines of growth. Shell very finely punctate. Internal loop unknown.

Very common in beds of the age of the Hamilton period, associated with *Spirifera parryana*, *S. undifera*, *Cyrtina hamiltonensis*, *Atrypa reticularis* and other characteristic species, at one locality near Fayette, Iowa.

Large specimens are an inch and a quarter in length, more than an inch in width, and three fourths of an inch in thickness. Immature forms are very common.

In none of the specimens have I been able to find any traces of the internal loop. The shells in a large proportion of cases are hollow, the cavity being lined with crystals of calcite. The elongate muscular impressions are characteristic of the genus *Cryptonella*, as described by Professor Hall in the Fifteenth and Sixteenth Annual Reports on the State Cabinet of New York, and in the fourth volume of the Paleontology of New York, but whether the calcareous loop possessed the distinguishing characteristics of that genus has not been determined.

For some time I was inclined to regard the specimens from Fayette as merely large forms of *Terebratula lincklœni*, Hall, and numbers of them have been distributed to correspondents so named; but the larger size, the differently shaped and differently proportioned muscular impressions, the more nearly parallel dental laminæ and the finer punctation entitle this form to rank as a distinct species.

SCHIZODUS, King.

Schizodus symmetricus, n. s.

PLATE II., FIGS. 3, a, b.

Shell rather large for the genus, suborbicular in outline, length about one and one-eigth times the height; valves moderately convex; beak somewhat prominent, incurved, situated but a little forward of the middle of the slightly curved hinge line; anterior margin regularly rounded and passing without abrupt change of curvature into the rounded ventral margin; posterior margin obliquely truncated and joining the ventral margin in a short, abrupt curve; an obscure ridge extends from the umbo downward and backward to the junction of the posterior and ventral margins; shell somewhat concave between umbonal ridge and posterior margin; in the cast a distinct groove passes from the beak along the anterior border of the umbonal ridge, nearly half way to the basal margin.

Height, a little more than one inch. Length, exceeding one and one-eighth inches. Convexity about three-fourths of an inch.

This species resembles somewhat the form described as *Dolabra* (?) *alpina* by Professor James Hall in *Geological Survey of Iowa*, *Vol. I.*, *Part 2*, page 716, Plate XXIX., Fig. 2, but the difference in the outline of the front margin and in the width of the shell behind the beaks afford easily recognized distinguishing characteristics.

Found in the Upper Coal Measures at Braddyville, Iowa, associated with *Spirifera camerata*, *Streptorhynchus robustus*, *Terebratula bovidens*, *Productus semireticulatus*, *P. symmetricus*, *Chonetes granulifera* and other forms characteristic of that horizon.

PLATYSTOMA, CONRAD.

PLATYSTOMA NIAGARENSE, var. MULTILINEATUM, n. var.

PLATE II., FIGS. 4 a-c.

Platystoma niagarense, *Hall*, Twenty-Eighth Report on the State Museum, p. 175, Plate 28, Figures 1–4. Not the specimens of *P. niagarense* illustrated by other figures in the same report, nor those in Pal. N. Y., Vol. II.

Among the specimens of *Platystoma* from Waldron, Indiana, there is occasionally one conforming in outline to the typical specimens of *P. niagarense*, Hall, but differing in having the lines of growth, usually so prominent in this species, suppressed more or less completely, and the surface of the shell ornamented with well-defined, regular, equidistant revolving striæ. The form illustrated on Plate II., Figures 4 a–c, has the revolving striæ very perfectly developed, and the lines of growth are completely obsolete, so that the surface of the shell presents not even a suggestion of cancellation. Were the two types of *Platystoma* found in different localities, without intergrading forms, the characters in respect to which they differ would have specific value. The form is so distinct from the normal type of *P. niagarense*, that it will be convenient to have some ready means of designating it by name, and so I propose to separate it as variety *multilineatum*.

HOLOPEA, HALL.

HOLOPEA GRANDIS, N. S.

PLATE III., FIGS. 1 a, b.

Shell very large, ventricose, subconical; spire moderately elevated; whorls three or more, orbicular in cross section, lax in cast of the interior of the shell, increasing regularly and somewhat rapidly in size; aperture nearly circular; umbilicus, judging from the cast, relatively wide and deep; surface unknown.

Holopea magniventra, Whitfield, from the Guelph limestone of Wisconsin, is a large form allied to *H. grandis*. The present form, however, will be distinguished from *H. magniventra* by its more elevated spire, lax volutions, wider umbilicus and consequently greater difference in the lateral sweep of the successive volutions.

Found in Niagara limestone at Monmouth, Iowa, associated with *Pentamerus oblongus*, *Straparollus bicarinatus*, etc.

Height of specimen containing three large volutions, two and a half inches; width of base, measured from side to side at right angles to axis, two and a half inches.

STRAPAROLLUS, MONTFORT.

EUOMPHALUS, *Sowerby*.
ECCYLIOMPHALUS, *Portlock*.
PHANEROTINUS, *Sowerby*.

STRAPAROLLUS LATIVOLVIS, N. S.

PLATE I., FIG. I, AND PLATE II., FIG. I.

Shell very large, discoid, planorbicular; spire depressed below the level of the outer volutions; whorls few, not more than three, the casts rarely preserving more than one and a half; whorls rapidly enlarging from the apex, the outer one in large specimens attaining a diameter of more than two and a half inches. The contiguous volutions are scarcely in contact, and lie so nearly in the same plane as to make the spire and umbilical sides very much alike. Volutions slightly flattened above, more regularly rounded below. Aperture transversely elliptical. No carinæ.

From casts in the matrix it is seen that the surface was ornamented by regular, rather coarse striæ transverse to the whorls and parallel to the lines of growth.

This shell is known from natural casts of the interior and impressions of the external surface in the original matrix. The species is one of the largest of the genus, one of the specimens having a maximum diameter of six and one-fourth inches.

Found abundantly in limestone usually referred to the age of the Hamilton group of New York in Newton township, Buchanan county, Iowa, and occasionally in limestone of the same age at other localities in the same state.

I know of no species with which this could be directly compared. *Euomphalus decewi*, Billings, is a large species belonging to this same group, but *S. lativolvis* differs conspicuously from *E. decewi* in having fewer, broader and more rapidly expanding whorls; the whorls are more symmetrical; the flattening is on the upper, instead of on the lower side of the volutions, and the spire is proportionately less depressed. The whole shell is thinner and more discoidal.

STRAPAROLLUS BICARINATUS, N. S.

PLATE III., FIGS. 2 a, b.

Shell of medium size, rather large, whorls oblique, spire slightly elevated; lower side with a broad and moderately deep umbilicus, in which the successive volutions are each about half exposed; volutions four or five, very gradually expanding, suborbicular in cross section; periphery marked by a strong carina; a second carina, less prominent, sometimes almost obsolete, marks the middle of the dorsal side of each volution; lower side of the volutions rounded or marked in the middle line by a revolving, sub-angular ridge. On the upper side the spaces between the peripheral and dorsal carinæ and between the dorsal carina and the suture are regularly convex. Aperture nearly round, the deviation from the orbicular form being due chiefly to the salient angles corresponding to the carinæ. Surface marked by irregular, sinuous lines of growth. Indications of fine revolving striæ are seen on the casts. Maximum diameter of a large specimen, three inches.

All the known specimens of this fine species are in the form of casts in magnesian limestone.

Found in the Niagara limestone at Monmouth, Iowa.

STRAPAROLLUS TRICARINATUS, N. S.

PLATE II., FIGS. 2 a, b.

Shell of medium size, smaller than the preceding, spire depressed, but little elevated above the outer volution; umbilicus deep, exposing less than half of each successive volution; volutions four, the last enlarging rapidly, sub-pentagonal in transverse section; periphery carinated; a second carina on middle of dorsal side, and a third, less sharp than others, on middle of ventral side of each volution; volutions flat between peripheral carinæ and the median dorsal and ventral carinæ, sometimes even concave between periphery and middle of upper side; distinctly concave above between median carina and suture; lower side of volutions rounded between median carina and umbilicus. Aperture sub-pentangular.

Surface marked by transverse lines of growth crossed by faint revolving striæ.

Associated with *S. bicarinatus* in Niagara limestone at Monmouth, Iowa.

BUCANIA, HALL.

BUCANIA PERORNATA, N. S.

PLATE III., FIGS. 3 a, b.

Shell large; two and three eighths inches in length; volutions symmetrical, in same plane, transversely flattened and elliptical in cross section except toward the aperture, four in number, partly embracing but all showing in the deep umbilicus on either side, expanding slowly at first, then abruptly toward the mouth, which is longitudinally elliptical with a diameter equalling two thirds the entire length of the shell; dorsal surface rounded; margin of umbilicus marked in the earlier volutions by a sub-angular ridge which disappears toward the aperture; middle of dorsum marked by a low revolving ridge bounded on either side by a shallow groove; the rest of the surface ornamented by low ridges beginning on either side at the dorsal groove and running obliquely outward and forward over the lateral margin to the umbilicus, and crossed nearly at right angles by another system of more closely set ridges that, beginning in the umbilicus, run out over the lateral margin, and thence over the dorsal surface in a direction inward and forward, and so divide the surface into a series of symmetrically arranged quadrangular pits; the ridges of the second system are sometimes not quite continuous on opposite sides of a ridge of the first system, so that in some cases the pits in a given row stand opposite the broken ridges separating the pits in a contiguous row.

The foregoing description applies to cast of the interior.

Known only from casts found in Niagara limestone at Maquoketa, Iowa.

BUCANIA CYCLOSTOMA, N. S.

PLATE I., FIGS. 2 a, b.

A larger and more robust shell than the preceding, with volutions at first transversely elliptical in cross section, but gradually changing form and gradually expanding toward the circular aperture. Surface unknown, except that there are indications in the cast of a median dorsal groove; distinguished from other species of this genus by its size and shape, for particulars of which the reader is referred to the figures.

Found associated with preceding species in Niagara limestone at Maquoketa, Iowa.

THE SAPROPHYTIC FUNGI OF EASTERN IOWA.

T. H. McBRIDE.

On page 34 preceding, reference was made to certain plates which should serve to illustrate some of the structural peculiarities of the plants herein discussed. The plates Nos. IV. and V. accompanying the present issue are intended to accomplish this purpose. On Plate IV., Figures 3, 4 and 5 illustrate the Basidiomycetes (p. 32). Figures 3 and 4 represent the genus *Agaricus*, "trama filamentose," and Figure 4 of *Russula*, "trama vesiculose," both as defined on page 34.

To the white-spored Agarics already described we add the following species identified since the issue of BULLETIN No. 1:

Subgenus Amanita.

2[a]. AGARICUS VIROSUS, *Fr.*

Pileus conic-convex, then expanded, viscid, white, margin sub-lobate, repand, smooth; stipe stuffed, stout, rising from a bulbous base, more or less squamous all the way up to the broad, dependent annulus; lamellæ free, linear-lanceolate.

Height about 8′. Pileus 6′. September.

Spores spheroidal, .007–.008 mm.

Rare in damp woods. Reputed poisonous.

The whole plant is snow-white, and very stout and robust-looking; beautiful but ill-odorous. I have met with it but twice, but have no doubt of the identity of the species, as it agrees perfectly with Fries' description (as above) and with plate 1 in Cooke's Illustrations.

4[a]. AGARICUS PANTHERINUS, *DC.*

Pileus convex-expanded, at length perfectly flat, viscid, margin striate, flesh white; stipe stuffed, at length hollow, the enlarged base sheathed by the blunt-edged volva; lamellæ attenuate, free; annulus distinct and persistent, about half way up the slender stipe.

Height 4′–6′. Pileus 2′–4′.

Spores .007×.005. mm.

This species is also quite rare in our region; occurs in June and July in unfrequented woodlands. The color is described as variable, but never red or yellow. Ours are pure white, sometimes a little dusky about the disk, never so deeply tinted (not anything like it) as in Cooke's plate, although in other particulars closely correspondent.

Subgenus Pleurotus.

22[a]. AGARICUS ULMARIUS, *Bull.*

Pileus plano-convex, solid, fleshy, smooth, cream-white, sometimes flecked with darker tints; stipe sub-excentric, thickened downward, more or less tomentose at base, very stout; lamellæ adnate, crowded, broad and white.

Height 4′–5′. Pileus 6′–8′. Spores, .005 mm.

Habitat on elm trees, often high above the ground. Rare.

Ours are not very good Pleuroti, if we insist on defining Pleurotus as having the stipe lateral. Specimens of our present species are often perfectly symmetrical. However, the Pleuroti are epixylous, i. e., developed on wood, as tree-trunks, etc., and this peculiarity is frequently all one needs in order to make the proper generic reference. In the next species following, the stipe is wanting altogether.

22[b]. AGARICUS APPLICATUS, *Batsch.*

Pileus sessile, pale ashen, sub-membranaceous, somewhat firm, cup-shaped, resupinate, villous at the base; lamellæ broad, not crowded, thin.

Pileus a line or two wide.

Not rare on the bark of trees, chiefly oaks, associated with lichens, some of which the agaric much resembles. Only to be recognized, or at least identified, by the aid of a good lens.

Of the genus under consideration we may now proceed to the third section.

SERIES III. DERMINI.—The Rusty-Spored Agarics.

The spores in this series are well described as ferruginous (having the color of iron-rust). They are always of some shade of yellowish or reddish brown. Because of the color of the spores Saccardo includes here the genera *Cortinarius* and *Paxillus*, and names the series *Ochrosporæ* or *Derminæ*.[1] But the former genus is so well defined by its remarkable veil, as well as by the *tout ensemble* of its characters, that it seems convenient to leave it apart, and Paxillus verges so closely upon the Boleti and Polypores that it may well be dis-

1 As to the orthography here, the concord of *Dermini* was doubtless intended to be with *Agarici*, tawny Agarics, *Agaricus* being masculine; *Derminæ* is better, the concord being with *sporæ*, i. e., tawny spores. The old form is here retained because the term is employed in the original limited sense as by Fries.

cussed later. Besides, in our Iowa species of Paxillus the spores are whitish or yellow.

Subgenus Pholiota.

Stipe annulate and confluent with the hymenophore.

25. AGARICUS ADIPOSUS, *Fr.*

Pileus yellow, compact, firm, convexo-plane, viscid when moist, covered with seceding scurfy, brown or reddish scales, somewhat concentrically arranged; lamellæ, broad, adnate, at first yellow, then stained with the ferruginous spores; stipe firm, stuffed or solid (nearly), concolorous, somewhat scaly and slightly bulbous at the base; annulus inconspicuous.

Height 3′–5′. Pileus 2′–3′. Stipe ½′. Spores elliptic, .004×.008 mm. September–October.

This, one of our most beautiful species, is not rare in all our wooded region. The plants are generally cœspitose and more or less distorted by mutual interference. They spring out horizontally from some log or stump, at first golden-yellow flecked with brown, and exceedingly sticky, at length paler, smooth and shiny when dry. Not edible; the taste that of the rotten wood from which the fungus springs.

26. AGARICUS TUBERCULOSUS, *Fr.*

Pileus dull yellow, fleshy, convexo-plane, obtuse, *dry*, covered with innate, appressed, scurfy scales; lamellæ broad, serrulate, yellow, inclining to cinnamon; stipe concolorous, scaly or fibrillose, hollow, short and bulbous; annulus sub-membranaceous and deciduous.

Height 1′–2′. Pileus 1½′–3′. Spores elliptic, .005×.009 mm. June.

Rare. Resembles somewhat the preceding species, is lignatile and somewhat cœspitose, but is smaller, not brightly colored, and is never glutinous. Inedible.

27. AGARICUS UNICOLOR, *Vahl*, *Fl. Dan.*

Pileus brown, ochraceous, somewhat fleshy, campanulate, becoming convex, smooth, hygrophanous; lamellæ adnate, seceding, broad, pale cinnamon brown; stipe concolorous, at length hollow, distinctly and persistently annulate.

Height 1′–2′. Pileus about 1′. Spores elliptic, .006×.008 mm. Autumn.

A very common little species, found everywhere on rotten logs, etc., in moist ravines; inclined to be cœspitose, when it forms a conspicuous object long after the leaves have fallen.

Subgenus Inocybe.

Veil universal, concrete with the cuticle of the pileus, and sometimes dependent from the margin in form of cobwebby threads. Some forms resemble species of the genus *Cortinarius*, but differ in having the lamellæ moist, or at least not dusted by the seceding spores.

28. AGARICUS LANUGINOSUS.—*Bull.*

Pileus brown, becoming yellowish, somewhat fleshy, hemispherical, then expanded, adorned with floccose scales, those on the disk (center) erect, pointed; lamellæ seceding, thin, denticulate, pale yellow; stipe solid, fibrillose, whitish above.

Height 1′–2′. Pileus 1′ or less. Spores——.

Rare. A terrestrial species described as occurring under beech trees or in beech forests. The specimens referred here to this species seem to correspond to Fries' descriptions, but occur in our oak groves and undisturbed woodlands generally.

Subgenus Flammula.

Pileus fleshy, margin at first involute. Veil fibrillose or none. Stipe fleshy—fibrous. Lamellæ decurrent, or at least adnate.

29. AGARICUS FUSUS, *Batsch.*

Pileus dull brown, compact, convex-expanded, smooth, somewhat viscid; lamellæ narrow, decurrent, from dull yellow becoming brown; stipe stuffed, concolorous, fibrillose-striate, sub-fusiform, attenuate, rooted. Annulus none.

Height 2′–3′. Pileus 3′–4′. Spores elliptic, .008–.012× .005–.006 mm.

Very common in woodlands on the ground in late summer and fall. Ours have the stipe nearly solid, or stuffed below only. The disk is somewhat depressed in older specimens. The gills are decurrent, as in Cooke's figure, plate 434; in all other particulars our specimens correspond to the figures on plate 433, Cooke's Ill. Br. Fungi.

Subgenus Naucoria.

Pileus as in Flammula. Veil none. Stipe cartilaginous. Lamellæ free or adnate, but not decurrent.

30. AGARICUS SEMIORBICULARIS, *Bull.*

Pileus rusty yellow, somewhat fleshy, hemispheric, smooth, somewhat viscid; lamellæ adnate, broad, close, at length ferruginous; stipe graceful, slender, pale yellowish, shining, stuffed with a distinct pith. Annulus none.

Height 2′–3′. Pileus ½′–1′. Spores elliptic, .0075× .012 mm.

Rather common in autumn in pasture fields, woodlands, and by the waysides everywhere.

Subgenus Galera.

Pileus more or less membranaceous, conic, oval, then expanded, margin at first straight and appressed to the stem. Veil none. Stipe cartilaginous. Lamellæ not decurrent.

31. AGARICUS TENER, *Schæff.*

Pileus pale brown, hygrophanous, paler when dry, conic-campanulate, obtuse; lamellæ adnate, close, linear, cinnamon; stipe straight, fragile, shining, concolorous, ex-annulate.

Height 2′–5′. Pileus ½′–1′. Spores elliptic, .007×.014 mm.

Very common in summer on lawns and grassy places, coming up thickly after a warm rain; a most delicate and beautiful little species. Usually striatulate when wet, and having the stipe frequently pubescent at the base.

32. AGARICUS HYPNORUM, *Batsch.*

Pileus pale brown, membranaceous, campanulate, smooth, striate, hygrophanous; lamellæ adnate, broad, remote, pale cinnamon; stipe slender, flexuous, concolorous, pruinose above.

Height 1′–1½′. Pileus ¼′–½′. Spores .006×.012 mm.

A delicate little plant, common in spring on fresh, green tufts of various mosses, in damp woods.

Subgenus Crepidotus.

Pileus excentric, lateral or resupinate.

33. AGARICUS MOLLIS, *Schæff.*

Pileus gelatinous-fleshy, soft, obovate or reniform, sessile, smooth, pallid becoming canescent; lamellæ decurrent, crowded, linear, tawny.

Pileus ¾′–1½′. Spores elliptic, .005×.009 mm.

Common on fallen trees and branches, particularly on species of Populus. Variable in form and color, either solitary or imbricated. September–December.

SERIES IV. PRATELLI.—The Purple-Spored Agarics.

Spores blackish-purple or purplish-brown, rarely fuscous.[1]

Subgenus Psalliota.[2]

Stipe annulate and lamellæ free.

34. AGARICUS ARVENSIS, *Schæff.*

Pileus white or smoky-tinted, conic-campanulate, at length explanate, at first floccose-farinose, then nearly glabrous; lamellæ free, outwardly broadening, at first white, then somewhat tinged with pink, at last blackish brown; stipe hollow with floccose pith; annulus pendulous, large, double, the outer part radiately cleft.

1 Cooke's Handbook of British Fungi.

2 In Saccardo's enumeration of Agaricine species, where all the sections here referred to as subgenera are raised to the rank of genera, the generic name *Agaricus*, L., supplants *Psalliota*, Fr., so that the three species 34, 35 and 36 may be considered as Agarics *par excellence*.

Height 3′–6′. Pileus 3′–8′. Spores elliptic, .009×.006 mm.

This mushroom is very much like the "common mushroom," next described, so much so that it is by many regarded a mere variety of that species. American authorities seem to agree in regarding it a distinct species, and possibly it is here more distinct, though certainly not more so than is indicated by Cooke's illustrations. Variations in Iowa are to be explained by local conditions. As the name indicates, the species appears in cultivated grounds (*arvum*), is cœspitose in habit and not abundant, sometimes of great size, and is here called the "Big Mushroom" or "Field Mushroom." In England the proper name is "Horse Mushroom," and that name is also sometimes heard here.

The flesh is white, and, when bruised, shows a yellowish tinge, if any. The lamellæ are never deliquescent, but endure a long time and finally dry up. September and October.

35. AGARICUS CAMPESTER, *L.*

Pileus white or dusky, fleshy, plano-convex, floccose-silky or scurfy, the margin surpassing the lamellæ; lamellæ free, rounded, at first pink (very delicate), then brown, at length almost black, and watery or somewhat deliquescent; stipe stuffed, smooth and white; annulus not large, about midway on the stem.

Height 2′–4′. Pileus 1½′–4′. Spores elliptic, .0065×.009 mm.

This is the "Common Mushroom," the "Edible Mushroom," etc., extensively cultivated and used for food in all lands, and exhibiting many varieties, of which I have recognized perhaps one here, var. *hortensis*, in which the pileus is brownish and covered with hairy fibrils. See also the next article, and Plate IV., Figs. 1, 2 and 3.

36. AGARICUS SYLVATICUS, *Schæff.*

Pileus white or tawny, at first brown, scaly, then smooth, thin, campanulate, then expanded; lamellæ free, close, thin, narrowed each way, at first reddish, then cinnamon; stipe slender, equal, hollow, with a slight annulus.

Height 3′–4′. Pileus 2′–3′. Spores elliptic, .004×.007 mm.

In the woods, but not common. Here denominated the "Wild Mushroom," and deemed poisonous. Probably we may say inedible and let it alone; the pileus is thin, and the whole plant looks like a depauperate form of some nobler species.

Subgenus Stropharia.

Hymenophore continuous with the stipe. Stipe annulate. Gills more or less adnate.

36. AGARICUS SEMIGLOBATUS, *Batsch.*

Pileus pale yellow, somewhat fleshy, hemispherical, viscid when moist, smooth and shining when dry; lamellæ broad, attached, clouded with black; stipe slender, graceful, hollow, glutinous and yellow, like the pileus, the annulus slight and spore-stained.

Height 3′–4′. Pileus ½′–1′. Spores elliptic, .009× .014 mm.

Very common on manure in pasture fields and on manured ground, lawns, etc., from May to late fall. Said to be poisonous; it is in any case insignificant and inedible.

37. AGARICUS STERCORARIUS, *Fr.*

Pileus dull or bright yellow, somewhat fleshy, hemispheric, at length expanded, smooth and slightly viscid; lamellæ broad, adnate, white, at length of varying tints, brown to ochraceous, black; stipe slender, slightly viscid when moist, stuffed with a white pith, more or less floccose below the ring.

Height 2′–3′. Pileus ½′–1′. Spores .012×.018 mm.

This little species is like the preceding in appearance, habitat and abundance. It is distinguished by the expanded pileus and stuffed stipe. Both species are of wide distribution, very pretty, and, from an economic point of view, very useless.

Subgenus Hypholoma.

Pileus fleshy, at first incurved; the veil rudimentary and adherent to the margin. Annulus none.

38. AGARICUS SUBLATERITIUS, *Schæff.*

Pileus yellow, the disk reddish brown, fleshy, convex, then expanded, at first silky then glabrous; lamellæ not broad, adnate, yellowish, olive-green, then purple or purplish brown; stipe yellow, equal, sometimes silky or fibrillose and brown at the base, hollow or stuffed.

Height 2′–6′. Pileus 2′–5′. Spores .004×.006 mm.

One of our most common autumnal species, in protected situations fruiting through the winter. Found at the base of stumps, in crowded, cœspitose tufts, but sometimes isolated, when the maximum size is attained. A spore-stained band sometimes marks the place of the annulus. The changing lamellæ are very characteristic, and all the tints named can easily be found in a single tuft. *A. perplexus*, of the Twenty-third New York Report, seems to be the same thing.

Inedible, the taste by no means enticing.

39. AGARICUS LACHRYMABUNDUS, *Fr.*

Pileus pale brown, scaly, the scales innate and darker, fleshy, convex; lamellæ adnate, crowded, purplish-brown, generally edged with minute water-drops like so many beads of white; stipe white, fibrillose-scaly, hollow.

Height 3′–5′. Pileus 2′–4′. Spores elliptic, .005×.009 mm.

A stout, handsome and well-marked species, easily recognized by the characters cited. Found in autumn on the ground and on rotten trunks, commonly in clusters, gregarious or cœspitose.

A tough, persistent species, the odor and taste alike disagreeable. Not common.

40. AGARICUS VELUTINUS, *Pers.*

Pileus somewhat fleshy, slaty-brown in color, campanulate-expanded, umbonate, at first tomentose with appressed fibrils, at length smooth, the flesh thin, concolorous; lamellæ seceding, close but not crowded, brown, often beaded with drops of moisture; stipe hollow, more or less fibrillose, brownish at base, yellow above.

Height 4′–6′. Pileus 3′–4′. Spores elliptic, .005 × .009 mm.

Not common. Distinguished from the preceding species by the pileus not scaly, campanulate and thin. In No. 39 the whole make-up is stout and firm; here, just the reverse.

Found in unkept yards and lawns about the city. Inedible.

41. AGARICUS CANDOLLEANUS, *Fr.*

Pileus yellowish-white or dusky, thin, from campanulate-convex at length expanded, smooth, hygrophanous; lamellæ round-adnate, crowded, at first violet, then brownish to cinnamon; stipe white, hollow, very frail, striate above.

Height 2′–5′. Pileus 2′–4′. Spores elliptic, .004 × .007 mm.

Very common from May to October about decaying stumps or roots, anywhere on lawns, in pastures and in woods, and very well defined. In large specimens the lamellæ seem narrow for the size of the pileus, and the margin becomes reflexed and lacerate in wet weather. The spores by reflected light show the rich purplish-brown characteristic of the series, but on the microscope the purple tints disappear, and only a beautiful brown (*spadiceus*) remains. Usually in dense clusters, sometimes solitary or gregarious. Not edible, though the taste is pleasant and the odor mealy.

Subgenus Psilocybe.

Pileus more or less fleshy, the margin at first incurved. Veil none. Stipe subcartilaginous.

42. AGARICUS SPADICEUS, *Fr.*

Pileus hygrophanous, brown, becoming pale when dry, fleshy, convexo-plane, smooth; lamellæ round-adnate, dry, close, white, then rusty brown; stipe hollow, tough, smooth at the apex.

Height 2′–3′. Pileus 1′–3′. Spores elliptic, .008×.005 mm.

Very common on lawns and in cultivated lands all summer, especially after rains. Older specimens are paler, almost white, and have the pileus completely explanate and split about the margin. Not edible.

SERIES V. COPRINARII.—The Black-Spored Agarics.

The spores in this series are jet black, and the species differ from those of the following genus, *Coprinus*, only in that they are not deliquescent.[1]

Subgenus Panæolus.

Pileus somewhat fleshy, not striate, the margin exceeding the lamellæ.

43. AGARICUS CAMPANULATUS, *Linn.*

Pileus somewhat fleshy, campanulate, dry, even and sub-shining, yellowish; lamellæ adnate, seceding, gray becoming black; stipe straight, slender, reddish, hollow, striate and dark-pulverulent at the apex.

Height 4′–6′. Pileus ½′–1½′. Spores elliptic, .012× .015 mm.

Very common all summer on horse dung and richly manured land; remarkable for the rapidity of its development.

44. AGARICUS FIMICOLA, *Fr.*

Pileus somewhat fleshy, sordid whitish, campanulate-convex, smooth, marked with a narrow fuscous zone around the margin; lamellæ adnate, broad, gray mottled with black; stipe frail, equal, pallid, whitish at the apex.

Height 2′–4′. Pileus 1′–2′. Spores elliptic, .010×.015 mm.

Very common in similar places and with the preceding. Easily known by the marginal band, which is very noticeable when the plant is moist.

1 By Saccardo all the black-spored genera are grouped together in a single section, i. e., the *Pratelli*, the *Coprinarii* and the *Coprini*, as here described, are united under the title *Melanosporæ*. The arrangement of Fries is, nevertheless, a convenient one, and cannot in any systematic arrangement well be ignored. The sub-divisions instituted at the outset are therefore still adhered to.

45. Agaricus papilionaceus, *Fr.*

Pileus yellowish, somewhat fleshy, hemispheric, smooth, the cuticle sometimes breaking into scales; lamellæ very broad, adnate, at length jet black; stipe slender, firm, hollow, pruinose and slightly striate above.

Height 3′–5′. Pileus ½′–¾′. Spores elliptic, .008× .015 mm.

Common. Occurs in similar places and with the preceding species. Resembles *A. semiglobatus*, but has no annulus. The very wide lamellæ distinguish the plant from No. 43.

Subgenus Psathyrella.

Pileus membranaceous, striate, the margin not surpassing the lamellæ.

46. Agaricus atomatus, *Fr.*

Pileus whitish, sub-membranaceous, campanulate, obtuse, striatulate, hygrophanous, rugulose when dry, covered with minute, shining particles; lamellæ adnate, broad, quite distant, becoming black; stipe slender, flexuous, white.

Height 2′–3′. Pileus ½′–¾′. Spores elliptic, .008× .012 mm.

A very delicate species, distantly resembling *Coprinus plicatilis*, for which it is often mistaken. Our species are pure white, except the disk, which is ochraceous or reddish. Common on grassy lawns, the stipe rooting and mycelio-attached to the decaying leaves and to the ground.

GENUS COPRINUS, *Fr.*

Hymenophore distinct from the stipe. Lamellæ membranaceous, at first cohering, easily split, at length dissolving into an inky fluid; trama none. Spores black.

The species of this genus are easily known by their deliquescent lamellæ. Some of them are exceedingly transient, springing up in a night and melting with the advancing sun. Most species grow about manure heaps, as the name of the genus would apprise us, or on manured land, but some flourish on decaying wood. For description the genus has been divided into two sections according to the nature of the pileus:

a. Pileus splitting, but *not* along the back of the lamellæ, - *Pelliculosi.*
b. Pileus splitting along the back of the lamellæ, - - *Veliformes.*

a. Pelliculosi.

1. COPRINUS COMATUS, *Fr.*

Pileus at first cylindric, then expanded, roughened with broad, fibrous scales, the margin presently lacerate and revolute; lamellæ linear, crowded, free, white then pink, finally black; stipe hollow, fibrillose, annulate with a movable ring.

Height 6′–10′. Pileus, unexpanded, 1′–2′. Spores elliptic, .008 × .15 mm.

A most showy and beautiful species. Rather common in September and October about hot-beds and manure heaps, or even in rich soil or in grassy places along the highway. The pileus is often snowy white, generally sordid or ashy. The lamellæ pass rapidly through a great variety of shades from white through pink, "ashes of roses" to black, dissolving from the reflexed margin upwards, and at length vanishing in a puddle of inky fluid surprising to behold! Gregarious or solitary, not cœspitose. Edible.

2. COPRINUS ATRAMENTARIUS, *Bull.*

Pileus cinereous or brown, somewhat fleshy, ovate-expanded, spotted on the disk with innate brown scales; lamellæ free, ventricose, tapering both ways, at first white, then purplish-black; stipe hollow, firm, with an evanescent annulus.

Height 2′–6′. Pileus 1½′–3′. Spores elliptic, .006 × .009 mm.

Very common everywhere in dense tufts and masses, rarely solitary, of all shapes, usually rugose-plicate. Much more enduring than the preceding species; appearing from May until December; not edible.

3. COPRINUS NIVEUS, *Fr.*

Pileus white, sub-membranaceous, oval-campanulate, then expanded, villous or floccose-scaly; lamellæ narrow, crowded, attached, white, then pinkish, at length black; stipe hollow, equal, fragile, white and villous. Annulus none.

Height 3′–4′. Pileus 1′–1½′. Spores .010×.014 mm.

Common about stables, especially after summer showers. Very pretty and delicate, the margin soon revolute.

4. COPRINUS MICACEUS, *Fr.*

Pileus ochraceous or brown, membranaceous, ovate, then campanulate, repand, striate, rimose, sprinkled with minute glittering particles, but soon entirely nude; lamellæ adnate, lanceolate, crowded, white, at length black; stipe hollow, silky, smooth, white, easily splitting.

Height 2′–6′. Pileus ½′–1′. Spores apiculate, .006×.008 mm.

Very common the year through at the base of stumps and on the ground in dense cœspitose masses. Like No. 2, but much smaller and more delicate every way. Has no annulus and no scales. The shining particles, except in young specimens, can rarely be detected by the unaided eye.

b. Veliformes.

5. COPRINUS NYCTHEMERUS, *Fr.*

Pileus ashy white, the disk yellowish, very thin and delicate, at first conic-cylindric, soon splitting and expanded, radiato-plicate; lamellæ free, narrow, few, vanishing to mere black lines; stipe very slender, hollow, white.

Height ½′–1½′ or more. Pileus about ½′ or less.

Everywhere on manured land, lawns, etc., from May to September.

6. COPRINUS PLICATILIS, *Fr.*

Pileus pale, very thin, at first conic-campanulate, then expanded, sulcate-striate, the disk smooth, brownish, depressed; lamellæ adnate to the expanded top of the stipe, as if attached to a collar, narrow, remote; stipe slender, fragile, smooth, hollow.

On the moist earth on lawns, fields, woodlands, very short-lived, evanescent.

COMMON SPECIES OF EDIBLE FUNGI.

T. H. McBRIDE.

Many of our Saprophytic Fungi are edible. Some, however, are not. Of these the greater number are simply unpalatable, woody or insipid; some few are actually poisonous. This last fact has been sufficient usually to exclude the whole class, not from our tables only, but even from acquaintance and experiment. Nevertheless, edible fungi there are, and these, when properly cooked and served, constitute most palatable and nutritious food, and well repay the trouble of their collection.

We have not here opportunity to portray all the edible species of our Iowa flora, but simply attempt by description and figure to make familiar one or two long approved species which are happily common, and ought to be everywhere recognized and made serviceable.

The question constantly comes up, "How do you distinguish a toadstool from a mushroom?"—mushrooms being esteemed edible, toadstools not. It is hoped that the following descriptions, with accompanying illustrations, will at least be helpful to all interested in solving this problem.

In respect to form—

Our edible fungi offer three distinct types, popularly known as Mushrooms, Puff-balls and Morels. This popular classification is perfectly good so far as it goes; external form and internal structure alike corroborate it. The Morels proper are, I believe, without exception esculent, yet these, in this part of the world, are least of all known and appreciated. Mushrooms and Puff-balls require close attention and accurate discrimination.

Our common MOREL is —

MORCHELLA ESCULENTA, *Linn.*

Pileus (upper, cap-like part) cream-yellow or buff when mature, ovate, oblong or even globose, attached to the stem below, and covered all over with (more or less) shallow depressions or pits caused by the uniting or anastomosing of the numerous ribs; stipe short (about 1′ or 2′), often irregular, hollow, concolorous, slightly granular.

Height 4′–6′. Diameter of pileus about 1′. Plate V., Figs. 1 and 2.

This species, when collected fresh and suitably cooked, certainly affords a welcome dish. It appears in early spring (April to May in our latitude), in woodlands, orchards and meadows, supported apparently by the decaying roots of trees recently felled, though not confined to these; hence more commonly found about stumps, sometimes cœspitose, in clusters from two or three to a dozen together.

The entire make-up of the plant is so characteristic and peculiar that it seems hardly possible that anyone having once seen a specimen or even a reasonably good figure should ever mistake the species. Young specimens have generally a sooty or smoky tint between the ridges, sometimes almost black. Such specimens are perfectly edible, though hardly at their best.

A related form, *Gyromitra esculenta*, Fr., rare in our locality, is much larger, is undulate-rugose, not pitted, and is brown in color. This species is reckoned edible, although the English botanists say "not always safe." The denuded pileus of the stink-horn (*Phallus dæmonum*, Rumph.) is pitted, but is sufficiently repulsive on general principles to ward off the boldest collector, and needs no description here.

The edible mushroom, however, is —

AGARICUS CAMPESTER, *L.*

Pileus solid, fleshy, smooth or silky-floccose, pale brown or tawny, at first convex-hemispherical, at length expanded, the margin thin and slightly exceeding the gills; lamellæ broad, rounded, and free behind, at first delicate pink, then brown to almost black, becoming watery with age; stipe short, slightly bulbous at base, stuffed, girt about the middle with a distinct ragged ring.

Spores rich brown in color, with a purplish tinge.

Height 2′–4′. Pileus about the same. Plate IV., Figs. 1 and 2.

This species will be easily recognized by the color of the gills, or lamellæ, *at first pink*, as the veil breaks away, *becoming brown*, at length almost black. The pileus is rarely smooth, usually silky, of various brown tints, sometimes almost white. There are several varieties, but the variations are chiefly in the surface of the pileus, and concern the color and degree of silkiness.

Not abundant, the edible mushroom may yet be found common in richly manured gardens and fields, abandoned stock-yards and similar places from August until October, or later in favorable seasons. It is extensively cultivated in Iowa and Illinois in green-houses, cellars, abandoned cement quarries and caves, and it may be fairly questioned whether the species has not been so introduced from the eastern states or from England.

A. arvensis, *Schæff.*, is a native species closely related to the "edible mushroom" and occurring in similar situations. It is commonly called "horse mushroom," is a much coarser and larger form, and, though edible, is not so highly esteemed as is *A. campester*. It may be usually distinguished by the characters named, as well as by the fact that the lamellæ are at the outset *white*, then pink or flesh-color, at length brown. The ring or annulus is much larger and more persistent. The size is variable, but may be given: Height 3′–4′. Pileus 3′ 6′. Stipe often an inch or more thick.

Both *A. campester* and *A. arvensis* grow singly and in tufts.

Our Puff-balls are nearly all edible. Some, however, are so small as to be of no practical value, and a few are not palatable. The species we have selected to figure is one very common in our region—

LYCOPERDON CYATHIFORME, *Bosc.*

Purple-spored Puff-ball.

Nearly globose, sessile, or with a short, stout, stem-like base firmly attached to the ground; in color ashy, often with a tinge of pink; surface smooth or smoothish and marked in reticulated pattern, the epidermis seceding in patches. At maturity the plant breaks away, leaving a more or less cup-like base with lacerate margin (*cyathiforme*=cup-shaped). The entire contents, capillitium and spores, purplish-brown, with exposure fading to a delicate ashy purple. Diameter three to six inches. Spores rough, .00016′–.00025′ inches. Plate V., Figs. 3 and 4.

The purple-spored Puff-ball is autumnal, and very common in our fields and meadows; occurs either solitary, when the size may reach the maximum (6′), or gregariously, when a number of medium-sized individuals are found occupying a small area.

To be associated with this species as likewise edible and palatable are *L. bovista*, *L.*, and *L. cœlatum*, *Bull.* The first is commonly known as the giant puff-ball, frequently fourteen to sixteen inches in diameter; the second much smaller, but with a short, stout stem or stem-like base, is not favored with any popular scientific name—is simply a puff-ball. Both species are well worth knowing and enjoying *when fresh.* Both two are rather common in our locality, eastern Iowa, the first-named especially so, fine specimens reaching our laboratories every fall.(1)

(1) See on this subject, also on mode of cooking puff-balls, 32nd An. Rep., N. Y. Museum Natural History; Morels and Puff-balls of Madison, Wis., by Prof. Trelease, Pop. Sci. Monthly, Vol. XXXV, pp. 187–93.

THE LŒSS AND ITS FOSSILS.[1]

B. SHIMEK.

In the determination of the physical conditions under which the formation of various strata of the earth took place, the fossils have always furnished one of the most satisfactory, and consequently most important considerations. Organic forms, being dependent for their very existence upon these conditions, and usually readily responding to any modification of them, would certainly reflect their character most clearly. This importance of organic remains being manifest, it is purposed here to view the extensive Lœss deposits which overlie the drift over large areas of the Mississippi and Missouri River drainage in the light of their fossils. The fauna of the Lœss is essentially molluscan. While remains of Vertebrates, and perhaps representatives of other branches, are occasionally found, certainly the Mollusks furnish the most abundant and the clearly characteristic fossils.

Consequently such conclusions as we draw from the character of the life of the Lœss must be based primarily upon the molluscan remains.

1 As the writer contemplates publishing very soon a detailed description and comparison of the Lœss Mollusca, proper credit will then be given for material kindly furnished by a number of persons. The observations here recorded were made upon many thousands of fossil specimens from Dubuque, Bremer, Scott, Muscatine, Johnson, Iowa, Polk, and Pottawattamie counties in Iowa; and Douglas, Saunders, Lancaster, and Cuming counties in Nebraska. These were compared with recent specimens from all portions of this continent north of Mexico, as noted in connection with each species. The comparisons were made by placing large series of the recent and fossil shells side by side, and, where necessary, by making careful measurements. The partial results here noted represent a more or less continuour study of the Lœss and its fossils during the past eight years.

I. THE FOSSILS.

The list of fossils here given includes only those which the writer has examined, and which, considering that they were collected in at least twenty-five widely separated localities in Iowa and Nebraska, certainly may be considered as representative of the fauna of the Lœss in these states.

In this section of this paper the fossils are first arranged systematically with brief comparative notes on form and size and also on the distribution [1] of recent representatives of the species noted. This is followed by a grouping of the species according to habitat and abundance.

Helicina oculta, Say. Abundant. Fossils from Johnson, Scott, and Polk counties, Iowa, and Cuming and Lancaster counties, Nebraska were compared with recent specimens from Hardin and Johnson counties, Iowa, On the whole the fossils are a little smaller in average size than the recent shells, though many of them exceed the smaller ones from Hardin county. None of the fossils equal the larger Johnson county specimens.

This species has frequently been mentioned as an aquatic or semi-aquatic Mollusk belonging to the Lœss, though its habitat (in Iowa at least) is on very high, steep, cool hillsides, where it is associated with *mesodon profunda* and *Selenites concava* (which preys on it). This error arises from the fact that *Helicina* belongs to the gill-bearing *Prosobranchiata*, though it is strictly terrestrial in its habits. Recent shells have been found in Wisconsin, Virginia, and Johnson and Hardin counties, Iowa.

Zonites arboreus, (Say) Binn. Rare in the Lœss of Johnson and Polk counties, Iowa. The condition and small number of the specimens make it unsafe to refer definitely to the comparative development of the fossil and recent shells. Recent

1 The limits of distribution were ascertained from Binney's "*Terr. and Air-breathing Moll. of the U. S.*" Vol. V, Pilsbry's "*Nomenclature and Check-list of N. American Land Shells*," Proc. Acad. Nat. Science, Phila., 1889, and the writer's private collection.

specimens from all of the states from Nebraska to Canada show considerable variation in size, within the extremes of which the few fossils which were examined would easily fall.

This species occurs at present throughout the United States.

Zonites radiatulus, Alder. Not common. Fossils from Johnson county, Iowa, and Lancaster county, Nebraska were compared with recent shells from Iowa, Illinois and Nebraska. The latter are somewhat variable, the range of variation covering the fossils. At present this species is circumpolar in its distribution, and extends southward to the Gulf of Mexico.

Zonites minusculus (Binn.) Fisch. and Cr. Rather rare. Fossils from Johnson county, Iowa, and Lancaster county, Nebraska, were studied. Owing to the scarcity and condition of the fossil material satisfactory comparisons could not be made.

Distributed at present throughout the United States.

Zonites limatulus, (Ward) Binn. Common. Fossils from Johnson county, Iowa, and Cuming, Saunders, and Lancaster counties, Nebraska were compared with recent specimens from Indiana and Illinois. The fossils, which show but little variation, are uniformly larger than any recent shells observed by the writer, and exceed the dimensions given by Binney.

The present range of typical *Z. limatulus* is from New York to California, and northward.

Zonites fulvus, (Drap.) Binn. Quite common. Fossils from Johnson, Polk and Pottawattamie counties, Iowa; and Cuming, Saunders, and Lancaster counties, Nebraska were compared with recent shells from Montana, Nebraska, Iowa, Illinois, Ohio, and New York. The fossils average larger than the recent shells, the Montana specimens alone equalling them in size.

A circumpolar species, occuring now throughout the United States.

Helicodiscus lineatus, (Say) Morse. Not common. Fossils from Bremer, Dubuque, Scott, and Johnson counties, Iowa were compared with recent specimens from Nebraska, Iowa, Illinois, Ohio, and Vermont. No notable difference was discovered.

The species now occurs throughout the United States.

Patula strigosa cooperi, W. G. B. Not common. Fossils from Johnson and Polk counties, Iowa were compared with recent specimens from Idaho, Montana, and Wyoming.

The fossils are much smaller than most of the recent shells which were examined, those from Mullan, Montana (altitude, 5,600 feet) alone approaching them.

This form occurs at present from Colorado to Montana.

Patula alternata, (Say) Binn. Not common. The fossils from Pottawattamie county, Iowa, closely resemble recent shells from Northern Michigan, though rather smaller. The Polk county, Iowa fossils are still smaller. The recent shells from Nebraska, Iowa, Minnesota, Illinois, Tennessee, etc., are uniformly larger than the fossils. The small number of specimens of the latter however render all estimates of variation unsatisfactory.

The species occurs at present over all the eastern portion of the United States, and north to Labrador.

Patula striatella, (Anth.) Morse. Very common. Fossils from all of the localities mentioned in the foot-note on page 200, were compared with recent specimens from Iowa, Minnesota, Michigan, Illinois, Ohio, and New York. The variation in size is but slight, and there is no appreciable difference between the recent and fossil shells in this respect.

Fossil eggs of this species are not uncommon. These were compared with recent eggs from Iowa City. Those from Lancaster county, Nebraska are smaller than the recent specimens, those from Johnson county, Iowa equal them, while those from Cuming county, Nebraska are larger.

This species is now distributed from Virginia to Kansas, and northward.

Stenotrema leaii, (Ward) Binn. Not common. Fossils from Polk county, Iowa, and Saunders county, Nebraska, closely resemble recent specimens from Iowa, Illinois and Nebraska.

This form is at present found from Ohio to Nebraska, and north to Michigan.

Mesodon multilineata, (Say) Try. Not uncommon. Fossils from Johnson county, Iowa, and Cuming and Saunders counties, Nebraska, are much smaller than the ordinary form of this species which is commonly found on river bottoms, but in size and in the heavier shell they very closely approach specimens from Johnson, Hardin, and Pottawattamie counties, Iowa, which were collected in the vicinity of prairie swamps.

Vallonia pulchella, (Muella) Binn. Quite common. Fossils from Johnson and Muscatine counties, Iowa, and Cuming, Lancaster, and Saunders counties, Nebraska were compared with recent specimens from Nevada, Montana, Dakota, Iowa, Minnesota, Indiana, Ohio, New York, and Vermont. The fossils are somewhat larger than than the majority of the recent specimens which were examined, being equalled only by those from Montana and Nevada (in both cases from high altitudes). There is some variation in both the recent and fossil shells, but the averages are as above stated. This form is the typical *V. pulchella*. The smaller var. *costata* was not found in the Lœss.

Ferussacia subcylindrica, (L.) Binn. Not very common· Fossils from Johnson county, Iowa, and Lancaster county, Nebraska were compared with recent specimens from Montana, Nebraska, Iowa, Ohio, New York, and Canada. There is but little variation in the size and form of both the recent and fossil shells, and the latter are not distinguishable from the former except by the bleached appearance peculiar to the Lœss fossils. This species is now found from Nebraska to New York, and northward, and is common to Europe, Asia, and North America.

Pupa pentodon, (Say) Gld. Rare. Fossils from Lancaster county, Nebraska are of the same size and form as recent shells from Iowa and Nebraska. The species now ranges from Minnesota to Texas.

Pupa armifera, Say. Not common. Recent specimens from all of the states from Nebraska to New York show much variation in size and form. The range of variation would easily include the fossils from Johnson county, Iowa, and Saunders county, Nebraska. The fossils from the latter locality are more cylindrical than those from the former, but not more so than many of the recent shells.

This species occurs now from Dakota to Kansas, and eastward.

Pupa decora, Gld. This species, which the writer formerly[1] identified as *Pupa blandi*, Morse, is very abundant in the Lœss. Fossils from Dubuque, Scott, Muscatine, and Johnson counties, Iowa, and Lancaster, Cuming, and Saunders counties, Nebraska were carefully studied. These present some variation in form and size, and also in the number of parietal teeth, some specimens exhibiting two, others only one fold, but this variation may be observed in large sets from any of the localities cited.

The species belong to the northern portion of the continent, ranging from New York to the Great Slave Lake.

Pupa muscorum, L. Quite common. Fossils from Scott, Muscatine, Johnson, and Polk counties, Iowa; and Lancaster and Cuming counties, Nebraska were compared with recent specimens from Anticosti Island, Gulf of St. Lawrence. The fossils from Scott county, Iowa, and Lancaster county, Nebraska are rather more slender than the recent shells, while those from the remaining localities are precisely like them.

This species is now found on this continent in Maine, New

1 See "The Am. Geologist," Vol. I., No. 3. March, 1888.

York, Vermont, the Islands of the St. Lawrence, Nevada, and Colorado. In the old world it ranges from Siberia to Sicily.

Pupa alticola, Ingersoll. Very common. Fossils were obtained from nearly all of the localities heretofore mentioned. These vary but slightly in size. All of the sets contain the longer specimens with enlarged and distorted body-whorl, and greater number of whorls which characterize true *Pupa alticola*. These are exactly like recent specimens from the Yellowstone Park, and from Mullan, Montana. The younger fossil (as well as recent) shells are not distinguishable from *Pupa edentula*, Drap. (*Vertigo simplex*, Gld.) of which this seems to be a variety.

The younger fossils were compared with specimens of *Pupa edentula* from Ottawa and Ohio. Typical *Pupa alticola* occurs at present in the Rocky Mountains from Colorado and Utah to Montana. *Pupa edentula* occurs from Ohio to Canada and New England.

Vertigo ovata, Say. Not uncommon. Fossils from Johnson and Scott counties, Iowa; and Lancaster and Cuming counties, Nebraska were compared with recent specimens from Vermont, Iowa, and Nebraska. Both the fossil and recent shells show some variation, the fossils being on an average somewhat smaller. This species is at present distributed throughout the United States.

Vertigo gouldii, (Binn.) Stimp. Rare. Fossils from Muscatine county, Iowa are slightly larger than recent shells from Iowa City, while those from Lancaster county, Nebraska are about equal to them. Both sets of fossils are small. The species occurs at present from Iowa to New England.

Succinea ovalis, Gld. Rare. A small set of fossils from Lancaster county, Nebraska is made up of very young shells. No satisfactory comparison could be made.

The species is now found throughout the northern and middle portions of the United States.

Succinea verrilli, Bland. Very common. Specimens were received from all of the localities cited. This species is closely connected with *S. avara* by a large series of fossils.

The majority of the specimens answer perfectly to the description and figures of *S. verrilli* given by Binney.[1] Some are even more slender, with longer spire and smaller aperture than shown by Binney's figures. Each of the larger sets of fossils shows considerable variation. They somewhat resemble the smaller form of *S. avara* which occurs on high or comparatively dry ground, but all are more slender, with a more elevated spire and smaller aperture than is possessed by the latter. Some of the larger specimens are very similar to medium-sized slender specimens of *S. avara* which were collected in the vicinity of prairie ponds and streams in Marshall county, Iowa, and Lancaster county, Nebraska.

S. verrilli occurs at present in northern New England, and on the islands of the Gulf of St. Lawrence.

Succinea avara, Say. Large specimens of the preceding species grade into a form which may be referred to this species. It is not as common as the preceding and following species, but is always associated with them. The present range of this very variable species is throughout the northern parts of the United States.

Succinea lineata, W. G. B. A most abundant form, found at all of the localities cited, is referred by the writer to this species. It is usually identified as *S. avara*, but while equalling or even exceeding in size the larger, river-bottom form of that species, it has a more elevated spire, more convex whorls, and a heavier shell, thus exactly resembling (as in all other characters) *Succinea* which occurs commonly on the prairies of Nebraska and Dakota, and which is ordinarily identified as *S. lineata*, though comparatively few shells show the revolving lines which characterize the types of the species. Whether we regard this as a distinct species, or refer it to *S.*

1 In "*Terr. and Air Breathing Moll. of the U. S.*" Vol. V., page 422.

avara, it certainly is not the large, more eastern variety of the latter species, but is identical with the form now found abundantly on the western plains from Kansas to Dakota, and here referred to *S. lineata*.

Succinea obliqua, Say. Rather common. Fossils from Johnson and Polk counties, Iowa, and Saunders and Lancaster counties, Nebraska show considerable variation in size and form. Those from Iowa, and Lancaster county, Nebraska are like recent specimens from Indiana, Ohio, and Hardin and Benton counties, Iowa, being more slender than typical *S. obliqua*, and having a more elevated spire. Those from Saunders county, Nebraska are larger and resemble more nearly the typical recent shells from Illinois, Michigan, and Johnson county, Iowa. The fossils however have a somewhat smaller average size than the recent shells. Large specimens of the preceding species approach smaller specimens of the fossil *S. obliqua* so closely that it is very difficult to separate them.

This species, as at present found, is very variable in form and size, and ranges from Arkansas to Georgia, and northward.

Carychium exiguum, (Say.) Rare. Fossils from Lancaster county, Nebraska are like recent shells from Iowa and Nebraska, but larger than those from Texas. The present range of this species is from Texas to New England.

Limnæa caperata, Say. Rather common locally. Fossils from Scott and Johnson counties, Iowa, and Lancaster county, Nebraska were compared with recent shells from Iowa, Minnesota, Nebraska, and Dakota. The recent form is very variable. Specimens from Minnesota and Dakota are much larger than the fossils, with a larger aperture and a broader shell. Those from Iowa City are but little larger, while those from Marshall county, Iowa, and South Bend and Fremont, Nebraska, are about equal to the fossils. The recent shells from Lincoln, Nebraska show much variation, and in the length and diameter of the shell, and size of the aperture range from those which are much smaller and more slender than the fossils, to those which are somewhat larger. The present distribution of this species is through the Northern States to Hudson Bay.

Limnæa humilis, Say. Not uncommon. Fossils from Johnson and Scott counties, Iowa, and Lancaster county, Nebraska closely resemble rather large recent specimens from Johnson county, Iowa. These have an elevated spire, very convex whorls, and rather small, regularly rounded aperture. This form grades into the following. This exceedingly variable species ranges from Kansas to Lake Superior and eastward.

Limnæa humilis parva, Lea. This occurs commonly in the Lœss with the two preceding species, and is more abundant than either of them. There is much variation in each set, some of the specimens being very slender, with small aperture and very convex whorls, while others approach the typical *L. humilis* quite closely. The fossils were compared with recent specimens from Iowa City, New York and Michigan. The fossils are more slender, with longer spire and smaller aperture.

Physa —— sp? Rare. Fossils from Lancaster county, Nebraska, and Johnson county, Iowa are evidently immature shells, and in such condition that the species could not be determined.

Planorbis parvus, Say. Rare. Fossils from Lancaster county, Nebraska do not differ from recent Iowa and Nebraska shells. The present distribution is throughout eastern North America.

Pisidium——sp? Rare. The few valves and fragments from Johnson county, Iowa are in such condition that the species could not be determined.

All of the species in the foregoing list, and with the exception of the first and the last, are air-breathing *Pulmonata*. With the exception of the last six species (and possibly *Suc-*

cinea ovalis) all are strictly terrestrial in their habits. The following species are now found in North America only in mountainous regions, or far to the north of the region now covered by the Lœss.

Pupa decora. *Pupa alticola.*
Pupa muscorum. *Succinea verilli.*
Patula strigosa cooperi.

Of the species *Pupa muscorum* is circumpolar, but while on this continent a boreal species, it ranges in the Old World from Siberia to Sicily.[1]

In addition to this species the following are also circumpolar, but extend into, or even south of the Interior region as limited by Binney:

Zonites radiatulus *Vallonia pulchella.*
Zonites fulvus. *Ferussacia subcylindrica.*

Those which are northerly in distribution, but are also abundant in the latitude of the Lœss deposits are the following:

Zonites limatulus. *Succinea ovalis.*
Patulus striatella. *Succinea avara.*
Vertigo gouldii. *Limnæa caperata.*

The following additional species range over all of the continent east of the Rocky Mountains, those marked (*) occurring throughout the United States:

**Zonites arboreus.* **Vertigo ovata.*
**Zonites minusculus.* *Succinea obliqua.*
**Helicodiscus lineatus.* *Carychium exiguum.*
Patula alternata. *Limnæa humilis.*
Pupa pentodon. *Planorbis parvus.*
Pupa armifera.

The remaining identified species are restricted approximately to the latitude of the Lœss.

Helicina occulta. *Mesodon multilineata.*
Stenotrema leaii. *Succinea lineata.*
Limnæa humilis parva.

1 "Binney, Vol. V.," page 198.

Nothing definite can be said concerning the distribution of the species of which only the generic names have been given (*i. e. Physa* ——sp ? and *Pisidium* ——sp ?) but species of these genera closely related to the fossils, and in all probability identical with them., are widely distributed throughout the eastern portion of the United States.

The most marked feature of this fauna is the mingling of forms now belonging to northern and middle latitudes.[1]

Of the species named, *five* are boreal (or high-altitude); *ten* extend over both the Northern and Interior Regions (but not beyond); *eleven* have a very wide distribution over all of the eastern part of the United States; and *five* are now restricted to the Interior Region.

Judging from the sets of fossils upon which these notes are based, the species herein mentioned, if arranged according to their abundance and extent of distribution in the Lœss, would stand about as follows:

Succinea verilli.
Succinea lineata.
Patula striatella.
Pupa decora.
Pupa alticola.
Pupa muscorum.
Zonites fulvus.
Zonites limatulus.
Succinea obliqua.
Vallonia pulchella.
Helicina occulta.
Succinea avara.
Vertigo ovata.
Ferussacia subcylindrica.
Mesodon multilineata.
Limnæa caperata.
Limnæa humilis parva.
Zonites arboreus.
Zonites radiatulus.
Zonites minusculus.
Carychium exiguum.
Pupa pentodon.
Vertigo gouldii.
Succinea ovalis.
Physa ——— ?
Planorbis parvus.
Pisidium ——— ?

1 The *Northern* and *Interior Regions* of the *Eastern Province* of Binney, see Vol. V.

Limnœa humilis.
Helicodiscus lineatus.
Pupa armifera.
Patula alternata.
Patula strigosa cooperi.
Stenotrema leaii.

Those which are placed in the left-hand column are more abundant and more generally distributed, and may be considered the characteristic fossils of the Lœss of Iowa and Nebraska. The first three particularly are excedingly abundant, and the writer has yet to find an exposure of fossiliferous Lœss in which they do not occur.

In the distribution of the fossils we find the same peculiarities which may be observed in that of the recent shells.

Occasionally exposures are found in which a certain species will occur in great numbers, but restricted to a very narrow portion of the exposure, just as we find limited localities in which the recent shells of the same species are very abundant, largely to the exclusion of others. Such are notably *Helicina occulta*, *Mesodon multilineata*, the *Limnœæ*, etc.

Others again are very generally and quite uniformly scattered throughout large portions of the Lœss, both horizontally and vertically, while the occurence of still others is exceptional. The same species which to-day show the greatest adaptability to circumstances, and which cover the widest range in habitat are, as a rule, the most widely distributed in the Lœss.

The study of the habitat of the species represented in the Lœss is of special interest. All of the species herein listed are partial to moist, or even decidedly wet places, though *Patula trigosa cooperi*, *Pupa alticola* and *Succinea lineata* (the two latter among the most abundant of our fossils) are now found in great numbers in regions with a dry or very dry climate, though they are active only in moist places in these regions.

Of the remaining species, *Helicina occulta* and *Vertigo* *gouldii* habitually occur on high, cool, damp, wooded hillsides; *Stenotrema leaii*, *Mesodon multilineata* (the small form), *Ferussacia subcylindrica* and *Vertigo ovata* prefer low and very wet places; *Zonites radiatulus*, *Succinea avara*, *Succinea obliqua* and *Patula striatella* are habitually found under sticks, leaves, etc., in low valleys of streams, or near the edges of ponds, whether they are wooded or not; *Zonites arboreus*, *Zonites minusculus*, *Zonites fulvus*, *Helicodiscus lineatus*, *Vallonia pulchella*, *Carychium exiguum*, *Pupa armifera* and *Patula alternata* range as widely in habitat as they do in geographical distribution, being found in high and low, wooded and open country, the only seemingly necessary condition being the presence of a little (often very little) moisture; and *Succinea ovalis*, the *Limnææ*, *Physa*, *Planorbis parvus* and *Pisidium* frequent ponds and sluggish streams, or their muddy shores.

The writer was unable to get information concerning the exact habitat of *Zonites limatulus*, *Pupa decora*, *Pupa muscorum* and *Succinea verilli*. All of these are northern or northerly species.

With the exception of *Helicina occulta*, *Vertigo gouldii*, and the boreal species, all of these species have been found by the writer in the vicinity of prairie ponds and streams in central Iowa and eastern Nebraska, and but for the comparative paucity of the *Limnæidæ*, and the entire absence of *Unionidæ* (which however are not as a rule very abundant in the prairie streams and ponds of to-day) they would closely represent the recent molluscan fauna of these regions. Indeed *Succinea lineata*, the small form of *Mesodon multilineata*, the narrow form of *Succinea obliqua*, and *Stenotrema leaii* are rather characteristic of the region, while the remaining species extend over it.

Of the fossils listed *Patula strigosa cooperi* and the *Limnææ* show the most marked depauperation. *Helicina occulta*, *Patula alternata*, *Mesodon multilineata*, *Succinea obliqua*, and probably *Vertigo ovata* average somewhat smaller in size than recent shells, though some of the latter approach them very closely; while *Zonites limatulus*, *Zonites fulvus*, and *Vallonia pulchella* average rather larger in size than recent shells. The remaining species are very similar to their modern representatives, or like the boreal species heretofore mentioned, do not now occur in the region occupied by the Lœss. That the variation in the comparative sizes of the recent and fossil shells is not more uniform is not at all remarkable when we consider the great variation in adaptability to circumstances. Most of the species represented in the Lœss have a very wide distribution at present, and a study of sets of recent shells from various altitudes and latitudes reveals the fact that the species which are now the most constant (some of which are also the most widely distributed), as well as those which seem now to be the most variable in form and size possessed the same characteristics during Lœss times.

A NEW SPECIES OF FRESH WATER MOLLUSK.

B. SHIMEK.

ANCYLUS OBLIQUUS, nov. sp.

PLATE III., FIGS. 5a 5b 5c.

Shell elevated, thin, transparent, horn-colored, with a yellowish-brown epidermis; aperture ovate, conspicuously wider anteriorly, in many (especially young) specimens slightly reniform by a barely perceptible incurving of the right margin, the anterior, left and posterior margins regularly rounded, the right slightly incurved, straight, or but slightly convex; apex somewhat acute, elevated, strongly deflected posteriorly and to the right, and curved downward, in most specimens quite overhanging the posterior right margin of the shell; the apical portion of the shell (one-half or more) is strongly laterally, or rather obliquely, compressed, a character which makes the young appear proportionately much narrower than the adults; the anterior slope of the shell is long and strongly convex, the posterior being short and concave.

The surface is marked by fine lines of growth. The largest specimen which was secured has the following dimensions: length, 3.5 mm.; width, 1.8 mm.; height, 1.5 mm. The average dimensions are: length, 2.7 mm.; width, 1.7 mm.; height, 1.2 mm. The radula is rather narrow, the dental formula being 12–1–12. A rachidian tooth and one of the innermost laterals will be figured on a plate in our next BULLETIN.

The animal is of a uniform bluish-white color; the foot is ovate, wider anteriorly, and rather narrow for an *Ancylus*.

This species occurs, not uncommonly, about five miles east of Lincoln, Neb., in Dead Man's Run, a streamlet with numerous pond-like enlargements. Specimens were found by the author at all seasons of the year, adhering to shells of *Anodonta plana*, sticks, leaves, etc. Though diligent search has been made, no specimens have thus far been found in any other than the above-mentioned locality.

The only other specimen of the genus which has been found by the author in the vicinity of Lincoln is *A. rivularis*, Say, which is rather rare in Oak Creek, west of Lincoln.

A more complete description and representation of the dentition will be made in a subsequent issue of this BULLETIN, in a paper on the comparative dentition of the species of *Ancylus*.

THE PSELAPHIDÆ OF NORTH AMERICA.

A MONOGRAPH BY

EMIL BRENDEL, M. D., AND H. F. WICKHAM.

In preparing this monograph the authors hope to aid students of this large and interesting family, by sufficiently minute descriptions and synoptical tables, to recognize any species known to the fauna of the United States and British America, and to see the affinities of American species to members of this family in other lands.

Far from believing this to be a perfect work, the authors submit it as a contribution liable to future revision. Even if the ideas herein set forth are not accepted, the present compilation of hitherto scattered descriptions will, it is hoped, be of value.

The descriptions of early authors were sufficiently minute to differentiate the small number of species then known. At present many of those descriptions are applicable to quite different forms, and synoptical tables based upon the old descriptions have become an impossibility. Up to the time of Jno. L. Leconte, the number of species was very limited. In 1817 Say described but three species—*Tmesiphorus carinatus*, *Bryaxis dentata* and *Batrisus riparius*. Aubé in 1834 added three or four, some not now recognizable, and Motschulsky in 1845 two or three more—ill described. Leconte followed with eighty-four species.

Although the number of descriptions is now quite considerable, their insufficiency has been a great difficulty, and ocular comparison of specimens is often necessary to determine a species. By exactness of description and by carefully drawn figures we hope to relieve the student henceforth from the necessity of such direct comparison.

As to classification, it is a matter of comparatively small moment whether we call a particular group genus or subgenus, provided only the group be recognizable. Any variation in nomenclature or classification will, however, be noticed appropriately in the proper place.

As to the natural sequence of genera, now apparently continuous, future discoveries in the Pacific region will perhaps necessitate some changes. If we take into account the fauna of other countries, the difficulties are greater, and will not be solved until more exhaustive investigation shall supply some forms now lacking.

Having collected in different parts of the United States and obtained by exchange specimens from elsewhere, we have been enabled to compare most of the species described. Of the species not in our possession some have been borrowed for description here; the descriptions of such as we have not handled are inserted in their original form. Names not accompanied by sufficient description are merely mentioned.

In the genus *Bryaxis* the section *Reichenbachia* is most incomplete. Among the forms near to *B. rubicunda* are many which cannot be kept asunder. In this case the extreme members of the series are described. We approve the separation of *Actium* from *Trimium*, and of *Trimioplectus* from *Euplectus*. The new genera present salient differences from the old ones, both in general form and in minor diagnostic characters. These changes may meet with criticism. We have exercised our best judgment, and shall be first to welcome any arrangement that can be shown to be better.

" . . . . . *dum loquimur fugerit invida*
Ætas."

We shall always thankfully consider ourselves under obligations, for valuable information and specimens, to Dr. David Sharp, London, Eng.; to Capt. Thos. L. Casey, U. S. A., for various assistance and contributions; to Charles and Marie Fuchs, of San Francisco, California, for many important contributions.

It is proper to say in conclusion, that in bringing out the monograph, the plan of the enterprise, the descriptions of the species, and the delineation of all the plates have been the work of the senior author, while the preparation of the matter for the press, its final redaction, belongs to the junior,

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The family Pselaphidæ, with which is here included the Clavigeridæ, ranges next to the Staphylinidæ from which it differs by the prosternum invariably narrow, the large metasternum and by the palpi always four-jointed. The abdomen has five or six flexible corneous ventral segments, the dorsals not, or very slightly, movable upwards but to a certain extent retractile; the middle coxæ are rounded, the posterior transverse; the tarsi two or three-jointed. In the Staphylinidæ the prosternum is variable in form, the metasternum smaller, the palpi four or five-jointed, the abdomen with seven or eight freely movable segments. The middle coxæ are conical, the posterior variable in form, and the tarsi four or five-jointed except in the Oxytelini where they are three-jointed, and which group presents the nearest affinities to the Pselaphidæ.

On the other hand this family approximates the Scydmænidæ, and shows also some relations with the Silphidæ. The Scydmænidæ differ chiefly in the conical, distant posterior coxæ, the longer elytra and the five-jointed tarsi.

The Clavigeridæ bearing in general the same characteristics as the Pselaphidæ, are distinguished by their imperfect embryonic forms, the antennæ with six or less articulations, and by the structure of the abdomen. They are here treated as a subfamily.

The Pselaphidæ present the following characters: mentum corneous, ligula membranous, with large paraglossæ, labial palpi hardly visible. Maxillæ partly membranous and ciliated, their palpi always four-jointed, usually long. Antennæ moniliform or clavate, not more than eleven-jointed. Prothorax with the side pieces not distinct, ankylosed, prosternum very narrow, often not visible between the coxæ. Mesosternum very short, metasternum very broad. Elytra truncate, subtriangular. Abdomen with five dorsal and five or six ventral segments. The anterior coxæ are prominent, conical, nearly contiguous, the intermediate rounded and near together, the posterior ones transverse, not prominent.

The Pselaphidæ proper are divided into three sections, the Pselaphini, Bryaxini, and Euplectini which sections become almost yearly more indefinite by the discovery of intermediate forms, thus demonstrating the unity of the present family.

The Pselaphini were formerly considered a well defined section, but later discoveries such as the Bythinoid forms of Machærodes, Eutrichites and Scalenarthrus link them with the Bryaxini. The genera Pselaptus, Verticinotus, and Eupsenius on one hand and Arthmius on the other lead from Bryaxis to Batrisus and the general form of the latter is repeated in Trimium. For want of a better place, the Trogasterini are placed between Trimium and Euplectus, as they exhibit radiating affinities.

The species of the second section of Capt. Casey's synoptical table are in our opinion not Euplecti. They stand between Euplectus and Trimium, nearer the latter, and have received the name Trimioplectus.

The forms of Eutyphlus, Thesium and Faliscus approach the Faronii which latter we leave intact under the old genus Faronus for want of a more complete knowledge of the foreign members of this section.

All of the Pselaphidæ live on animal substances, and the comparatively powerful mandibles and maxillæ together with long palpal members seem to indicate that they capture fleet and hard-shelled prey. As a rule the Pselaphini live mostly in pairs while all the others are gregarious at least during the period of copulation when so-called "rare" species may be found in numbers.

The Clavigeridæ live seemingly solitary; the construction and smallness of the oral organs seem to indicate that their nourishment is taken in liquid form.

Of the larvæ nothing is known, our own investigations yielding doubtful results.

I. CLAVIGERIDÆ.

Antennæ and tarsi two-jointed, anterior coxæ contiguous, posterior ones distant. Two genera are represented in our fauna:

Eyes wanting. - - - -	*Adranes, Lec.*
Eyes present. - - - -	*Articerus, Dahlm.*

ADRANES (from ἀδρανής, imbecile).

Prothorax, when viewed from above, conical; head cylindrical. Length, 1.8 mm. - -	*cœcus.*
Prothorax campanulate; head obconical. Length 2.5 mm. - - - - - - -	*lecontei.*

A. CŒCUS, *Lec.* Orange yellow, pubescence in regular rows of short, recumbent setæ. Length, 1.8 mm. Plate I., Figs. 4 and 5.

Head variolate, frontal margin straight, antennal foveæ large, extending to the middle of the clypeus and leaving a narrow septum connecting the frontal margin with the labium. The last antennal joint is rounded at the base, longer than one-half the length of the head, squarely truncate and narrower at the distal end. Palpi small, hidden inside of the circular oral opening. *Prothorax* as long as wide near the base, where the width equals the length of the head, neck half as wide as the base. Sides, at base, rounded, arcuate, straight towards the neck. Disk variolate, with a deep median sub-basal, circular fovea. *Elytra* with the suture as long as the prothorax, which they very slightly exceed in width at base, middle depressed, sides straight, divergent, longer than the suture, posterior margin of each elytron triangularly lobed; disk without impressed lines, apex of lobe tufted with hairs.

Abdomen broader than the elytra, convex, polished, impunctate, the first dorsal segment very large, longer than wide, broadly margined, margin convolute at base, hairy, diminishing in width posteriorly, basal fovea extending from the suture two-fifths of the length of the segment. Two posterior dorsals very short. Mesosternum arrow-shaped, anterior coxæ cylindrical, contiguous, their trochanters arcuately conical, half as long as the femora; intermediate coxæ small, rounded, posterior transverse, femora angulate, the ridges setigerous, grooved externally at the distal end for the reception of the cylindrical, two-jointed tarsus.

In the male the end of the middle trochanter has a curved claw as long as that member.

Habitat. Pennsylvania, Georgia, Illinois.

A. LECONTEI, *Brend.* Honey yellow, pubescence in regular rows. Length, 2.5 mm. Plate VI., Figs. 1 and 2.

Head twice as long as broad, broadest along the inter-antennal line, base only two-thirds of that width. Frontal margin and sides straight as seen from above; vertex with two entire, shallow, longitudinal impressions. Last antennal joint slightly arcuate, otherwise of the same form as in *A. cæcus*. *Prothorax* bell-shaped, a little longer than the head, base twice as wide as the neck, sides slightly arcuate, disk transversely convex, with a transverse sulcus one-fifth from the base, which is interrupted in the middle by an oval tubercle. Space between the sulcus and the base ring shaped, convex, with a flat, circular plane in the middle bearing a center-point. *Elytra* as in *A. cæcus*. Basal abdominal segment wider than the elytra, margin arcuate and convolute near the base, thence divergent in a nearly straight line to the posterior limit of the segment. Disk trapeziform, convex, foveæ similar in form to those of *A. cæcus*, which it also resembles in the sexual characters.

Habitat. Mississippi Valley.

ARTICERUS, *Dahlman* (ἀρτι, short, κέρας, horn).

Antennal foveæ not reaching the eye, head wider, last antennal joint with lateral outlines arcuate. Length, 1.5 mm. - - - *californicus*.

Antennal foveæ reaching the eye, head narrower, last antennal joint with lateral outlines straight. Length, 1.66 mm. - - - - *fuchsii*.

A. FUCHSII, *Brend.* (*Fustiger*, *Lec.*) Dark yellow, translucent, pubescence setiform, in regular rows. Length, 1.66 mm. Plate VI., Fig. 6.

Head much variolate, flattened above, sides subangular near the eyes, which are situated about one-third of the length from the base. Frontal margin and base nearly equal in width to each other and to three-fourths of the length of the head; frontal margin slightly impressed at middle, frontal septum narrow, antennal cavities very large. On the occiput are seen two small, shining points (also present in the European species), which have the appearance of ocelli. The eyes have eight facets. *Antennæ* with the basal joint small, quadrate, root-pulp partly exserted, second joint straight, tuba-shaped, tip truncate and three times wider than the base. *Prothorax* variolate, equal to the head in length, as long as wide, subglobular, truncate at base and apex, with a deep, median, sub-basal, variolate scar. *Elytra* at the base as wide as the prothorax; no humeral tubercles, suture not longer than the head, width across the tips equal to one and three-fourths times the length of the suture. Posterior limit of each elytron angularly lobed near the lateral limit, and having a tuft of hair; disk slightly depressed along the suture, with sutural lines and about six rows of recumbent setæ. Posteriorly the elytra are declivous to the deep, transverse abdominal fovea. *Abdomen* wider than the elytra, the basal segment longer than wide, deeply transversely foveate, evenly convex posteriorly, lateral margin convolute near the base, where it is widest and retuse, gradually narrowing behind. First ventral transversely impressed on either side. Legs prismatic, the thighs slightly compressed laterally, grooved for the reception of the tibiæ, which latter are thicker at the distal end and grooved externally for the reception of the tarsi. Tarsi cylindrical, joints connate (three in number?) with a single strong claw. The male has the last ventral segment sinuate in the middle and the venter more concave.

Found in eastern Tennessee by Fr. Fuchs in 1866. Also occurs at Williams, Arizona. (Wickham).

A. FUCHSII, var. CALIFORNICUS, *Brend.* This differs in the form of the head, which is just perceptibly wider and seemingly shorter. The antennal foveæ are limited anterior to the eye, while in the specimens from Tennessee they are drawn up backward above the eye, gradually becoming shallower. The funicle of the antennæ is darker in *A. californicus*, the first joint constricted near the base, with the root partly exposed, discernible in the bottom of the fovea; second joint as in *A. fuchsii*, but with the outlines concave. Discovered by my friend Carl Fuchs at Los Angeles, California. Occurs in March.

SYSTEMATIC OUTLINE OF THE FAMILY PSELAPHIDÆ.

I. Antennæ approximate, inserted beneath prominent, porrected, contiguous, tubercles. (*Pselaphini*).

a^1 Posterior coxæ, distant, tarsi with two equal claws.

b^1 Maxillary palpi with the last two joints similar in form like the cotyledons of an acorn, without appendages.

Antennæ robust moniliform the last two joints of the maxillary palpi compressed, fusiform. - - CEOPHYLLUS, *Lec.*

Antennæ with the last three joints forming a club, the last two joints of maxillary palpi lunate, the terminal one longer. CEDIUS, *Lec.*

b^2 Antennæ clavate, maxillary palpi with the last three joints bearing lateral setiform appendages.

Last three joints of maxillary palpi triangular, appendages short. TMESIPHORUS, *Lec.*

Last three joints of maxillary palpi oval-transverse, appendages very long. - - - - - - CTENISTES, *Reichenb.*

b[3] Maxillary palpi without appendages.

Antennæ moniliform maxillary palpi minute, the basal joints hidden, the last two connate, together forming a globular club. - - - - - - - CHENNIUM, *Latr.*

Last three joints of antennæ forming a club Last joint of maxillary palpi elongate with a terminal seta. - TYRUS, *Aubé.*

Last joint of antennæ enormously enlarged, last joint of maxillary palpi cylindroid, rounded at tip. - - HAMOTUS, *Aubé.*

a[2] Tarsi with a single claw, posterior coxæ distant.

Maxillary palpi excessively long, third joint small, globular, second and fourth pedunculate-clavate, very long.

PSELAPHUS, *Hbst.*

Maxillary palpi with the second joint tuberculate-clavate, the third quadrate, fourth broadly securiform.

PSELAPTRICHUS, *Brendel.*

Maxillary palpi with the second joint clavate, pedunculate, the third triangular, the fourth long, securiform. TYCHUS, *Leach.*

a[3] Posterior coxæ approximate. Tarsi with a single claw. Body linear depressed. - - - - - - - - RHINOSCEPSIS, *Lec.*

II. Antennæ distant, inserted on the sides of the head, beneath short, distant, not porrected tubercles.

a[1] Posterior coxæ distant, only one claw fully developed.

b[1] Body broad transversely cylindrical in cross section. Abdomen more or less broadly margined.

c[1] Abdominal margin retuse, narrow, dorsal segments unequal. Two basal ventrals longer, elytra narrow-shouldered very long, vertex bifoveate. (*Bythinini.*)

d[1] Last palpal joint cultriform antennal club three-jointed. First antennal joint very long, vertex differently sculptured in the sexes.

MACHÆRODES, *Brendel.*

d[2] Last palpal joint acuminate-ovate.

Penultimate joint of antennæ small, lenticular, the last ovate.

EUTRICHITES, *Lec.*

Penultimate joint of antennæ larger trapezoidal, the last long fusiform. - - - - - SCALENARTHRUS, *Lec.*

c[2] Abdominal margin broadly retuse the basal segments of the dorsum and venter much longer, tarsi with a single claw. Elytra flat, last palpal joint fusiform. (*Bryaxini*).

Vertex bifoveate, prothorax with lateral edge rounded, unifoveate, antennæ ten-jointed with a three-jointed club. Body broad, sexual marks on the intermediate thighs, elytral lines and abdominal carinæ long, parallel, and distant.

DECARTHRON, *Brendel.*

Vertex not foveate prothorax faintly trifoveate, under surface of head bicarinate body broad, antennal club three-jointed, only four ventral abdominal segments visible. - NISAXIS, *Casey*.

Vertex and pronotum trifoveate, body broad, each elytron with a long discal line, antennæ with a three-jointed club, under surface of head unicarinate. - - - BRYAXIS, *Leach*.

Vertex bifoveate with a transverse frontal impression and absolutely circumambient sulcus, prothorax trifoveate, only the last antennal joint enlarged, body elongate. EUPSENIUS, *Lec*.

b^2 Body convex abdominal border narrow, prothorax without, or with one basal fovea, base of the abdominal dorsum without carinæ, or only indications of them, mutually far distant.

Pronotum not foveate, elytral lines wanting vertex impressed in front. - - - - - - - - PSELAPTUS, *Lec*.

Pronotum unifoveate, elytral lines present, the discal ones very short, vertex and antennæ differently sculptured in the sexes. VERTICINOTUS, *Brendel*.

Vertex with four faint foveæ different in the sexes; prothorax bifoveate, with a shallow basal transverse sulcus; elytral discal lines obsolete or wanting, sutural lines present, abdominal border on each segment not triangular, basal carinæ present. Sexual differences in the vertex, antennæ and anterior tibiæ, tarsi with two unequal claws. ARTHMIUS, *Lec*.

b^3 Body circulo-cylindrical, narrow, elongate, very convex; abdominal margin with the edges not parallel, triangular on each segment, the external edges obsolete; vertex arcuately impressed. Prothorax with two or three longitudinal grooves, claws two, unequal. BATRISUS, *Lec*.

a^2 Posterior coxæ approximate.

d^3 Body circulo-cylindrical, narrow, vertex arcuately impressed, prothorax without longitudinal sulcus, the last antennal joint only enlarged, tarsi with a single claw (*Trimiini*).

Elytral base bifoveate, no subhumeral fovea, head larger. TRIMIUM, *Aubé*.

Elytral base trifoveate, with a subhumeral fovea, head smaller. ACTIUM, *Casey*.

d^4 Body elliptico-cylindrical, convex, broader, the last three antennal joints enlarged, head transverse, prothorax with sharp, straight, linear longitudinal and basal sulci crossing each other, tarsi with two unequal claws (*Trogasterini*.)

e^1 Prothorax at sides not spinous. Elytra with four basal punctures, each with a line, the discal ones abbreviated. - - RHEXIDIUS, *Casey*.

e^2 Prothorax at the sides spinous.

Prothorax armed at the sides with a single sharp tooth, elytra with three discal lines. - - - - - OROPUS, *Casey*.

Prothorax twice as wide as long, armed at sides with three recurved spines, elytra with one discal line, antennæ geniculate.
RHEXIUS, *Lec.*

d^5 Body depressed, antennæ thicker towards the apex.

f^1 Tarsi with a single claw, antennal club three-jointed, vertex arcuately impressed, not produced in front.

Body broader, lateral margin of the pronotum crenate, prosternum carinate, fourth dorsal segment not prolonged.
THESIUM, *Casey.*

Form convex, not depressed, dorsal abdominal border moderate, slightly retuse, dorsal segments five, subequal, the fourth not prolonged, visible ventral segments five, the two basal ones longer. - - - - - TRIMIOPLECTUS, *Brendel.*

Form depressed, linear, abdominal border wide, retuse, the three basal segments equal in length, the fourth prolonged, consisting of two segments united, ventrals six in female, seven in male, of equal length. - - - EUPLECTUS, *Leach.*

Form depressed like Euplectus, prosternum carinate, the fourth dorsal segment not prolonged, eyes of female rudimentary.
EUTYPHLUS, *Lec.*

Body slender, pronotum with lateral longitudinal grooves, prosternum carinate, fourth dorsal not prolonged.
FALISCUS, *Casey.*

f^2 Tarsi with two equal claws, body linear, antennal joints gradually slightly larger towards the apex. - - - - - - FARONUS, *Aubé.*

CEOPHYLLUS, *Leconte* (κέω, I hide, φύλλον, a leaf).

Antennal tubercles transverse, contiguous, antennæ eleven-jointed, palpi with the two terminal joints lamellate. Pubescence short, appressed. Tarsi with two equal claws, anterior femora each with three strong spines. Body elongate, not compact.

C. MONILIS, *Lec.* Cinnamon-brown, impunctate; length, 3.3 mm. Plate VI., Figs. 7, 8 and 9. *Head* from base to frontal margin as long as the prothorax; width between (but excluding) the eyes, three-fourths that of the prothorax. Base evenly rounded, tempora not prominent, as long as the eyes. Frontal tubercles transverse, divided by a fine fissure which ends in a deep, oblong impression one-third the length of the head. Eyes not prominent, facets fine. Disk evenly vaulted.

Clypeus swollen, convex, subangulate anteriorly. Antennæ robust, one-half as long as the beetle, first joint about two-thirds as long as the frontal margin, cylindrico-conical; second smaller, of the same shape, two-thirds the length of the first, third and fourth equal, shorter than the second, and nearly as wide. Fifth and sixth, in the male, globose, wider than the fourth. Seventh, eighth, ninth and tenth, globose, the last two each equalling the third, which slightly exceeds the seventh, this being again exceeded by the eighth; eleventh subglobular a little wider than the tenth, and bluntly pointed. In the female these joints are subequal, subglobose, a little longer than wide, and becoming almost imperceptibly larger towards the tip. *Palpi* with the first joint very small, quadrate, second more than half as long as the head, small at base gradually increasing in width, sigmoid; third pedunculate, lamellate, fourth with the lamella opposite, and as long as, that of the third, the two resembling the cotyledons of a bean. *Prothorax* campanulate length and width equal to that of the head including the eyes, sides evenly arcuate, becoming straight and parallel posteriorly, base a little less than twice as wide as the neck, with a fine impressed line around it; disk evenly vaulted, pubescence radiating from the center. *Elytra* across the shoulders one-half wider than the base of the prothorax; at the widest point which is just two-thirds of the length from the base they are just one-half wider than the breadth of the shoulders. Anterior half of the disk flat, tip and sides obliquely declivous, sutural lines nearly parallel, discal lines sulciform with flat bottoms, and evanescent near the middle of the elytral length. Shoulders prominent. *Abdomen* at base one-eighth narrower than the greatest width of the elytra, and as long as the width at the shoulders, very convex, broadly margined. First segment one-fourth as long as the basal width, sides divergent, a deep transverse impression near the middle of each half of the base. Ventral segments equal in length with no perceptible sexual differences. Legs long, slender, anterior femora with three spines. Tarsi slender, half the length of the tibiæ, which are longer than the femora, joints two and three equal in length. Claws equal in length but not in strength.

Habitat. Ohio river to the Great Lakes.

CEDIUS, *Leconte*. (κήδειος, careful).

Antennal tubercles transverse contiguous, antennæ eleven-jointed. Palpi with the last two joints unequal, cotyledonous, the third triangular or lunate acuminate inside; fourth thick, oblong or triangular free angles rounded. Tarsi with the last two joints equal, claws two, equal, anterior femora strongly tri-spinous. Body robust compact.

C. ZIEGLERI, *Lec.* Umber brown, punctate, pubescence appressed, short and dense. Length 2.7 mm. Pl. VI., Figs. 11 and 11[a].

Head from base to frontal margin equal in length to the width just behind the eyes, tempora not prominent, nearly straight, convergent, shorter than the large prominent coarsely facetted eyes; frontal tubercles transverse, half as long as wide, separated by an ample sulcus which extends half way to the base. Disk between the eyes convex, punctured, with two circular foveæ in the line of the posterior margins of the eyes and twice as distant from one another as from the eyes. On the under surface of each side behind the eyes is a strong prominent spine. Clypeus convex, rounded anteriorly. *Palpi* with the second joint as long as the third or fourth, curved, fusiform; third triangular, the basal and free angles acute, the sides including the latter angle longest, apical angle rounded. Fourth joint fusiform sides arcuate. *Antennæ* nearly half as long as the body, robust, the first joint as long and wide as the frontal tubercles; second, third, and fourth equal, as long as wide; fifth smaller, subglobular; sixth and seventh globular subequal; eighth shorter, transverse, and differing in the sexes, that of the male having the inside prolonged into a very long, sharp, flat tooth, reaching to the base of the tenth joint. Ninth obconical, twice as wide as the eighth, tenth obconical, truncate at base, twice as wide as long, eleventh ovate, base truncate, wider than the tenth and a little wider than long. *Prothorax* equal in length to the width of the head with the eyes included, a little wider in the middle for about one-sixth of the length. At this point the sides are strongly arcuate, anteriorly and posteriorly becoming nearly straight, neck half as wide as the base. Disk coarsely and deeply punctured with two slightly marked circular impressions one-sixth of the distance from the neck, and a deeper fovea on each side near the base connected with its fellow by a straight conspicuous sulcus. Basal margin just perceptibly raised in a sharp ridge. *Elytra* coarsely punctured, rather depressed anteriorly, the width across the shoulders equal to the length of the suture, and one-eighth more than that of the prothorax. They are widest one-fourth of the length from the tip and here the width is one-third greater than at the shoulders, which are prominent as a rounded, elevated ridge. Disk not very convex, sutural lines straight, nearly parallel, suture depressed, discal lines rather sulciform at base, evanescent near the middle. *Abdomen* very broadly margined, first dorsal as wide as the elytra, widening behind, length, one-fourth of the width, and with two entire longitudinal carinæ including about one-half of the segmental surface; posterior segments very convex, the margins converging. Ventral segments equal, the last, in the male with a small digital impression. Legs strong, anterior femora strongly tri-spinous. Tarsi half as long as the tibiæ the second joint just visibly longer than the third. Claws equally strong.

Habitat. East and west of the Alleghenies, along the Ohio river to Missouri and Southern Iowa.

C. SPINOSUS, *Lec.* Umber brown, punctate, pubescence short, appressed. Length, 1.9 mm. Plate VI., Fig. 10.

Head broader than long, tempora as long as the eye, which has coarse facets. Frontal tubercles more than twice as wide as long, separated by an ample sulcus, which is faintly prolonged backward, as a shallow impression, to a line between the foveæ. These latter are circular, separated by a space three times as great as that intervening between each one and the eye, and are situated on a line passing from center to center of the eyes. Below and posterior to either eye is a strong spine. *Palpi* with the first joint gradually curved, increasing in thickness toward the third, which it exceeds three times in length. Third joint triangular, with the free angle produced into a spine; fourth triangular, free angles obtuse. *Antennæ* with the first joint cylindrical, not so long as the width of the adjoining frontal tubercle; second to sixth oblong-subglobular, gradually shorter, the seventh small, globular, eighth as long as the third, drawn out on the inner side into a long, concavo-convex tooth reaching the base of the tenth joint. Ninth and tenth transverse, the latter three times as wide as the seventh, last joint wider than the tenth, ovoid, slightly truncate at base, and longer than the two preceding. *Prothorax* convex, widest at the middle, where the sides are strongly arcuate, but they become straight in front of and behind the point. Neck half as wide as the greatest width, and not quite two-thirds that of the base. Disk punctulate, without anterior circular impressions, and with small basal foveæ connected by a fine linear sulcus. *Elytra* depressed anteriorly, breadth at the shoulders a little less than the length of the suture, tip one-fourth wider. Disk punctulate, shoulders prominent, subangulate, sutural lines entire, parallel, suture depressed, discal lines sulciform, bottoms flat, reaching half-way to the tip. *Abdomen* convex, wider across the posterior margin of the first segment, which has no carinæ, the posterior segments rapidly decreasing in width. *Legs* with anterior femora tri-spinous, joints two and three of the tarsi equal in length.

Habitat. Same as for *C. ziegleri.*

TMESIPHORUS, *Leconte* (Τμῆσις, a fissure, φόρειν, to carry).

Antennæ clavate, frontal tubercles not transverse, palpi with the second joint pedunculate-triangular, third equilateral-triangular, fourth triangular, free side emarginate, appendages setiform, short. Body variolate.

T. COSTALIS, *Lec.* Piceous, shining, pubescence short, appressed. Length, 3.3 mm. Plate VI., Fig. 13.

Head, exclusive of the eyes, two-thirds as long as broad, eyes very prominent, facets coarse. Frontal fissure deep, branching behind the frontal tubercles toward the foveæ, which are situated on a line passing through the centers of the eyes. Occiput convex; below and behind the eyes is found a small, horizontal spine. *Antennæ* of the male more than one-half the length of the body, first joint cylindrical, as long as the frontal margin and not quite half as thick; second, one-third as long and two-thirds as wide as the first, cylindrical; third, fourth and fifth globular, as thick as the second; sixth and seventh smaller, also globular; eighth, ninth and tenth gradually larger, obconical, the eighth as thick as the first, the tenth twice as thick; eleventh thicker and as long as the ninth and tenth conjointly, emarginate on one side near the base. Pubescence denser on the club. Female antennæ shorter, less robust, and without the basal emargination on the last joint. *Prothorax* campanulate, widest at middle, as wide and long as the head, convex, neck half as long as the base, sides rounded at middle, straight towards the neck and base. Disk with two slightly impressed foveæ on the anterior fourth, and an ample one on each side near the base; lateral margin depressed, subsulcate by the convexity of the disk. *Elytra* convex posteriorly, half as long again as the head, breadth at the shoulders four-fifths the length of the suture, at the tip one-third more than the shoulders. Humeri high, prominent, discal lines in the form of a broad, flat-bottomed sulcus, abbreviated at middle, sutural lines parallel, curving outward at the base. *Abdomen* broadly margined, first dorsal segment wider posteriorly, this and the second carinate, the latter a little longer. Ventrals subequal, flattened in the male, metasternum longitudinally impressed in the middle. Legs very long, slender, tibiæ slightly increasing in thickness toward the end, anterior ones in the male dilated outside in the middle, straight inwardly. Female the same, except that the middle is slightly thicker.

Habitat. Found over the entire extent of our territory east of Kansas and the Missouri River and south of the Great Lakes.

T. CARINATUS, *Lec.* Brown, densely punctate, pubescence short, appressed. Plate VI., Fig., 12.

Form of body, sculpture and sexual characters same as in *T. costalis*, except that the vertex has the median frontal fissure broader, abbreviated one-third of the length from the frontal margin and not connected by branches with the foveæ. The anterior prothoracic foveæ are wanting, and the abdomen has a medial carina extending backward over the third dorsal, besides the lateral ones. Length, 2.5 mm.

Habitat. Same as *T. costalis.*

CHENNIUM *Latreille.* (Derivation unknown.)

Biotus, Casey. *Atinus*, Horn.

Palpi very small and short, basal joints invisible, the two last joints connate, forming a globular club, the last covering the penultimate one in the shape of a cone of large area and little height. Antennæ moniliform. Pubescence short, appressed, setiform, clypeus prominent, uniformly convex, rounded anteriorly, prothorax wider than the head, tri-foveate. Elytral impressed lines very long, nearly entire, second dorsal longer than the first.

CH. MONILICORNE, *Brend.* Cinnamon-brown, strongly punctate, pubescence short, dense, appressed, prothorax as long as wide. Length, 2.8 mm. Plate VI., Fig. 15.

Head conical, punctured, widest between the eyes, which are prominent, with fine facets; distance from frontal margin to base, one-half longer than the width between the eyes and about equal to the width of the head, eyes included; tempora not prominent, convergent, frontal tubercles together half as wide as the head and eyes, divided by a sharp cut running backward to the inter-ocular line. Immediately behind the tubercles the head is constricted to less than two-thirds of the width of the frontal margin, and thence the sides diverge to the eyes. Between the eyes are two large pubescent foveæ, and on the occiput at the base a small obsolete tubercle. *Antennæ* moniliform, except the first joint, which is cylindrical, nearly twice as long as thick. The second and third are longer than wide, joints four to eight shorter, equal in length, subequal in thickness, the fourth very slightly transverse; the ninth and tenth are very little larger, equal, globular; eleventh slightly longer than thick. *Prothorax* uniformly convex, slightly transverse, widest one-third of the length from the base, which is nearly twice as wide as the neck and as wide as the length, or four-fifths the greatest width. One-sixth from the base are three sharply impressed foveæ, the lateral ones partly hidden from above. *Elytra* across the shoulders broader than the prothorax, and nearly as wide as the suture is long. The humeral width is about two-thirds that of the tip. The sides are divergent from the shoulders and nearly straight, disk not, or very little convex; lines entire, deeply impressed, suture depressed, humeri forming a prominent ridge. *Abdomen* rather convex, broadly margined, edge of margin curved, segments uniformly vaulted from side to side; first dorsal shorter than the second, ventrals subequal, diminishing slightly in length. Legs long and slender, femora cylindrical, tibiæ thicker toward the end, or, in the male, the intermediate ones slightly bent inward at the lower third, and the posterior very much dilated, tapering at the distal third to the compressed tarsus.

Habitat. Mountains of Virginia and Tennessee.

CH. (?) FORMICARIUM, *Casey*. (*Biotus formicarius*, *Cas.*)

Cinnamon red, faintly punctulate, polished, prothorax transverse, wider than long. Length 2.8 mm. Plate VI., Fig. 14.

Head, including eyes, slightly longer than wide, eyes large, distant about their own length from the base and from the constriction behind the frontal tubercles which are small, longer than broad, and divided by a fine sharply defined line. Vertex convex; between the eyes are situated two large pubescent foveæ mutually a little more distant than they are from the eyes. *Antennæ* one-half the length of the body, joints at base and tip oblique, parallel, the first cylindrical, equal in length to the width of the frontal tubercles taken together, second smallest, rounded, transverse. Joints three to ten nearly equal, very little broader than long, eleventh cylindrical tapering for the last third to a point, and about as long as the two preceding. *Prothorax* about equal in width at the middle to the length of the head and two-thirds as long. Sides evenly rounded in the middle and straight toward the neck and base. The latter is one-third wider than the neck and slightly narrower than the disk in the middle, Lateral foveæ small, circular, one-third the length from the base, middle one oblong, shallow. *Elytra*, across the rounded, not very prominent humeri, one-fifth wider than the prothorax, suture twice as long as the prothorax and one-eighth shorter than the greatest width of the elytra. Basal foveæ deep sutural lines converging on the posterior half, discal lines divergent, obsolete near the tip. *Abdomen* broadly margined, sides uniformly arcuate, edges of each segment slightly so, each segment uniformly vaulted from side to side, the first shorter than the second. Legs long slender, tarsi one-third the length of the tibiæ, claws equal, small. Sexual differences unknown.

Habitat. Middle California.

CTENISTES *Reichenb.* (Κτενὶστης—a hair dresser.)

CT. PULVEREUS, *Lec.* Piceous brown, pubescence scaly, gray. Length 2.3 mm. Plate VI., Fig. 16.

Head (including eyes) longer than wide, frontal tubercles one-third the width of the head, broad, divided by a fine line which is prolonged backward and dilated into a broad shallow sulcus reaching to a line drawn through the anterior margin of the eyes. The posterior foveæ are small and deep, placed in semicircular impressions, open towards the eyes, and leaving in the middle a narrow ridge which connects the elevated occiput with the two ridges running alongside the frontal sulcus to the frontal tubercles. The palpal joints are very transverse, bottle-shaped, terminating in long setæ. *Antennæ* in female half as long as the body, in the male longer, the first joint more than half the width of the frontal margin, concave anteriorly. The second is as thick as the first and half as long, third and fourth equal, longer than the second but not thicker; fifth to tenth equal in width, decreasing in length, tenth perceptibly longer than wide. Eleventh very little thicker and as long as the four preceding joints. In the female it is thicker and shorter. *Prothorax* barrel-shaped, convex, evenly vaulted, same length as the head, as wide as long, widest behind the middle, the median basal fovea oblong, reaching one-third from the base and thickly filled with pubescence; lateral foveæ ample, pubescent, lateral depression shallow. *Elytra* one-third longer than the prothorax, width across shoulders equal to the length, tips one-fourth wider; humeri moderately prominent, discal lines abbreviated near the tip. *Abdomen* along the posterior margin of the first segments wider than at base, broadly margined, margins of the segments arcuate, equally convex, the two basal segments nearly equal in length. Legs very long the second tarsal joint longer than the third.

Habitat. California. Arizona. (Wickham).

CT. PICEUS, *Lec.* Dark piceous, elytra, antennæ, and legs reddish brown, palpi paler. Length 1.9 mm. Plate VI., Fig. 18.

Head, including eyes, as wide as long, frontal tubercles, narrow posteriorly, not transverse, the dividing line scarcely perceptible, frontal fovea rounded, occipital foveæ in depressions which are not open towards the eyes and which leave between them a narrow ridge connecting the occiput (which is not elevated) with the anterior part of the vertex. *Palpi* with the second joint pedunculate, somewhat triangular at the thick end, the last two transversely ovate, the appendages three times as long and hooked at the free end. *Antennæ* of the male three-fourths the length of the body, joints nearly equal, cylindrical, twice as long as thick, scarcely larger towards the end, last joint as long as the three preceding, flattened on the inside. Females with joints 7, 8, 9, and 10 transverse, short, last joint shorter, oblong oval. *Prothorax* wider than long, and as wide as the head is long; the basal median foveæ reach the middle of the disk, the lateral ones are smaller, lateral sulcus or depression fully separating the margin which is strongly arcuate. *Elytra* more convex than in *Ct. consobrinus*, the discal and sutural lines though deep nearest the base, leave the intervals not very convex. *Abdomen* convex, margin broad, the edges arcuate. Legs long.

Habitat. Territory east of the Mississippi. Iowa.

CT. CONSOBRINUS, *Lec.* Usually uniformly dark piceous or with paler elytra, legs, and antennæ, pubescence very dense giving a rather rough appearance. Length, 1.75 mm. Plate VI., Fig. 17.

Head with the frontal incision reaching the oblong fovea, the occipital foveæ are small, the depression continuous from side to side and very shallow causing the occiput not to appear elevated. Otherwise the same as in the preceding species. *Prothorax* as long as wide, the basal median fovea shorter, the lateral sulcus separating a narrow slightly arcuate margin. *Elytra* more depressed, flat, the linear impressions deeper and the shoulders more prominent than in *Ct. piceus*.

Habitat. Same territory as the preceding.

CT. ZIMMERMANNI, *Lec.* Pale brown or testaceous, not densely pubescent. Length, 1.65 mm.

Head with the frontal incision reaching the oblong frontal fovea, occipital foveæ large, farther apart and nearer the eye, tubercles on each side of the frontal foveæ conspicuous, occiput elevated. *Prothorax* as long as wide, narrower anteriorly than in the other species, widest a little behind the middle; the median fovea is nearly circular the lateral ones small, the lateral sulcus is a fine line not perceptibly separating the narrow margin. *Elytra* more convex, the lines not deeply impressed, shoulders more rounded, otherwise as in *Ct. piceus.*

TYRUS, *Aubé.*

Antennæ clavate, palpi with first joint minute, second long, arcuate, clavate, third short, obovate, the last joint longer than the third and mucronate at apex. Third tarsal joint longer than the second, with two equal claws. Form robust, compact. Pubescence long, not squamiform.

T. HUMERALIS, *Aubé.* Piceous-black, pubescence fine, short, appressed; elytra, antennæ and legs reddish, palpi paler. Length, 1.6 mm. Plate VI., Fig. 19.

Head, eyes included as long as broad, frontal tubercles transverse, divided by a sharply cut line, faintly connected with the oblong anterior fovea. Between the eyes are two small foveæ not connected by a depression. *Palpi* with the second joint long, strongly clavate at the end, third obovate as large as the club of the second, fourth joint larger, ovate, mucronate at the apex. *Antennæ* with joints one and two cylindrical, the first larger, three to seven rounded, gradually becoming smaller, eighth and ninth larger, globular, tenth twice as long and thick as ninth, rounded obconical, eleventh the largest, ovate in the male; in the female the joints three to nine are subequal, tenth larger, less rounded, eleventh oval. *Prothorax* bell-shaped, wider near the middle, where it is as wide as long, sides behind the middle straight or very slightly sinuate, base nearly as wide as the middle, neck a little more than half as wide, evenly vaulted. One-fifth of the length from the base is a fine transverse sulcus; a rounded fovea is in the middle; lateral foveæ small. *Elytra* one-fourth longer than the prothorax across the high, prominent shoulders, and not quite double the length across the hips. Disk finely punctulate, impressed lines and two basal foveæ deep, the sides slightly arcuate. *Abdomen* but little longer than the elytra, and narrower at the base than across the posterior margin of the first segment, which is almost imperceptibly longer than the second. Margins very broad, retuse, a minute tubercle in the middle of the base. Legs strong, middle trochanters with a strong, blunt spine at the ends, anterior tibiæ with a short, spinulate submedian carina. Male with the last dorsal emarginate at tip, last ventral slightly impressed, punctured, these characters being wanting in the female. The male has also the posterior tibiæ more arcuate.

Habitat. Eastern slope of the United States.

T. CORTICINUS, *Casey*. Brown, elytra red, abdomen piceous-black, pubescence fine, short, appressed. Length 2 to 2.2 mm. Plate VI., Fig. 20.

Head, eyes included, slightly longer than wide, frontal tubercles quadrate, separated by a fine line which is connected with an oblong frontal fovea. There are also two small foveæ between the eyes. *Antennæ* more than half as long as the body, joint one long and conical, two smaller, of the same form, three to seven subequal, only very slightly decreasing in size. The eighth joint is the smallest and is quadrate, the ninth is as long as the two preceding together, obconical, longer than wide, the tenth is larger, of the same form as the ninth. The eleventh is ovate, one-half wider and twice as long as the tenth. *Palpi* with the second joint long, clavate, arcuate, third shorter, obovate, as thick as the club of the second; fourth not thicker than the third and twice as long, fusiform, pointed at both ends with a long terminal seta. *Prothorax* about as wide as long, widest one-third from the neck, where the sides are rounded; from this point the sides are nearly straight anteriorly and posteriorly. Base very little narrower than the width of the disk; one-fourth from it are three small foveæ, the lateral oues on the declivity of the sides and connected with the middle one by a fine, nearly straight sulcus. *Elytra* one-third longer than the prothorax across the high, prominent shoulders, twice as wide as the head behind the eyes and twice as wide as the base of the prothorax across their tips; lines and basal impressions deep, disk slightly more convex than in *T. humeralis*. *Abdomen* of the same form as in the preceding species, the median basal tubercle elongate, visible. Legs stout, intermediate trochanters bluntly spinose, anterior tibiæ rough near the middle. The last dorsal is truncate in the male and pointed in the female.

Habitat. Western slope of the Sierra Nevada, Montana. (Wickham).

T. ELONGATUS, *Brend.* n. sp. Slender, brownish-red, elytra and legs brighter, impunctate, pubescence long and abundant. Length, 1.95 mm. Plate VI., Fig. 21.

Head sessile, as long as its width behind the eyes, occiput evenly transversely convex, base sharply edged. Tempora as large as the eye, convergent, eyes large, supra-antennal process rhomboidal, the upper surface declining to the median sulcus, frontal fovea large, interocular foveæ small, deep, obliquely elongate. *Antennæ* longer than the head and prothorax; joints one to three longer than wide, subcylindrical, decreasing in size, four to eight transversely oval, half as wide as the first and little narrower than the third. The ninth and tenth are trapezoidal, the base of the former being equal in width to that of the second; the eleventh is as long as the ninth and tenth together, ovate, the truncate base half as wide again as that of the ninth. *Palpi* dirty yellow, second joint sigmoid, clubbed, as long as the last, third rounded, quadrate; the last is fusiform, nearly four times as long as wide and furnished with a terminal seta. *Prothorax* widest in the anterior third, length and breadth nearly equal, sides straight from middle to base and more convergent than in *T. humer-*

alis. The disk is very convex, middle fovea large, hidden by a bunch of long, convergent hairs, giving the appearance of a sharp-pointed tubercle; transverse sulcus very fine, lateral foveæ small. *Elytra* equal in length to their width across the shoulders, which are not prominent; disk rather convex, base bifoveate, sutural lines parallel, converging in the posterior fourth, discal lines none, replaced by an ample but shallow basal impression. *Abdomen* longer than the elytra, convex in both directions, border wider, retuse, the basal segment shorter than the second or third, which are equal, longitudinally very convex and depressed at the base; no median basal tubercle visible. Legs long, the anterior trochanters of the male with a long, bluntly-pointed spine, anterior thighs with a small, sharp thorn on the basal, and a minute sharp tubercle on the second third. Posterior tibiæ spurred, tarsi with long hair on the sole.

One specimen ♂. Williams, Arizona. H. F. Wickham.

We have placed this species in *Tyrus*, but the form of the prothorax and head resembles more closely *Hamotus batrisioides* while the antennæ, palpi and locomotive organs are those of Tyrus, thus demonstrating the close affinity of these two genera.

HAMOTUS, *Aubé.*

(*Cercocerus, Motsch.*)

Pubescence loose, coarse, and long; head not constricted behind the frontal tubercles, eyes finely facetted. Elytra and abdomen very convex. Palpi with the second joint fusiform, third compressed subglobular, fourth elongate fusiform. Second and third tarsal joints equal, claws two, equal.

H. BATRISIOIDES, *Lec.* Umber brown, elongate, convex, polished pubescence long, coarse, yellow, not appressed; punctuation faint, irregular, punctures large. Length, 1.8 mm. Plate VII., Fig. 22.

Head as broad as long, very convex; eyes large moderately prominent, finely facetted; tempora convergent, little longer than the eyes, not convex, frontal tubercles rather short, not constricted posteriorly, scissure sharp and ending in a small elongate fovea one-fourth the length from the frontal margin. There are two small, round, well-defined foveæ in a line with the anterior quarter of the eyes, separated from each other by twice as great a distance as from the eyes. Clypeus with the anterior margin rounded, labrum bilobed. *Antennæ* not quite half the length of the body, the first joint cylindrical, arcuate below, as long as the eye and half as thick; second joint quadrate, as wide as the first, third to fifth gradually smaller, quadrate, sixth to tenth gradually wider, tenth as wide as the second, twice as thick as long. The last joint is pear-shaped, compressed, half as long as the preceding portion of the antennæ, and one-third from the apex the width is equal to the length of the first three joints together; pubescence sparse, surface faintly punctulate. *Palpi* with the first joint small, cylindrical; second fusiform; third irregular globular; fourth longer than the preceding joints together, cylindrico-fusiform. *Prothorax* as wide as long, widest a little before the middle, very convex transversely, sides evenly arcuate, becoming straight and convergent near the base. One-fifth from the base is a small triangular fovea connected with the very small, rounded, lateral foveæ by a well defined and very thin slightly arcuate line. *Elytra* one-fifth longer than the pronotum, length equal to the humeral width, shoulders with small, not prominent humeral tubercles, one-fourth wider across the middle than the length of the suture, disk convex, pubescence coarser than on the anterior part of the body. Sutural striæ well defined anteriorly originating from transverse basal impressions and obsolete posteriorly; discal impressed line short, foveate at base, becoming obsolete one-third before the middle. *Dorsal segments* subequal in length, the basal one-fourth as long as wide, wider behind, convex, slightly impressed at the sides of the base, and, compared with the other species of this group, very moderately margined. Venter flattened along the middle, anterior trochanters with a hair-like spine contiguous to the surface of the femur. Legs moderately strong, tibiæ nearly straight. No reliable sexual marks have been discovered in any species of this genus.

Habitat.

PSELAPTRICHUS, *Brendel.*

Antennal insertions approximate, front prolonged narrow, sulcate. Maxillary palpus very long, the second joint sigmoid-clavate and coarsely tuberculate, the third small quadrate, the fourth broadly securiform, as long as the second with short erect pubescence.

P. TUBERCULIPALPUS, *Brendel.* Yellowish brown, pubescence in regular rows, form slender, slightly convex. Length, 1.66 mm. Plate VII., Fig. 24.

Head flat above, longer than wide, widest between the eyes, which are small and situated at the angles of a pentagon forming the discus of the vertex posterior to the oblong frontal prolongation; the latter nearly quadrate, arcuate in front, sulcate in the middle, the lateral half with the suface plane and inclined toward the sulcus; just before the eye-line are two small foveæ, mutually twice as distant as either from the eye and connected by a straight angular shallow sulcus with the frontal fissure; occiput slightly elevated with a fine carina in the middle, labrum small transverse, clypeus anteriorly trisinuate; antennal cavities large, from the middle of the eyes to the middle of the posterior limit of the antennal cavities a fine carina, and between those cavities a narrow frontal septum. *Antennæ* as long as the head and prothorax conjoined, first joint cono-cylindrical, half as long as the head, second oval, as wide as the first, third and seventh less than half as wide as the preceding joints, globular, eighth wider, not longer, ninth transversly oval, tenth twice as wide as long, eleventh oval, twice as wide as the second joint and one-half longer, with long pubescence. *Prothorax* as long as wide, and one-half wider than the head, widest behind the anterior third where the sides are acutely rounded and toward the neck and the base nearly straight; disk moderately convex, near the base with an angulated transverse sulcus, ending on the sides in an ample impression, containing a small fovea. *Elytra* across the shoulders as wide as the prothorax, widest behind the middle, where it is one-half wider and along the suture one-third longer than the shoulder-width; disk rather depressed near the base, sutural lines slightly impressed, basal foveæ small, the sutural ones near a transverse elevation of the base, the discal ones in the anterior part of a shallow oblong depression, below the humeral ridge a fovea connected by an oblique line with the lateral margin. *Abdomen* as wide as the elytra, slightly convex, without the basal impressions, segments subequal, border narrow. The pubescence of the elytra and the dorsal segment arranged in regular rows. Anterior coxæ contiguous, posterior ones distant, trochanters short triangular, legs slender, anterior femora crenate below, tarsi with one claw, second joint twice as long as the third, metasternum not impressed. ♂ anterior tibiæ arcuate with a deep notch inside on the distal fourth of its length, clypeus with a medial ridge. ♀ tibiæ and clypeus simple.

Habitat. Alameda county, California.

This singular insect unites some of the characters of *Bythinus* (*Machærodes*) *carinatus* and *Pselaphus longipalpus*, the antennæ and the palpi belonging to the European *Machærites* group of the *Bythini*, the form of the head approaching that of *Pselaphus*. According to the testimony of Dr. David Sharp, there is no genus known, with which it can be united.

PSELAPHUS, *Hbst.* (ψηλαφάω, I feel my way—referring to the very long maxillary palpi.)

Head longer than broad, eyes large, prominent. Prothorax as long as the head, barrel-shaped, polished, nearly twice as long as thick. Elytra conjointly forming nearly an equilateral triangle with the anterior angle but little truncate; abdomen with the first dorsal as broad as the tip of the elytra, and half as long, the sides parallel, broadly margined. The other segment is short and retractile. Legs long, antennæ more than half as long as the body, palpi with the second and fourth joints longer than the head, the first and third being small and globular.

P. ERICHSONII, *Lec.* Red or reddish-brown, polished, not punctured. Length, 1.75 mm. Plate VII., Fig. 23.

Head larger before the eyes, narrow, frontal tubercles oblong-quadrate, divided by a fine incision which is dilated behind into a deep sulcus running through an ample median groove to the occiput. On each side of the groove is a hollow, bladder-like organ, yellow in color, which commonly shrinks after death to a triangular form. Occiput narrowed to the width of the neck. *Prothorax* twice as long as thick, with a nearly imperceptible puncture near the base. *Elytra* depressed, flat, dorsal lines sharp, entire, base angulate toward the suture, the shoulders closely adjoining the base of the prothorax. Sutural striæ dilated behind the middle, deeply sunk below the general level. The posterior margin is declivous except on the outer angles, from which it is separated by a short oblique ridge. *Abdomen* depressed at base, convex from side to side, broadly margined, the other segments together shorter than the first, declivous and very retractile. *Antennæ* with the first joint three times as long as thick, cylindrical, second to eighth obconic, gradually smaller; ninth and tenth oblong, rounded, larger, the eleventh twice the length and thickness of the ninth, oblong-ovate, acute at the tip. *Palpi* with the last joint clavate from the distal fourth, the club covered with rasp-like teeth and ending in a terminal seta.

Legs long, femora clavate, tibiæ dilated in the lower half, tarsi with the second joint dilated.

Habitat. Eastern States.

P. LONGICLAVUS, *Lec.* Blackish-brown elytra blood-red, legs, antennæ and palpi reddish-brown. Club of the fourth antennal joint longer than the peduncle. Length, 1.8 mm.

Besides the difference in size, form and color of the last palpal joint, this species differs from *P. erichsonii* in the prothorax being more convex at sides, and thicker, the elytra less depressed on each side of the sutural lines, the interval not dilated behind the middle, more convex from base to tip, and the first dorsal segment more depressed at the base. The males of both this and the preceding species have the middle of the postpectus angularly impressed lengthwise.

Habitat. Mississippi Valley from Iowa to Louisiana.

TYCHUS, *Leach.*

The characters given in the synopsis of genera will sufficiently distinguish this genus.

TABLE OF SPECIES.

1[1] Elytra depressed, prothorax without median basal puncture, sutural lines parallel.

Palpi with the second, third and fourth joints nearly equal in length. Color testaceous. Length, 1.17 mm. . *longipalpus.*

1[2] Elytra more convex, sutural lines arcuate.

2[1] Base of pronotum with five punctures; basal dorsal segment not longer, third palpal joint triangular, shorter than the fourth. Vertex with two punctures.

3[1] Black with red extremities. Antennal joints 3–6 quadrate, 7–10 transverse, rounded, obconical. - - - - - - - *minor.*

3[2] Color testaceous or light brown, free angle of the third palpal joint rounded.

Elytra broadly convex, antennal joints oblong, slightly diminishing in size, eighth smallest, the ninth twice as large, both subglobose, tenth transversely oval. ♂ with the anterior trochanters spined. Length, 1.5 mm. - - - *testaceus.*

Elytra very convex, antennal joints 8–10 transverse, 3–6 equal, quadrate. Punctures on the vertex obsolete. Tarsi with a thin second claw. Length, 1.3 mm. - - *cognatus.*

2[2] Color, black with red extremities and elytra. Abdominal basal segment longer, base of pronotum punctured.

3[3] Head without the usual two punctures.

Base of pronotum with three punctures, third palpal joint shorter than the fourth. Antennal joints 8–10 transverse. - *tenellus.*

Base of pronotum with five punctures, third palpal joint fusiform, nearly as long as the fourth, which is cultiform. ♂ anterior trochanters and middle coxæ spined. - - - *puberulus.*

T. LONGIPALPUS, *Lec.* Yellowish-brown, impunctate, subdepressed, pubescence long, erect. Plate VII., Figs. 25 and 26.

Head, including the eyes, as long as wide, tempora slightly arcuate, convergent, not prominent, longer than the eyes, which are prominent, coarsely facetted, lateral margin straight between the eyes and the frontal tubercle, edge rounded. Frontal tubercles quadrate, separated by a fine impressed line prolonged backward, disk transversely convex, longitudinally not so; half-way between the eye and the frontal tubercle on each side is a sharp tubercle pointing outward. The declivous frontal surface and the concave clypeus are perpendicular to the vertex; labium three times wider than long, not emarginate. *Palpi* with the second joint arcuate, clavate beyond the middle, extending from its insertion to the posterior margin of the eye. Third joint more than half as long, cultriform, widest at the base, fourth securiform, shortly pedunculate, widest at middle and as long as the second. *Antennæ* longer than the head and prothorax, first joint obconical, flattened above, twice as long as the second, which is oval and not so thick; third to eighth subequal, the fifth being but slightly stronger and the eighth the smallest; ninth globular, twice as wide as the eighth, tenth larger, globular, eleventh ovate, twice as long as the tenth. *Prothorax* widest near the middle, slightly wider than long, convex, base double the width of the neck, median fovea small and rounded. Lateral foveæ situated in shallow longitudinal impressions, no intermediate ones. *Elytra* depressed, one-half longer than the prothorax, the distance across the prominent shoulders being the same. They are broadest one-third from the tip, disk slightly broadly arcuate at the sides, sutural lines deep, discal lines abbreviated near the middle. Shoulders rounded, prominent, the declivous lateral portions punctured. *Abdomen* narrowly margined, segments subequal, the first longest, one-third as long as wide. The fourth is also longer than its neighbors. Legs with the third tarsal joint longer than the second.

Habitat. United States east of the Rocky Mountains.

T. MINOR, *Lec.* Black, polished, convex, coarsely pubescent; antennæ, palpi, frontal tubercles, legs, and fourth and fifth abdominal segments reddish brown. Length, 1.4 mm. Plate VII., Fig. 27.

Head polished, as long as broad, tempora as long as the eyes, frontal tubercles transverse, incision conspicuous. Nearer to the frontal tubercles than to the eyes on each side is an acute tubercle pointing outward, behind which is a punctiform impression. Occiput higher than in *T. longipalpus*, longitudinally plane, transversely convex. *Palpi* with the third joint triangular, the sides enclosing the free and tufted angle equal, shorter than the third, which is more than half the length of the last joint. This joint is securiform, shortly pedunculate, more than half as long as the head, broadest in the middle. *Antennæ* slightly longer than the head and prothorax, the two basal joints more robust; the first obconical, flattened above, the second smaller. Joints three to seven are only about half as wide as the preceding, cylindrical, very little longer than wide, eighth globular, ninth and tenth subglobular, slightly transverse, eleventh twice as thick as the ninth, rounded ovate, and as long as the two preceding. *Prothorax* polished, wider than long, and as long as the head, widest slightly before the middle, where it is strongly arcuate; anteriorly and posteriorly it is nearly straight, slightly sinuate, disk very convex, the base twice as wide as the neck. Lateral foveæ rather large, basal foveæ five in number, placed in a transverse row very near the base, the middle one larger, along the sides anterior to the lateral foveæ almost imperceptibly impressed, the impression visible only in a certain light. *Elytra* faintly reticulate, as wide across the shoulders as the prothorax, and, near the tip, two-thirds wider. Shoulders elevated, not prominent laterally, disk convex both ways, sutural lines fine, not deeply impressed except near the base; interval flat. The basal and discal lines each originate in a fovea, the latter deep, reaching beyond the middle. The declivous lateral portion of the elytra is very broad, polished, impunctate.

Abdomen proportionately more broadly margined than in *T. longipalpus*, segments subequal, the basal ones just perceptibly longer, the fourth equal to or very slightly longer than its neighbors and one-fourth as long as wide. Legs proportionately longer than in *T. longipalpus.*

Habitat. Found between the Ohio River and the Great Lakes. Pennsylvania. New York.

T. TESTACEUS, *Casey*. Convex, impunctate, brown or paler, pubescence fine, sparse, erect. Length 1.5 mm. Plate VII., Fig. 28.

Head from the frontal tubercles to the base slightly longer than wide. Eyes prominent, finely facetted, tempora equal in length to the eyes, convergent, nearly straight, not prominent; occiput high, convex, obliquely declivous forwards towards the impression behind the frontal tubercle; sides convergent from the eyes to these tubercles. Between the frontal tubercles and the eye the lateral margin is expanded into a minute, sharp, horizontal tubercle overhanging the lateral declivity, and close behind this is a minute puncture. *Antennæ* as in *T. longipalpus*. *Palpi* with the second joint longest, a securiform pedunculated club. Third joint half as long as the second, exteriorly straight, interiorly arcuate, widest in the middle, half as wide as long,. Fourth joint one-half longer, securiform with a terminal seta. *Prothorax* widest at middle where it is arcuate, nearly straight toward the neck and base. Disk more convex than in *T. longipalpus*, near the base is an oblong median fovea and on each side between the median and lateral foveæ is a small puncture. *Elytra* very convex, as wide across the shoulders as the prothorax and two-thirds wider at tip. Sides divergent, slightly arcuate, disk impunctate, discal line abruptly ending at middle, sutural interval convex. *Abdomen* broadly margined the segments subequal in length the basal one-sixth as long as wide. Legs, antennæ and palpi not paler than the body.

Habitat. Found in the country around the Great Lakes.

T. COGNATUS, *Lec.* Form more robust and convex than in any other species known to us. Color, bright umber brown, pubescence fine, body impunctate. Length, 1.25 mm. Plate VII., Fig. 29.

Head with the eyes narrower than the prothorax, the usual lateral punctures and triangular projection quite obsolete, the frontal tubercles punctured. *Antennæ* longer than the head and prothorax, first joint three times longer than wide, second oval. Third to eighth globular, slightly decreasing in size, the eighth slightly transverse, ninth to eleventh rapidly increasing in size, ninth and tenth transverse, eleventh joint oval, as long as the first and three times thicker. *Palpi* with the first joint slender, cylindrical, sigmoid in the distal half, clubbed; third half as long as the second, triangular, the free angle rounded. Fourth half as wide as long equal in length to the second, finely pubescent and with a terminal seta. *Prothorax* very convex, one-third wider than the head, widest in the middle where the sides are arcuate, and thence straight toward the neck and base. Neck two-thirds as wide as the base, disk with five basal punctures, the lateral foveæ large. *Elytra* as long as the head and prothorax, very convex, sutural lines not parallel, curved, dorsal parallel to the sutural ones and half as long. *Abdomen* shorter than the elytra, segments equal in length. Legs slender.

Habitat. Vancouver Island.

T. TENELLUS, *Lec.* Black, polished, impunctate, elytra black or red, antennæ, legs and palpi, red. Length, 1.4 mm. Plate VII., Fig. 30.

Head as in *P. puberulus*, no punctures. *Antennæ* with the last three joints shorter, more rounded, obconical much more transverse than in the preceding species. Last joint ovate, acute, twice as thick as the tenth and scarcely longer, widest behind the middle. *Palpi* with the second joint bent, peduncle as long as the club, reaching backward to the anterior border of the eye. Third joint only one-third as long, triangular, free angle rounded, half as wide as long. Fourth pedunculate, three-fourths the length of the second, securiform, widest in the basal third, the width here equal to one-third of the length. *Prothorax* shaped as in *T. puberulus*, with five basal foveæ, of which the middle one is larger. Lateral foveæ inconspicuous. Posterior margin thin and finely elevated. *Elytra* as long as the prothorax and half the head, width across the high, prominent shoulders less by one-fifth of that measure. At the widest part, just behind the middle, they are one-fourth wider; sides of the disk more arcuate, otherwise as in *T. puberulus*. *Abdomen* rather short. Legs slender. ♂ with the venter longitudinally bent downward at the tip. ♀ elytra slightly shorter.

Habitat. California.

T. PUBERULUS, *Lec.* Black, polished impunctate, elytra, antennæ, palpi, and legs, red-brown. Length, 1.6 mm. Plate VII., Fig. 31.

Head very convex from side to side, occiput elevated, sloping evenly to the frontal tubercles which are square, the dividing incision deep, no punctures or foveæ on the vertex. Eyes prominent, rather coarsely facetted. *Antennæ* with the first joint obconical, longer than the adjoining frontal tubercle and half as thick as long; second a little smaller, rounded oval; third to eighth subequal, rounded, the eighth smallest; ninth and tenth obconical, longer than wide, of the same form, the tenth being at the tip, four times the width of the eighth. Last joint ovate, truncate at the base, one-half wider near the middle than the tenth joint, and as long as the two preceding, thinly pubescent. *Palpi* with the first joint small cylindrical, second clavate in the distal third, length equal to the distance separating the eyes. Third more than half as long again as the second, fusiform, more arcuate inside, widest near the middle, width equal to one-third of the length; fourth securiform, pedunculate, nearly as long as the second, widest one-third from its base. *Prothorax* longer than the head, of equal diameter, widest just behind the middle, somewhat more than half as wide near the neck as at the base, convex, equally vaulted, basal median fovea small, no additional basal punctures. *Elytra* as long as the prothorax and half the head; the width across the high prominent acutely rounded shoulders is four-fifths of this measure, and across the tip one-fifth greater. Disk convex, discal lines very deep at the base, abbreviated near the middle. Sutural lines straight, deep, especially near the base, leaving an interrupted transverse basal elevation. Sides from the shoulders to the posterior fourth almost imperceptibly arcuate. *Abdominal segments* subequal, the first dorsal depressed along the base, border narrow. Legs long, femora clavate, tibiæ angular lengthwise, tarsus thicker at the articulation of the second and third joints, tapering towards base and claws. ♂ anterior trochanters provided with a long slender spine at base, intermediate coxæ with a straight thinner spine.

Habitat. California.

RHINOSCEPSIS, *Lec.*

R. BISTRIATA, *Lec.* Body elongate, gradually and slightly widening from the base of the elytra to the end of the third abdominal segments, apex of prothorax and base of the head transversely dilated, scabrous or densely pubescent. Color, brown, lustreless. Length, 1 mm. Plate VII., Fig. 32.

Head triangular, the lateral angles behind the eyes truncate, parallel, acutely rounded to the nearly straight very slightly sinuate base, arcuate towards the eyes, anterior to the parallel tempora, thence abruptly narrowed and produced into a parallel-sided frontal protuberance, which has at the tip a conspicuous elongate impression. Vertex with two rounded foveæ in a transverse line one-third from the base, mutually separated by a distance as great as that separating them from the parallel tempora. Eyes small, at about the middle of the sides of the head, scarcely visible from above. *Antennæ* slightly shorter than the head and prothorax, first joint thick, twice as long as wide, nearly cylindrical, second half as long, third to eighth rounded, from globular becoming gradually transverse. Club irregular, the transverse lenticular ninth and tenth joints thicker externally, last joint conical, as long as the three preceding, length one-third greater than the width which is equal to that of the tenth. *Prothorax* obcampanulate, slightly longer than the head, and, near the anterior margin, about one-fourth wider; base one-fourth narrower than the head. Anterior edge nearly straight, parallel to the base of the head, three times as wide as the neck, anterior angles acutely rounded, sides convergent, behind the anterior third slightly sinuate. Basal angles acute, base subangularly arcuate; disk rather flat with a broadly impressed median sulcus reaching from the neck to the posterior fourth where it is strongly dilated and connected with the lateral foveæ by a finer obliquely transverse straight groove on each side. *Elytra* with the sides divergent, evenly arcuate from the base, one-third wider across the tip than the prothorax. Suture as long as the prothorax, base and tips broadly sinuate, disk depressed, tri-foveate at the base, foveæ small, sutural lines arcuate near the base; from the middle fovea runs a slightly arcuate discal line, the outer fovea being simple. Shoulder forming an obliquely longitudinal ridge. Lateral deflexed margin with a deep, entire line. *Abdomen* at base as wide as the elytra and slightly increasing in width to the fourth segment, broadly margined and without basal carinæ or impressions. Legs slender, tarsi with a single claw. ♂ with the anterior tibiæ enlarged at the middle, last ventral longitudinally impressed.

Habitat. Florida. An anomalous form presenting distant affinities to Trogasterini.

MACHÆRODES, *Brendel.*

This genus is closely related to Reitter's subgenus Machærites, differing from it in the lack of tuberculations on the second palpal joint; the form of the head offers sexual differences in the vertex, but none in the eyes. Like Machærites it has a rudimentary second claw, short, nearly equal dorsal segments, the two basal ventral segments prolonged, the abdominal border narrow, and the first antennal and fourth palpal joints cylindrical or four times longer than thick. Two species are known to us.

M. TYCHOIDES (*Tychus bythinoides*, Brend.) Chocolate-brown, punctured, sparsely pubescent, antennæ, palpi and legs dark yellow. Length, 1.2 mm. Plate VII., Fig. 35, ♀.

Head strongly punctured, as wide as long, tempora shorter than the large eyes, convergent, sides of the head anterior to the eyes convergent; a fine line, parallel to the rather sharp edge of the vertex, separates the middle part of the point from the supra-antennal portion, and ends posteriorly in an irregular fovea. The strip between this line and the lateral edge is flat and roughened by transverse marks. Occiput and interocular space evenly convex, the convexity limited by a line from the less convex inter-antennal space; there is no median carina; the frontal margin is transverse, slightly arcuate, suddenly declivous anteriorly. The declivity is excavated on each side of the median septum, forming cavities for the insertion of the antennæ; the clypeus is divided by the septum, and has a semicircular anterior margin. The last palpal joint is securiform, more than three times longer than its median width, the antennæ not differing from those of the next species. *Prothorax* punctate, widest in the middle, but little wider than long, arcuately angled, with the sides nearly straight from the middle to the neck and to the base. Base twice as wide as the neck, near it being a faintly impressed transverse line connecting the small lateral foveæ. *Elytra* punctured, as wide across the shoulders as the prothorax, and two-thirds wider across the tip. The suture is one-half longer, sides anteriorly nearly straight, sutural lines parallel, discal lines very short, faintly impressed. *Abdomen* shorter than the elytra, dorsal segments equal, thighs clavate. Only the female is known.

M. CARINATUS, *Brend.* Dark brown, strongly punctured, pubescence thin, recumbent. Length, 1.66 mm. Plate VII., Figs. 33 ♂, 34 ♀.

Head ♂ broader than long, eyes very prominent, coarsely facetted, tempora much convergent, nearly transverse, little shorter than the eye. Sides anterior to the eye convergent, frontal margin transverse, triangular, antennal tubercles flat, slightly elevated, separated from the median portion of the frontal margin by a fine, slightly impressed line, terminating posteriorly in small, very deep foveæ, which are situated on a line with the anterior margins of the eyes and are mutually three times farther distant than either is from the eye. The median part of the front is plane, not punctured, triangularly produced from the antennal tubercles to the middle, where it is narrowed into a septum separating the lateral surfaces of the clypeus. The plane triangular surface just described shows two pairs of deep punctures, one behind the other. The region between this and the occiput and between the occipital foveæ is very strongly elevated, convex, and crowned with a sharp longitudinal crest. The head of the ♀ differs greatly, and shows better the characters exhibited by the European Bythinini; the frontal margin between the tubercles is slightly convex, not at all triangular, the region between the occipital foveæ convex, but little elevated, and just visibly separated from the anterior portion by an arcuate line. The crest is not high, only just visible. The eyes and other parts of the body offer no differences. *Palpi* with the first joint very small, second half as long as the head, pedunculate-clavate, third globular, fourth as long as the second, cultriform, one-fourth as wide as long. *Antennæ* distant, as long as the head and prothorax together, first joint as wide as the last palpal joint, nearly one-third of the entire length of the antennæ. Second globose, as thick as the first, third to eighth very small, from globular becoming gradually transverse; ninth and tenth lenticular, the tenth three times as wide as long, eleventh as long as the three penultimate ones. Near the base it is thicker, and is conically pointed near the middle. *Prothorax* as wide as long, widest slightly behind the middle, evenly vaulted, the neck as wide as the base. Sides slightly impressed before and behind the middle, basal foveæ small, situated at the bottom of these impressions. Middle foveæ very small, the transverse sulcus conspicuous. *Elytra* across the shoulders very slightly wider than the prothorax, sutural lines parallel, sharply turned aside near the base, leaving there a narrow elevated ridge. In the place of a discal line is a broad basal depression, leaving a basal and a humeral ridge. Disk very convex, sides strongly arcuate. *Abdomen* of ♂ convex, shorter, as long as the prothorax, segments nearly equal in length, margin narrow. Legs long, slender, posterior tibiæ arcuate in ♂, straighter in ♀. The punctures and form of the elytra very strongly resemble those of *Bythinus burelli.*

Habitat. Alleghany Mountains. Canada. Mountains of Virginia.

SCALENARTHRUS, *Leconte.*

S. HORNII, *Lec.* Reddish brown, impunctate, pubescence, very fine sericeous. Length, 0.7 mm. Plate VII., Fig. 36 ♀.

Head wider than long, eyes large, prominent, disk of the vertex as wide as long, frontal margin triangularly produced and not separated from clypeus by a transverse impression, supra-antennal elevations very inconspicuous, each one being two very minute, black-pointed, sharp-pointed tubercles. Disk behind the inter-antennal line flat, quadrate, with rounded angles, between the eyes are two hardly visible punctures mutually four times farther distant than from the eye. Between the posterior limits of the eyes are two faint transverse elevations. *Antennæ* longer than the head and prothorax, the first and second joints nearly equal cylindrical, third to sixth half the size of the second, cylindrical. Seventh to tenth gradually increasing in size, the tenth nearly as wide as the second, the eleventh is fusiform, sharp-pointed, truncate at the base and half as wide as long. *Palpi* with the last joint sessile on the penultimate, with a broad base. *Prothorax* one-fifth shorter than its width, nearly globose, truncate at the neck and base, the latter one-fourth the wider; disk very convex without sculpture excepting a zone of punctures near the base. *Elytra* across the faint humeral ridge as wide as the prothorax, the suture being one-half longer. They are much the widest in the middle, sides evenly and strongly arcuate, disk very convex. Each elytron bears at the base three minute acu-punctures, the sutural lines very faint, parallel, dorsal lines wanting. *Abdomen* one-fifth narrower than the elytra, very convex, basal segment half as long as wide, border very narrow, two minute carinæ at base. First ventral of the same length, with a longitudinal carina on each side one-fifth from the margin. Legs long and slender, tarsi with the second joint twice as long as the third, posterior tibiæ with a long spur; the basal joint of the posterior tarsi is obliquely truncate and the trochanters are small. ♂ differs in the form of the last antennal joint which is larger, pointed at both ends, and the front is impressed. This singular form belongs between *Bythinus* and *Eutrichites*, differing from the latter in the form of the antennal club and the larger basal abdominal segment.

Habitat. Arizona.

EUTRICHITES, *Leconte.*

Head with two occipital foveæ and a frontal impression. Antennæ with the joints small, only the last being very large, inserted in front of the antennal tubercles. Palpi with the second joint clavate, the third small, globular, fourth ovate, acuminate, more convex internally. Prothorax globose unifoveate. Elytra convex, very long, discal lines wanting. Abdomen short, narrowly margined, dorsals equal or nearly so in length, first and second ventrals longer, tarsi long with a single claw.

E. ZIMMERMANNI, *Lec.* Reddish yellow, shining, convex, pubescence short. Length, 0.9 to 1.0 mm. Plate VII., Fig. 37.

Head smooth, as wide as long, tempora longer than the eye, arcuate, not prominent. Eyes not very prominent, front concave between the antennal tubercles, vertex convex, with two small, widely distant foveæ in a line with the posterior margin of the eye, these foveæ being connected with the frontal tubercles by a fine line. *Antennæ* as long as the head and prothorax, first and second joints stronger, subequal in length. Third to ninth transverse, moniliform, equal, tenth broader, not longer, eleventh very large, ovate-acute. *Prothorax* nearly globose, truncate at the base, polished, smooth, with a zone of basal punctures and a deeper median puncture. *Elytra* twice as long as the prothorax, which they slightly exceed in width across the low shoulders. Across the tip they are as wide as long, convex, sutural lines close, punctured like the disk, discoidal basal impressions faint. *Abdomen* short, segments nearly equal in length, convex, margin narrow. Legs strong, thighs clavate. ♂ last ventral deeply impressed, posterior tibiæ curved.

Habitat. Virginia, Georgia, Texas.

This species was previously described as *Bythinus zonatus*, Brend.

NISAXIS, *Casey*.

This genus was established by Capt. Thos. L. Casey, by reason of Reitter's division of the genus Bryaxis. In the opinion of many, this should be regarded as only a section of *Bryaxis*, but it seems to us entitled to recognition. It presents the following characters:

Vertex without foveæ, the frontal margin obliquely declivous, gula bicarinate. The ventral segments are four, the two basal ones very large, the third hardly visible except at the sides. The fifth may be ankylosed to the preceding, or wanting.

N. TOMENTOSA, *Aubé*. Reddish-brown throughout, pubescence fine, long, especially on the posterior part of the abdomen, body coarsely punctate. Length, 1.2. Plate XII., Fig. 128.

Head, exclusive of the large, coarsely-facetted eyes, as wide as long, trapezoidal, nearly quadrate, coarsely but not densely punctured, rather convex above, without occipital foveæ. There is an impression on each side of the convex middle portion of the front inside the supra-antennal tubercles; the sides are not carinate; gula bicarinate, tempora rounded, nearly as long as the eye. *Antennæ* with long pubescence, as long as the head and thorax, first joint cylindrical, flattened, above, more than twice as long as thick. Second a little shorter, equally thick, cylindrical, rounded at the tip; third to eighth smaller, narrower, obconical, gradually and slightly increasing in thickness, ninth and tenth evenly increasing in width, trapezoidal, the tenth twice as wide as long; eleventh oval, truncate at the base, one-half longer than wide. *Prothorax* wider than the head with the eyes, widest before the middle, sides convergent and very slightly sinuate toward the neck, less convergent but strongly sinuate near the base, which is twice as wide as the neck. Disk convex, coarsely and deeply punctured, the median basal punctures not at all conspicuous, the lateral foveæ impressed on the declivous impressed space near the basal angles. *Elytra* broad-shouldered, wider than the prothorax at the base, and with this width and length equal; beyond the middle they are one-third broader. Disk moderately evenly convex, less strongly punctured, bifoveate at base, sutural lines not very close, parallel, but convergent near the tip, not deeply impressed; discal lines one-half the length, fine, parallel to the suture. *Abdomen* short, strongly declivous behind, basal segment twice as wide as long, punctured, carinæ divergent, one-third the length of the segment and including half its width. The third segment in the ♂ has large impressions on each side of the middle converging forward, leaving an oblong median elevation bearing long hairs, legs slender.

Habitat. Northern Atlantic States. More rare in the West.

N. CINCINATA, *Casey*. Reddish-brown, pubescence moderately long and dense. Length, 1.0 mm.

Head as in *N. tomentosa*, but less deeply and densely punctured, especially in the middle, where it is to be seen in a certain light as a small, fine, linear, longitudinal impression. *Antennæ* with the ninth and tenth joints less trapezoidal, more rounded, the eleventh less truncate at the base and more ovoid than oval in comparison with the preceding species. *Prothorax* less impressed at the sides near the basal angles, punctuation feeble and sparse, the median basal puncture more conspicuous. *Elytra* as in *N. tomentosa*, inconspicuously punctulate, and not as wide across the shoulders. *Abdomen* sparsely punctulate, the basal segment rather shorter and the carinæ farther apart than in the preceding species. The sexual characters of the ♂ on the third segment are similar, but the median elevation is smaller, and the fourth segment is narrowly produced at the middle of the tip. The ninth and tenth joints of the antennæ are longer than in the ♀.

Habitat. Southern States and north to Illinois and Nebraska. We regard it as a more southern variety of *N. tomentosa*.

N. MARITIMA, *Casey*. Dark red, pubescence not dense. Length, 1.0 mm.

Head sparsely punctured near the eyes, impunctate in the middle. Antennæ as in *N. cincinata*. *Prothorax* minutely punctulate, strongly sinuate near the basal angles, basal median fovea minute, the lateral ones deep, larger at one-fourth of the length from the base. *Elytra* wider than long, and at the apex four-fifths wider than the prothorax; disk strongly convex, discal lines long, two-thirds of the elytral length. *Abdomen* with the basal carinæ short, including one-half of the segmental width. ♂ basal segment behind, deflexed in the middle, the deflected part transversely excavated, its lower margin reflexed, having in the middle a small tubercle; second segment short, with an anteriorly arcuate excavation in the middle third surrounding a strongly elevated carinate tubercle which bears two setæ. Its posterior surface is feebly and minutely tuberculate, the surface each side of the central excavation a transverse groove not connected. The third segment bears before the middle, two tubercles mutually distant one-half its width.

Habitat. Texas. Unknown to us.

DECARTHRON, *Brendel.*

Disk of the vertex longer than wide, quadrate, or less narrowed in front than in *Bryaxis*, the frontal foveæ wanting. Antennæ ten-jointed, the joints entirely rounded, excluding an ankylosis of any two. The prothorax is subglobose, the sides rounded, a single rude funnel-shaped fovea being situated near the middle of the base. The elytra are very broad shouldered, the base bifoveate, the sutural lines always straight, parallel, the discal lines divergent from the base and parallel in the posterior half. Abdomen short and wide, the basal dorsal segment not less than one-third as long as wide, the carinæ distant, parallel, almost entire. The intermediate thighs of the male are dilated, constricted in the distal half.

The following table will serve to separate our species:

a^1 Form of body, broad, robust.

b^1 Pubescence long, erect.

Occipital foveæ large, front depressed, connected with the foveæ by faint convergent sulci. Length, 1.4 mm. Color, black. ♂ femoral mark small near the end. - - *abnorme.*

Occipital foveæ small, lateral grooves parallel, dividing the front, which is not depressed, from the superantennal tubercles, the interval punctured. Length, 1.6 mm. Color, dark red. ♂ femoral mark large spinous near the middle. - *exsectum.*

b^2 Pubescence short. Male femoral marks small.

Occipital foveæ none, lateral groove interrupted, frontal space plane, punctured. Length, 1.7 mm. Color, brown, *brendelli.*

Occipital foveæ faint, pubescence very dense, hiding the sculpture of the entire upper surface. Length, 2 mm. Color, brown. - - - - - - - - *strenuum.*

a^2 Form, slender elongate, occipital foveæ present.

c^1 Prothorax impunctate.

Abdominal carinæ including more than one-half the segmental width. Color deep yellow. ♂ femoral spine short, near the distal end. - - - - - - - - *longulum.*

Abdominal carinæ separated by not more than one-half the segmental width. Color, dark brown, elytra and base of antennæ bright red. - - - - - - - - - *discolor.*

c^2 Prothorax punctulate.

Abdominal carinæ including less than one-half the segmental width. ♂ femoral spine excessively long and sharp, in the middle of the thigh. - - - - - - *formiceti.*

D. ABNORME, *Lec.* Black compact, not very visibly punctulate, pubescence long, dark, erect. Elytra varying from black to dark red, legs palpi and antennæ dull red. Length, 1.5 mm. Plate VIII., Fig. 40.

Head, excluding the eyes, quadrate above, frontal margin slightly and broadly emarginate inter-antennal space concave, occipital foveæ large, connected with the frontal concavity by faint convergent sulci, one on each side, which are sometimes absolute. Eyes prominent, facets coarse. *Palpi* with the third joint very stout, one-half longer than thick, acutely pointed. *Antennæ* as long as the head and prothorax, the joints nearly equal rounded, the basal ones more oblong. The fifth to the eighth are more transverse, ninth and tenth gradually increasing in width, also transverse, eleventh ovate, not acuminate, one-third longer than wide. *Prothorax* fovea small. *Elytra* one half longer than the prothorax, the width across the high prominent shoulders but little less than the sutural length; across the tip they are one-fourth wider. The discal and sutural lines are very deep the intervals evenly convex. *Abdomen* short, first dorsal three times as wide as long, the carinæ nearly entire including one-half of the entire width, borders broad, parallel. Legs strong, intermediate thighs with a rounded gouged channel from the upper edge posteriorly to the distal end, leaving a small sharp spine.

Habitat. Northern States east of the Missouri river. Canada.

D. EXSECTUM, *Brend.* Reddish-piceous, robust, somewhat more slender than *D. abnorme*, pubescence semi-erect, grayish-brown. Length 1.7 mm. Plate VIII., Fig. 41.

Head quadrate, eyes large, prominent, occipital foveæ small, grooves deep, dividing the frontal margin from the frontal tubercles, the intermediate space with nine punctures in three rows. In some specimens there is a round median impression on the vertex. *Antennæ* slightly longer than the head and prothorax, red; first joint obconical, half as thick as long, second oblong, slightly smaller, third to fifth gradually shorter becoming globular, the succeeding four gradually wider, not longer, obconical, tenth ovate, not acuminate, twice as thick as the ninth. The last palpal joint is twice as long as wide, conical, pointed from the middle. *Prothorax* with the basal foveæ longer than in *D. abnorme*. *Elytra* convex, suture one-fourth longer than the prothorax, width across the high prominent shoulders the same; tip one-fourth wider. Discal lines sharp, intervals not convex, sloping, highest next to the discal lines, sides arcuate. *Abdomen* with the first dorsal longer in the middle than at the sides, half as long as the elytra, carinæ including one-half of the entire width. ♂ with the intermediate thigh grooved from the middle above to the distal end below, the spine consequently more prominent. Dark ♀ specimens may be mistaken for large ♀♀ of *D. abnorme* with damaged pubescence.

Habitat. Northwestern States east of the Missouri river.

D. STIGMOSUM, *Brend.* Brown, pubescence short, appressed, thin, yellow. Length, 1.7 mm. Plate VII., Fig. 39.

Head nearly plane, but slightly convex, without occipital fovea, the lateral grooves interrupted, frontal margin straight. inter-antennal space very slightly depressed, densely punctured. *Antennæ* as long as the head and prothorax, joints one and two oblong, obconical, third to ninth gradually increasing in width, not in length, the third smaller than the second. The ninth joint is twice as wide as the third, the tenth oval, somewhat more roundly pointed in the middle, wider than the ninth. *Palpi* with the second joint clavate from near the middle, the third globular, as thick as the last which is three times longer and pointed at each end. *Pro-*

thorax finely punctulate, fovea large. *Elytra* one-third longer than the prothorax and the same width across the shoulders which are moderately prominent. Across the tips they are one-fourth wider. Lines deep near the base, intervals slightly and evenly convex. *Abdomen* punctulate, first segment nearly as long as wide, arcuate behind, carinæ reaching to the middle, enclosing one-half the total width. ♂ intermediate thigh grooved from the lower third to near the knee, spine not prominent.

Habitat. Eastern States.

D. BRENDELLII, *Casey.* Piceous-brown, elytra red, antennæ and legs paler brown. Length, 1.4 mm. Plate VIII., Fig. 43.

Head quadrate, eyes prominent, very near the base, tempora straight, entirely transverse; occipital foveæ deep, very far apart, lateral grooves convergent, dilated anteriorly and lost in the plane of the depressed middle portion of the front. The frontal margin anterior to the median plane is very narrowly retuse, the antennal tubercles more prominent than in the other species. *Antennæ* scarcely as long as the head and prothorax, first joint obconical, as thick as the tubercle, second oval, slightly smaller, third to seventh subequal, gradually becoming more transverse, eighth and ninth transversely oval, tenth three times as thick as the eighth and one-half longer than its width, ovate, truncate at the base *Prothorax* finely punctulate, slightly wider than long, fovea oblong, deeper at the base. *Elytra* one-half longer than the prothorax, measure across the shoulders the same, across the tips one-fifth wider. All impressed lines parallel, the basal fovea sharp, rounded, sides slightly arcuate, the intervals evenly and very broadly convex. *Abdomen* with the first dorsal half as long as the width between the borders, straight, cylindrical longitudinally, evenly convex from side to side, carinæ three-fourths the length enclosing one-half the entire width. Legs strong, ♂ intermediate thigh with the usual gouge mark near the distal end, and a rather deep oblong fovea near the middle and widest part of the thigh.

Habitat. Texas.

D. STRENUUM, *Brend.* Cinnamon-brown, robust, pubescence dense, gray, appressed, antennæ, palpi and legs paler than the body. Length, 2.0 mm. Plate VII., Fig. 38.

Head quadrate, nearly plane, but slightly convex, foveæ faintly discernible beneath the very dense pubescence, frontal margin straight, eyes large. *Antennæ* very stout, longer than the head and prothorax, first joint thick, obconical, second and third gradually narrower, as long as broad, fourth and fifth slightly longer, sixth heavier, globular, seventh smaller, of the same form; eighth and ninth transverse, gradually larger, tenth ovate, bluntly pointed. *Palpi* rather thick and short. *Prothorax* transverse, as long as the head and more than one-fifth wider, foveæ large, covered with dense pubescence. *Elytra* one and one-half times the length of the prothorax, width across the high, prominent shoulders the same. One-fourth from the tip they are one-fourth wider. Discal lines distinct, abbreviated before the tip. *Abdomen* as long as the elytra, length of the first dorsal equal to one-third of the width, carinæ half the length enclosing less than one-half the width, the border rather narrower than in the other species and not quite parallel. Legs stout.

The specimen from which the above description is made up is ♀, the ♂ being unknown to us. Leconte collection, Cambridge.

Habitat. Pennsylvania.

D. LONGULUM, *Brend.* Elongate, punctulate, depressed, red-brown, pubescence short, sparse. Length, 1.5 mm. Plate VIII., Fig. 42.

Head sulcate from the foveæ to the subangular frontal margin, eyes prominent. *Prothorax* nearly globose, as long as wide, widest before the middle, sinuate near the neck, the basal fovea nude, deep, funnel-shaped. *Elytra* one and one-half times as long as the prothorax, shoulders high, width of elytra across the tip a little more than twice the length of the head. Disk slightly convex, dorsal and sutural lines sharp, not deeply impressed, faintly punctulate, sides suddenly declivous, very slightly arcuate. *Abdomen* broadly margined, first segment two and one-half times as broad as long, the long carinæ including nearly one-half the width. *Antennæ* as long as the head and prothorax, first and second joints subcylindrical, third to sixth subequal, globular, seventh to ninth gradually increasing in width, tenth one-half longer than wide, ovate. Legs slender, the ♂ intermediate thighs slightly gouged on the lower fourth, leaving an inconspicuous spindle, the tibia slightly dilated from the middle, tarsi thicker than in the other species.

Habitat. United States south of the Ohio river.

D. DISCOLOR, *Brendel*, n. sp. Elongate, piceous-brown, impunctate, abdomen darker than the head and prothorax, elytra bright red, antennæ red at base, the club brown. Legs reddish-yellow, palpi sulphureous. Pubescence fine and scanty. Length, 1.5 mm.

Head with the vertex quadrate, evenly convex, inter-ocular foveæ large, nude, mutually three times as far distant as is either from the eye. Between them is a small punctiform impression. A very shallow longitudinal impression originates in the lateral foveæ each side and separates the middle of the front from the sides. Eyes large, very near the lateral margin of the vertex. Clypeus margined anteriorly. *Antennæ* as large as the head and half the prothorax, the two basal joints equal in width, the second shorter, third to seventh obconical, subequal, the third as long as the second; seventh half as long, transverse, eighth and ninth transverse, trapezoidal, rapidly increasing in width, last joint ovate, as long as the three preceding. *Prothorax* very convex, little wider than long, sides rounded, arcuate, basal foveæ nude, very large. *Elytra* with the shoulders moderately prominent, the width across them equal to the length of the suture and one-third less than the greatest discal width, discal lines fine, one-third shorter than the suture. *Abdomen* with the base segment half as long as wide, carinæ slightly divergent, of the usual length and including one-half of the segment.

Habitat. New Mexico (Albuquerque). H. F. Wickham.

D. FORMICETI, *Lec.* Elongate, punctulate, more slender than *D. longulum*, red-brown, pubescence short, sparse. Length, 1.2 mm. Plate VIII., Fig. 44.

Head with the occipital foveæ nearer together, the grooves convergent, dividing the frontal margin. Antennal tubercles more prominent, inter-tubercular space smooth, depressed. *Antennæ* shorter than head and prothorax, rather stout, second joint globular, second to seventh rounded, equal in length, scarcely perceptibly increasing in width, eighth longer, transverse, obconical, ninth twice as wide but little longer, transversely oval, last joint as wide as the ninth at base. Base truncated, tip rounded. *Palpi* with the last joint thick. *Prothorax* nearly circular, foveæ deep. *Elytra* depressed, punctulate, basal foveolæ deep, lines entire, sutural intervals flat, punctured, shoulders high, the humeral width equal to the sutural length. The apical width is one-fourth more, the suture being slightly shorter than the head and prothorax together. *Abdomen* with the first dorsal one-third as long as wide, carinæ entire, including more than one-third of the surface. ♂ with the intermediate thighs very broad, gouged from the middle to near the knee, leaving an excessively strong, sharp, spine above.

Habitat. Southern States.

BRYAXIS, *Leach.*

SYNOPSIS OF THE SPECIES OF BRYAXIS.

I. Elytra each with two basal foveolæ. Prothorax with three equal, pubescent foveæ.

  A. Prothorax with three basal foveæ connected by an arcuate groove, elytra with a subhumeral fovea and longitudinal groove. Sexual marks on the anterior tibiæ and antennæ. - (*Rybaxis*, Sauley).

1[1] Median fovea large, pubescent; abdominal carinæ including one-third of the segmental width. ♂ antennæ very long, the club slender. Length, 2.0–2.2 mm. Penna., New York, Ill. (*sanguinea* ? Leach) *valida.*

1[2] Median fovea small, nude.

Basal abdominal foveæ including one-fourth of the segmental width, antennal club loose, the penultimate joints not elongate nor compressed. Anterior trochanters blunt. Length, 1.8–2.0 mm. New York to Missouri. - - *conjuncta.*

Basal abdominal carinæ including one-third of the segmental width, antennal club three-jointed, dilated, compressed in ♂, densely covered with black pubescence. Anterior trochanters with a sharp-pointed tubercle. Length, 1.7–1.8 mm. Penna., Ill. - - - - - - - - - *brendelii*

B. Prothorax with three equal, small, pubescent foveæ, connecting groove wanting. Last three joints of the ♂ antennæ contorted in various ways. (*nisa*, Casey).

1[1] Prothorax as long as wide, convex, abdominal carinæ wanting.

The pubescent basal abdominal lines equal in length to one-third of the segmental width. Length, 2.0 mm. Virginia. *luniger.*

Basal pubescent patch not wider than the distance between the sutural lines. Length, 1.8 mm. Ill. - - *perpunctata.*

1[2] Prothorax wider than long, less convex.

Abdominal carinæ including two-fifths of the segmental width. Length, 2.2 mm. Virginia. - - - - *cavicornis.*

Abdominal carinæ including one-third of the segmental width. Length, 1.8 mm. Arizona. - - - - - *elegans.*

C. Prothorax with three large, equal, pubescent foveæ, sexual marks on the dorsal segments. (*Bryaxis*, Sauley).

1[1] Elytra impunctate, lateral margin and declivous sides nearly parallel, not divergent posteriorly.

Prothorax widest just before the middle, not very convex longitudinally, ♂ with three of the dorsal segments sculptured, the fourth produced over the fifth. Length, 2.0 mm. East of Alleghanies. - - - - - - - *abdominalis.*

Prothorax widest just behind the middle, longitudinally convex, ♂ with two segments sculptured, the third produced over the fourth. Length, 1.8 mm. Florida, Georgia, Tennessee. *floridana.*

1[2] Elytra with the sides divergent.

2[1] Occipital foveæ open toward the eyes or very near them.

3[1] Impunctate, ♂ with two dorsal segments sculptured. Length, 1.9 mm. Tennessee, Virginia. - - - - - - - - *intermedia.*

3[2] Punctulate.

A faint linear impression from the occipital foveæ to the corresponding frontal tubercle. ♂ with two segments sculptured, the second produced into a narrow, laterally emarginate lobe. Length, 1.8 mm. Virginia. - - - - - *ulkei.*

Occipital foveæ smaller than in *ulkei*, mutually more distant, ♂ with the first segment acutely bilobed, the second one broad, lobe overhanging the third segment. Length, 1.7 mm. Illinois, Iowa. - - - - - - - - - - *illinoiensis.*

2^2 Occipital foveæ isolated from the eyes.

4^1 Posterior limit of each elytron arcuate in the middle, sinuate externally, ♂ first dorsal triangularly produced in one broad lobe. Color brown. Length, 1.66 mm. Pennsylvania. - - - - - *dentata.*

4^2 Posterior limit of the elytra straight, pronotum impunctate.

Black, legs, antennæ and palpi dusky yellow, occipital foveæ small; abdominal carinæ including one-third of the segmental width; ♂ first dorsal broadly arcuated lobed, elevated in the middle of the posterior limit, second transversely convex, foveate at the middle posteriorly. Length, 1.2–1.3 mm. Michigan, Illinois, Iowa. - - - - - *perforata.*

Brown, head paler, all the foveæ on head and pronotum excessively large, ♂ posterior margin of first segment emarginate in the middle: second with a circular impression. Length, 1.3 mm. California. - - - - - - - - *foveata.*

Yellowish-brown, foveæ normal, abdominal foveæ including more than one-third of the width; ♂ first dorsal flattened, slightly deflexed, and foveate at the tip, second transversely convex. Length, 1.5 mm. Texas, Louisiana. (♂ *infinita*, Casey). - - - - - - - - - - *belfragei.*

Yellowish-red, prothorax sinuate at the sides behind the middle; ♂ first dorsal as long as wide, quadrate, carinæ including two-fifths of the width. Length, 1.3 mm. Texas, Arizona. *texana.*

II. Elytra each with three basal foveolæ. Prothorax with large, pubescent lateral foveæ and a small, wide median one. (*Reichenbachia*, Leach).

D. Abdominal carinæ including less than one-third of the segmental width. No secondary sexual marks on the antennæ.

1^1 Abdominal carinæ separated by a distance not exceeding that between the sutural lines, and including a rounded, pubescent pad, often covered by the elytra.

2^1 Pronotum punctured.

Pronotum evenly thinly punctulate, abdominal carinæ short; color at time of copulation, pale umber brown, elytra yellowish-red. Later in the year this color darkens. Length, 1.2 mm. - - - - - - - - - - - *gemmifer.*

Pronotum evenly densely punctate, elytra and dorsal segments regularly punctulate, abdominal carinæ very long. Color at time of copulation, dark piceous, elytra slightly paler. Length, 1.3–1.4 mm. Canada, Iowa. - - *canadensis.*

2[2] Pronotum impunctate.

Abdominal carinæ long, color ferruginous, ♂ last ventral concave, with a median longitudinal elevation. Length, 1.5 mm. Illinois. - - - - - - - - - - - *radians.*

Abdominal carinæ short, elytra punctured, color piceous, antennæ and legs yellowish-red. Length, 1.2 mm. Massachusetts. *divergens.*

Abdominal carinæ somewhat farther apart, not very short, median fovea of pronotum very small, occiput slightly impressed in the middle. Color ferruginous. Length, 1.3 mm. Florida, South Carolina near the coast. - - - - *atlantica.*

1[2] Pubescent pad at the base between the abdominal carinæ transverse, not broader than one-fifth of the abdominal width.

3[1] Pubescence very long, pronotum and elytra longitudinally very convex, nearly gibbous, median fovea very small.

Prothorax not punctured, abdominal carinæ very long, parallel, slightly divergent at the end and fully one-fifth of the abdominal width apart. Length, 1.33 mm. Louisiana, Illinois, Iowa. - - - - - - - - - - - *gracilis.*

Varieties of this species from Louisiana, with traces of punctures on the pronotum, are called *gracilicornis*, Casey. Others from Iowa, with shorter carinæ, constitute the typical *gracilis.*

3[2] Pubescence short, pronotum and elytra normal, not so convex.

4[1] Pronotum decidedly punctate.

Head and pronotum with closely placed, large, deep punctures, abdominal carinæ including one-fifth of the segmental width. Color black, elytra piceous, legs yellow. Length, 1.0 mm. New York, Long Island. - - - - - - *scabra.*

Head punctulate, pronotum polished, with deep, evenly-distributed, abundant punctures; abdominal carinæ long, parallel, slightly divergent posteriorly, including one-fifth of the abdominal width. Length, 1.5 mm. Illinois, Iowa. *cribricollis.*

(Varies slightly in the strength of puncture).

4[2] Head and pronotum impunctate, or with a few irregular, minute punctures. Abdominal carinæ divergent from the base onward.

Pale ferruginous or lighter, abdominal carinæ including one-sixth of the abdominal width. Length, 0.9 mm. New York, Virginia. - - - - - - - - - - - *congener.*

Piceous-black or dark-brown, with red or darker elytra, legs and antennæ yellowish-red or brown. Abdominal carinæ including from one-sixth to one-fifth of the segmental width, strongly divergent, disk of pronotum and elytra with a few minute, scattered punctures, or impunctate. Pubescence short, suberect. Length, 1.2–1.4 mm. Atlantic region, Illinois, Kansas. - - - - - - - - *rubicunda.*

Ferruginous, abdominal carinæ divergent, springing from a triangular pubescent pad. ♂ last ventral with a deep, sharply defined, small, oval fovea. Length, 1.8 mm. Missouri. *trigona.*

(Unknown to us).

Reddish-piceous or brown, head and prothorax brighter red, elytra piceous-black, pronotum polished, obsoletely punctured with distant, ample, shallow punctures; lateral foveæ small, median very conspicuous. Abdominal carinæ feebly divergent. Length, 1.1 mm. Iowa. - - - - - *bicolor.*

1^3 Pubescent pad linear, as long as one-third or more of the segmental width.

5^1 Pronotum punctured.

Head and pronotum evenly but not densely punctured, punctures varying in strength, especially in females. Lateral pronotal foveæ large, in full view from above; abdominal carinæ short, not perceptibly divergent, sometimes covered by the elytra in the ♂. Color, dark piceous or paler, elytra red or darker, legs and antennæ red. Length, 1.0–1.2 mm. Region east of the Missouri and Mississippi rivers. - *puncticollis.*

Head smooth, pronotum polished, with scattered, irregularly distributed, faint punctures. Lateral foveæ plainly visible from above. Color invariably a uniform dull orange, or ferruginous. Abdominal carinæ moderately long. Length, 1.2 mm. Lowlands from Texas to Pennsylvania, not occurring in the Mississippi valley. - - - - - *litoralis.*

Head and pronotum scarcely perceptibly punctulate, pronotal lateral foveæ impressed on the sides and not fully visible from above. Color black, elytra, legs, antennæ and palpi dull red, not polished. Length, 1.3 mm. Nevada. *nevadensis.*

5^2 Pronotum decidedly impunctate.

Form slender with narrow shoulders, elytra short, abdomen long, convex, highly polished, pubescence thin; abdominal carinæ including two-fifths of the total width, divergent. No sexual marks on the antennæ. ♂ with the last two ventrals impressed at base. Color dark grayish brown or piceous. Length, 1.2 mm. New York. - - - - - - *polita.*

E. Abdominal carinæ separated by more than one-third of the segmental width. Antennæ different in the sexes.

1^1 Frontal foveæ larger than or equal to the interocular foveæ.

2^1 Dark brownish red or milky coffee colored; legs commonly paler, sometimes darker.

Frontal fovea very large, ♂ antennæ with the fourth joint widely dilated, fifth to eighth small, closely united, transverse, ninth and tenth nearly as wide as the last. Length 1.2 mm. Southern California. - - - - - - - *sagax.*

Frontal fovea normal. ♂ antennæ in some specimens with the front joint very small, triangular, fifth more than twice as wide as the first, transverse, hemispherical or cup-shaped, sixth of the same form but a little smaller, seventh to ninth subequal, smaller of the same shape, tenth as large as, and like the sixth, the last obovate and as wide as the tenth. In others the fourth joint is larger, the fifth only one-half wider than the first, sixth to ninth a little narrower, tenth and eleventh in proportion. The posterior tibiæ are more or less flattened. Two forms are recognized by authors. Elytra more red; Washington, Idaho, Vancouver's Island, British Columbia. - - - - - - - - - *albinica.*

Elytra usually darker. Manitoba, Canada, and adjoining regions. - - - - - - - - - *propinqua.*

2² Orange or ferruginous.

Dark red, elytra red, antennæ and legs paler, prothorax and elytra minutely feebly punctuate, foveæ very small impressed on the sides. ♂ antennæ with joints two and five equal, larger, fourth and eighth smallest, sixth to ninth subequal, decreasing in size and obliquely truncate. Eleventh obliquely pointed. Length 1.4 mm. - - - - *informis.*

Ferruginous foveæ very small, length 1.2 mm. (♀) - *subtilis.* (Unknown to us—perhaps identical with *informis.*)

Piceous elytra red, legs and antennæ darker, punctulate, male antennæ with joints one to three obconical, decreasing in size, fourth to seventh transverse, differently formed, increasing in width, the seventh widest. Eighth joint transverse, equal to the fifth. Ninth joint equal to the second, obconical like the tenth; eleventh long. Length, 1.2 mm. *tumidecornis.*

Red, elytra, and legs paler, impunctate. ♂ antennæ with the fourth joint four times wider than long, fifth and sixth gradually narrower, seventh equal to the first, eighth smallest, quadrate. The remaining three joints gradually increase in size, the ninth and tenth being obconical, the eleventh long. Length, 1.4 mm. - - - - - - - - - - *tumorosa.*

Frontal fovea normal, (♂?) antennæ with the fifth and sixth joints stouter, elongate oval, ninth and tenth nearly as wide as the last joint. Hind tibiæ curved and flattened. May be identical with *tumida.* - - - - - - - - *complectens.*

1² Frontal fovea at the bottom of a transverse impression; in the male it is very minute or entirely wanting.

Elytra and prothorax densely punctured, pubescence long, dorsal lines convergent, basal abdominal carinæ not visible, antennæ stout; in the ♂ the joints sixth to eighth are narrower than the fourth and fifth. Color, light brown, legs paler. Length, 1.2 mm. California. - - - - - *compar.*

Elytra and prothorax very indistinctly punctuate, pubescence very fine; color, dark piceous, elytra, legs and palpi red, antennæ darker, not straight. In the male the second joint is very large, third and seventh lenticular, transverse, third and fourth smaller, the fifth wider than the first; eighth joint smallest, ninth, tenth and eleventh forming a connate club. Length 1.2 mm. California. - - - *deformata.*

Piceous-black, elytra red, pubescence fine, plentiful, antennæ dark brown, legs lighter. Prothorax very convex, the lateral foveæ not in full view from above, punctate near the base; abdominal carinæ separated by one-third of the segmental width. ♂ with the frontal fovea wanting, the first antennal joint transverse, truncated, pyramidal. The fifth, sixth and seventh are larger and thicker than the four preceding them. Length, 1.2 mm. California, Washington. - *fundata.*

Black, elytra dark red, antennæ and legs dark brown, pubescence fine, conspicuous; head distinctly, elytra sparsely, prothorax densely punctulate, abdominal carinæ distant, one-fourth of the segmental width. Antennæ of ♂ with the fifth joint larger than the second, sixth smaller, fourth and seventh equal, still smaller, all irregularly rounded. Length, 1.3 mm. California. - - - - - - - - *franciscana.*

Clear yellowish brown, pubescence fine, prothorax impunctate, elytra and abdomen sparsely punctulate, lateral foveæ of prothorax in full view from above, abdominal carinæ enclosing one-third of the segmental width. Antennæ of ♂ long, fifth and sixth joints larger, longer than wide, one-half wider than the first, fourth and seventh smallest, equal, seventh to tenth gradually wider, eleventh as wide as the fifth and one-third longer. ♀ with the frontal fovea conspicuous, fifth and sixth joints not quite so large. Resembles *B. complectens* and may be identical with it. Length, 1.2 mm. Texas. - *tumida.*

SECTION I. (RYBAXIS, *Saulcy.* BRYAXIS, *Thoms.*)

In addition to the characters given in the synopsis, the males have a strong tooth on the anterior tibiæ. Descriptions are appended of our three species and also of a European specimen of *sanguinea* which has been listed as a member of our fauna, probably through an error in determination.

B. SANGUINEA, *Leach.* (♂ LONGICORNIS, *Aubé,* var. LAMINATA, *Mots.*) Frontal margin straight, inter-antennal space slightly concave, surface of vertex quadrate. Antennæ of ♂ more than half the length of the body; joints are twice as long or longer than thick, ninth and tenth obconical, the last three times longer than thick. Elytra with the posterior limit arcuately lobed. Abdominal carinæ distant more than one-third of the segmental width. Length, 2.0 to 2.2 mm. Europe.

B. VALIDA, n. sp. Dark piceous-brown, elytra and antennæ red, legs paler or yellow.

Head trapezious, inter-antennal space deeply impressed, ♂ antennæ not half as long as the body, the first joint nearly as long as the third and fourth together; second shorter, oblong, rounded, third to sixth narrower not twice as long as thick, seventh and eighth gradually shorter and narrower, the latter quadrate. Ninth and tenth trapezoidal, suddenly increasing in size, wider than long, eleventh thicker and as long as the two preceding together, more convex outside. *Prothorax* deeply depressed each side near the base, *Elytra* with the shoulders slightly wider and the suture slightly shorter than in *B. sanguinea*, abdominal carinæ not including one-third of the segmental width, the segments less convex than in the European specimens. This species is the one called *B. sanguinea* in our cabinets. New York, Illinois. Length, 2.2 mm.

B. CONJUNCTA, *Lec.* Black, polished, impunctate, elytra red or darker, antennæ and legs brownish red, palpi yellow. Plate VIII., Fig. 46.

Head with the frontal margin emarginate, inter-antennal space very concave. *Antennæ* less than one-half the length of the body, first joint strong, obconical, second a little smaller, oval, third and fourth smaller, obconical, fifth to seventh larger, oval, eighth smaller, globular, ninth twice as wide as the eighth, trapezoidal, tenth wider, nearly quadrate, eleventh as long as the three preceding together, truncate at the base, acute at tip, as wide as the tenth. In the ♀ the intermediate joints of the antennæ are equal in length and width, cylindrical, eighth to tenth more or less globular, the last not so long in the male and not more convex outside. *Prothorax* with the basal sulcus sharply defined, the median fovea small. *Elytra* widest near the tip, which is one-fourth wider than the high prominent shoulders; posterior margins straight, fringed with yellow hair, discal lines more deeply impressed in the darker specimens. Abdominal carinæ short, more than one-fourth of the segmental width apart. Trochanters not spinous, anterior tibiæ emarginate inside from the upper third to the tarsus. Variable in color and size, also in the antennæ.

a. VARICORNIS. Last antennal yellow. Canada.

b. TRUNCATICORNIS. Tenth joint flattened on the inside, convex outside, last joint with a recumbent tooth. Iowa.

This species has a wide range. It occurs over the territory east of the Mississippi and and as far west as Idaho.

B. BRENDELII, *Horn.* Black, polished, impunctate, legs, antennæ and palpi brown, elytra varying to piceous-red. Length, 1.7 to 1.8 mm. Plate VIII., Fig. 47.

Head with the frontal margin nearly straight, less concave between the frontal tubercles, the foveæ larger. *Antennæ,* ♂ with the first joint obconical, not half as long as the frontal margin, flattened above, second smaller, oval. Third and fourth smaller, obconical, equal, fifth, sixth, seventh and eighth, equal in length and thickness, conspicuously larger than the preceding, subglobular, with darker pubescence; ninth and tenth oblique-transverse outside, rounded inside, pointed forward, equal and connate with one another and with the last joint which is obliquely ovate-acuminate. These last three joints have a velvety black, densely pubescent club, three times as thick as the eighth, and as long as the five preceding joints together. ♀ with the third to eighth joints equal, cylindrical, the last three forming a slightly smaller club with the joints not oblique, ninth and tenth trapezoidal, the pubescence not so dense as in the male. *Elytra* and *abdomen* as in *B. conjuncta.* ♂ anterior tibiæ toothed on the upper third, anterior trochanters armed with a slender spine.

Habitat. Region of the Great Lakes.

B. LUNIGER, *Lec.* Umber brown, punctulate, pubescence long, recumbent, elytra red, antennæ dark red, last four joints fuscous, legs uniform red-brown. Length, 2.0 mm. Plate VIII., Fig. 50.

Head hexagonal, frontal margin concave, foveæ large, eyes prominent. *Antennæ* longer than the head and prothorax, joints first to seventh cylindrical, gradually decreasing in length, less so in thickness, the fifth a little longer than its neighbors, eighth transverse. Club regularly thickened in the ♀; in the ♂ the eighth joint is wedge-shaped, transverse, the ninth bowl-shaped, tenth resembling a screw, eleventh oval, concavo-convex. Last joint of palpi rather long. *Prothorax* as long as wide, convex, punctulate, the rather small pubescent foveæ equal in size, the lateral ones impressed on the sides, therefore not fully visible from above. *Elytra* punctulate, shoulders high, discal lines straight, convergent, sutural interval elevated, highest in the middle. *Abdomen* punctulate, first segment as long as one-third its width, no carinæ, but with a transverse ciliated pad, one-third as wide as the segment. ♂ with the metasternum concave, anterior and intermediate trochanters with a short, strong spine.

Habitat. Low, swampy ground in Maryland and Virginia.

B. CAVICORNIS, *Brend.* Length, 2.2 mm. Plate VIII., Fig. 49.

Differs from *B. luniger* in the wider, less convex and punctulate prothorax, with the foveæ all in full view from above; the abdominal carinæ are visible, and include one-fifth of the segmental width. The ♂ antennæ have the last three joints different in form, the seventh, eighth and ninth transverse, the ninth wedge-shaped, the tenth screw-shaped, the eleventh triangular, resembling the last palpal joint of Tmesiphorus; ♂ anterior and posterior trochanters spinous.

Habitat. Maryland and Virginia.

B. PERPUNCTATA, *Brendel.* Brown, polished, punctate. thinly pubescent. Length, 1.8 mm. Only the ♀ known.

Head, excluding the eyes, longer than wide from base to frontal margin, trapezoidal, widest behind the eyes. Tempora slightly arcuate, very convergent, as long as the eyes, frontal tubercles high, rounded, space between them concave, foveæ moderately large. Vertex impunctate, occiput convex, labrum deeply emarginate, margin crenate. *Palpi* with the last joint cylindrical, acuminate, not thicker than the globular third joint. *Antennæ* as long as the head and prothorax together, first joint cylindrical, half as long as the frontal margin, second to fourth gradually smaller, oblong, rounded, second half as long as the first and nearly as thick; fifth stronger than its neighbors, sixth and seventh small, globular; eighth not wider, transverse, ninth and tenth gradually larger, obconical, eleventh truncate at the base, not wider than the tenth, widest before the middle, bluntly rounded at the tip and as long as the first. *Prothorax* not wider than the head with the eyes, nearly globose, base arcuate, one-half wider than the neck, foveæ small, filled with pubescence, the middle one very near the base, lateral ones invisible from above. *Elytra* reddish, convex, slightly wider than the prothorax across the high, prominent shoulders, and three-fourths wider across the tip. The suture is darker and one-third longer than the prothorax, the sutural interval is roof-shaped, discal lines fine, sharp, convergent, abbreviated near the tip. *Abdomen* as strongly punctured as the prothorax, first segment three times as wide as long, very broadly convex, carinæ indicated by a very small rounded, pubescent patch. Legs slender, thighs slightly clavate, posterior tibiæ slightly arcuate, thicker at the distal end. Tarsi not half as long as the tibiæ, joints two and three equal, rather thick. ♂ unknown to us.

Habitat. Georgia.

B. ELEGANS, *Brendel*, n. sp. Red-brown throughout, impunctate, covered with abundant, recumbent pubescence. Length, 1.8 mm. Plate VIII., Fig. 48.

Head, from the frontal ridge to the base, as long as the width between the eyes, tempora as long as the eye, the latter being large and prominent. Sides anterior to the eyes convergent, slightly sinuate, supra-antennal tubercles quadrately rounded, the front depressed in the middle, slightly arcuate, as wide as the neck; frontal fovea small, interocular foveæ twice as distant from one another as from the eye, connected with the frontal impression by an inconspicuous, interrupted depression. Occiput convex. *Antennæ* longer than the head and prothorax, first and second joints cylindrical or barrel-shaped, subequal, third and fourth smaller, subequal, fifth larger than the fourth, sixth and seventh smaller, obconical; eighth smallest, quadrate, ninth and tenth trapezoidal, rapidly increasing in size. Base of eleventh as wide as the tenth, middle twice as wide as the second; it is twice as long as wide and acuminate at tip. *Palpi* rather long, the first joint and the base of the second of a much darker brown than the rest, the last joint fusiform, four times longer than wide. *Prothorax* one and one-fifth times as long as the head is wide, sides from the neck to the middle divergent, thence convergent, slightly arcuate to near the base, where they are sinuate. Disk convex, with three small, equal, pubescent foveæ situated in slight depressions one-fourth from the base. *Elytra* little wider than the prothorax across the low shoulders, sutural length equal to this width; across the tip they are one-third wider. Sides divergent, slightly arcuate, the declivous part narrower than usual, disk with a nearly plane area in the neighborhood of the end of the suture and the shoulders. Base bifoveate, the respective lines sharply defined, the sutural ones parallel, the interval roof-shaped, discal lines parallel near the base, convergent behind the middle and abbreviated in the posterior fourth. *Abdomen* longer than the elytra, border wide, slightly retuse, first segment twice as wide as long, the carinæ parallel, reaching the middle and including one-third of the segmental width. Second and third dorsals equal in length, not quite half as long as the first. Legs long, the second and third tarsal joints subequal.

Williams, Arizona. H. F. Wickham.

B. ABDOMINALIS, *Aubé*. Uniform red-brown, impunctate, pubescence very fine, pruinose. Length, 1.9–2.0 mm. Plate VIII., Fig. 51 ♂.

Head, eyes excluded, nearly quadrate or slightly wider behind, fovea isolated, large, variolate, frontal margin wavy, slightly concave. *Antennæ* half as long as the entire body, first to eighth joints subequal, obconical, the first one-third as long as the frontal margin and half as wide as long. The eighth is nearly quadrate, ninth to eleventh gradually wider, ninth and tenth obconical, as long as the three preceding joints, eleventh ovoid-acute, as long as the eighth and ninth together. *Prothorax* as broad and as long as the head, including the eyes, widest at middle, not very convex, foveæ large and in full view from above. *Elytra* not very convex, sutural length much less than the humeral width, shoulders high, prominent. Across the tip the width is one-fifth greater than the sutural length. Suboral lines deep, straight, discal lines fine, arcuate, deeper near the base. *Abdomen* rather long, sides parallel, basal dorsal segment three times as wide as long, the obsolete carinæ including a space equal to the length of the segment, without sculpture in the ♀. ♂ abdomen with three modified dorsal segments, the first much depressed at the lateral basal angles. Next to the margin on each side is a large ovoid tumor. This gives the tip the appearance of being bilobed, The second segment is depressed at the sides of the base and in the middle is a deep, circular, punctured fovea. The third is produced, emarginate laterally, bilobed in the middle at the base, transversely depressed; the fourth is of nearly the same form, the two middle lobes, however, being united into one. Legs and under surface without sexual peculiarities. Antennæ of ♂ longer than in ♀. There is some variation in the sculpture of the first dorsal segment.

Habitat. Atlantic States.

B. FLORIDANA, *Brendel*. Uniformly reddish-brown, impunctate, pubescence very fine, pruinose. Length, 1.8 mm. Plate VIII., Fig. 53.

Head and elytra as in *B. abdominalis*, the impressions deeper. *Prothorax* widest slightly behind the middle and more convex toward the base, the lateral foveæ not in full view from above. *Antennæ* not quite half as long as the entire body, the fifth joint a little longer. *Abdomen* slightly divergent to the tip of the first segment, the obsolete carinæ including one-half the segmental width in the female. In the male the two basal segments are sculptured, the first much depressed at the lateral basal angles, posterior margin produced, emarginate at the sides, broadly gouged in the middle, leaving each side a blunt-pointed lobe. In the middle of the surface is an X-shaped elevation. The second segment is concave from side to side at the base, and in the middle is a large, deep, punctured fovea; the posterior margin is produced backward, broadly emarginate laterally, concave in the middle, leaving an oblong longitudinal elevation on each side. The third segment is of much the same general outlines as the second, but without visible sculpture. Legs and under surface not exhibiting any peculiarities. This insect represents the southern form of *B. abdominalis.*

Habitat. From the Gulf to the Ohio river.

B. INTERMEDIA, *Brendel.* Uniform brownish-red, impunctate, pruinose, more shining than *B. abdominalis.* Length, 1.9 mm. Plate VIII., Fig. 52.

Head and *prothorax* smaller, more deeply impressed, the occipital fovea large, open toward the eyes, the latter more convex, lateral fovea not in full view from above. *Elytra* more convex, the suture two-thirds, the shoulder-width one-half, and the width at tip not quite twice greater than the length of the prothorax. *Abdomen* with the margins of the basal segments parallel, carinæ including rather less than one-third of the segmental width. ♂ with the basal dorsal segment obliquely oblong-ovoidal, impressed from the anterior external angle to the posterior middle third of the segment, the impression limited inside by an obliquely arcuate ridge, which terminates posteriorly in a declivous sharp edge. The posterior margin is slightly produced, not emarginate laterally, semicircularly emarginate at middle between the oblique ridges; in the middle of this segment is a U-shaped elevation. The second segment is very long and narrowly produced, depressed along the base, with the usual large, punctured, median fovea. The sides of the prolongation are broadly emarginate and obliquely narrowly depressed on the surface, the middle of the segment from the basal fovea to the tip very high, elevated, flat above and as broad as one-fourth of the base of the segment, overreaching the last segments perpendicularly. Legs and antennæ presenting no peculiarities.

Habitat. Atlantic States.

B. ULKEI, *Brendel.* Brownish-black, punctulate, pubescence short, elytra, legs and antennæ red, palpi yellow. Length, 1.8 mm. Plate VIII., Fig. 54.

Head, excluding the eyes, wider at base than the frontal margin, occipital foveæ open toward the eye, a faint line connecting them with the frontal tubercles. *Antennæ* slender, half as long as the entire body, first joint very strong, second half as thick, obconical, twice as long as wide, third to eighth subequal, eighth quadrate; ninth and tenth obconical, together as long as the three preceding; eleventh oblong, equal in length to the ninth and tenth together. *Prothorax* as long as broad, widest through the middle, polished; base at the sides behind the lateral foveæ slightly transversely impressed. *Abdomen* punctured, margins of the first segment slightly divergent, carinæ visible, less than one-third of the segmental width apart. *Elytra* one-half longer than the prothorax, width at the shoulders the same, at the tip one-fourth broader; disk punctulate, sides very slightly arcuate, the discal and sutural lines parallel, deeply impressed, originating in deep basal punctures. ♂ abdominal basal segment produced from the lateral margin to the middle, the outlines oblique, converging, the middle semicircularly emarginate, leaving on each side of the emargination a long spinous process. Disk from the basal angles broadly, and towards the spines narrowly impressed. Second segment prolonged in the form of a trapezium, sides slightly emarginate, tip transverse, half as wide as the base, which is deeply concave, a dark cavity visible in the emargination of the first segment. Surface of the posterior segments perpendicular.

Habitat. Maryland, Virginia.

B. ILLINOIENSIS, *Brendel.* Dark piceous, elytra red-brown, antennæ piceous-brown, legs and palpi dull brownish-yellow, faintly punctate. Length, 1.7 mm. Plate VIII., Fig. 55.

Head with the occipital foveæ rather large, very near to the eye, frontal margin arcuate in the middle. *Antennæ* less than one-half as long as the body, first joint large, cylindrical; second smaller, rounded, third to eighth still smaller than the second, equal in thickness, subequal in length; eighth subglobular, ninth obconical, longer, tenth twice as wide as the eighth, trapezoidal, the eleventh oblong-ovoid, twice as thick as the ninth. *Prothorax* punctulate, visibly wider than long, the greatest width being attained at the middle, where it exceeds that of the head, convex, the lateral foveæ in nearly full view from above. *Elytra* punctulate, one-third longer than the prothorax, the width at the shoulders equal to the sutural length. Across the tip they are one-fifth broader. Shoulders moderately prominent, sutural and discal lines parallel, the latter deep near the base, convergent behind the middle, and abbreviated one-fifth from the tip. *Abdomen* with the first dorsal one-third as long as wide, the carinæ including more than one-third of the segmental width, and extending along one-fourth of the length. ♂ first dorsal produced behind into two acutely-pointed triangular lobes, depressed laterally from the apex to the basal marginal angle. Between the two cusps is a declining, posteriorly depressed, nearly level surface. Second segment arcuately produced, depressed at the base, and with a large punctate median fovea. Legs slender, the posterior tibiæ with a long terminal spine, the intermediate trochanters with a small sharp one.

Varies in brightness of colors and strength of punctuation.

Habitat. From the Atlantic coast to the Missouri river, north of the latitude of Tennessee.

B. DENTATA, *Say*. Brownish-black, minutely punctulate, pubescence dense, elytra and legs paler, reddish, palpi red. Length, 1.8 mm. Plate IX., Fig. 56.

Head with the frontal margin arcuate in the middle, the antennal tubercles sharply angulate laterally, occipital foveæ mutually three times as distant as either is from the eye. *Antennæ* less than one-half as long as the body, first, second and third joints cylindrical, gradually smaller, fourth, fifth and sixth a little larger, seventh and eighth again smaller, ninth and tenth much larger, the tenth joint is twice as long and thick as the ninth which is obconical and as thick as the second. The eleventh is double the length of the tenth and for one-third thicker, not very acutely pointed. *Prothorax* wider than long, widest at middle where it exceeds the head, convex, the lateral foveæ not in full view from above. *Elytra* evenly arched, the discal lines slightly convergent near the base; the sutural lines are parallel, the shoulders low, not prominent. Sides evenly arcuate, posterior margin of each elytron arcuate in the middle, sinuate at the sides. Sutural length and humeral width equal, width at tips less than one-third greater. *Abdomen* with the segment one-fourth as long as wide, the carinæ including one-fourth of the dorsal surface and not very conspicuous. ♂ basal abdominal segment produced in one triangular lobe, the sides of the triangle from the posterior lateral angle converging in straight lines toward the blunt pointed middle. Disk with a slight depression in the lateral quarters. The second segment is slightly swollen, perpendicular with the rest of the segments and impressed at the base, just beneath the lobe of the first segment with the usual fovea. Legs slender, posterior ♂ tibiæ arcuate.

Habitat. Atlantic States.

B. PERFORATA, *Brendel*. Black, impunctate, polished, pubescence inconspicuous. Antennæ, palpi, and legs reddish-brown. Length, 1.3 mm. Plate IX., Fig. 58.

Head small, frontal margin arcuate, depressed in the middle. *Antennæ* not as long as the head and prothorax, first joint cylindrical, second oblong, rounded, as thick as the first, third to fifth smaller, nearly globular, the sixth slightly larger. Seventh and eighth smaller, globular, ninth, tenth, and eleventh forming a club half as long as all the others taken together. The ninth is obconical, double the length and thickness of the eighth, tenth of the same form, the last oval not acute at tip. These three terminal joints gradually increase in thickness, the eleventh being three times as thick as the ninth and as long as the preceding ones. *Prothorax* as long as the head (including the eyes) is wide, and about one-sixth broader, very convex, the lateral foveæ not in quite full view from above. *Elytra* one-half longer than the prothorax, nearly the same across the prominent shoulders, and the apical width exceeding by one-third the sutural length. Sutural lines parallel, discal lines deep near the base, fine behind, entire. slightly arcuate, convergent from the base to the tip. *Abdomen* short, the basal segment one-fourth as long as wide, the carinæ conspicuous, including nearly one-half of the segmental width. ♂ with the basal abdominal segment depressed laterally next to the broad margin, elevated and broadly lobed posteriorly; in the middle of the posterior limit it is minutely foveate. Second dorsal depressed at base, with a large rather shallow semicircular fovea at middle, enclosing five deep perforate dark punctures arranged in a semicircle, the center of which is occupied by a much larger dark fovea. The third segment shows only two small dark punctures. The last is roundly impressed and tuberculate at base. Legs short.

Habitat. New York, New Jersey, Long Island.

B. FOVEATA, *Lec.* Umber brown, polished, impunctate. Length, 1.9 mm.

Head with the frontal margin arcuate, tubercles rounded outside, space between them concave, foveæ very large, the occipital ones near the eye. *Antennæ* more than one-half the length of the body, joints first to eighth cylindrical, the first large, second slightly smaller, third to eighth gradually shorter. Ninth transverse, obconical, tenth transverse cuneiform, last oval, somewhat oblique. *Palpi* yellow. *Prothorax* convex, widest behind the middle, highly polished, foveæ very large, the lateral ones partially hidden from view from above, and having the appearance of a longitudinal ellipse. *Elytra* convex, shoulders low, rounded, discal lines deeply impressed, abbreviated behind the middle, before which they are nearly parallel to the sutural lines. *Abdomen* convex, pubescent, the basal segment lacking visible carinæ. Legs slender, paler brown. ♂ first dorsal similar to that of *B. perforata*, emarginate in the middle behind, the second convex in the middle and with a flat circular impression at base.

Habitat. Pacific States, Southern California.

B. BELFRAGEI, *Lec.* Dark red-brown, polished, pubescence short, elytra red, antennæ and legs dark ferruginous. Length, 1.5 mm. Plate IX., Fig. 57.

Head wider than long, eyes large, prominent, foveæ equal, large. *Antennæ* longer than the head and prothorax, first joint thicker than the second, nearly quadrate, second longer than wide, third shorter, obconical, fourth to eighth equal, longer than wide. Ninth a little larger, rounded, tenth rounded, as long as wide, a little wider than the ninth. Last joint ovoid, obliquely acute, wider than the penultimate. *Prothorax* as wide as the head, much wider than long, sides very convergent behind the middle, disk convex with equal pubescent foveæ. *Elytra* across the shoulders wider than the prothorax and near the tip twice as wide; disk rather flat, slightly longer than the width at the humeri, sutural lines deep, parallel. Discal lines also deep, slightly convergent, turned outward near the posterior end. *Abdomen* broad, flattened, the basal carinæ short, including more than one-third of the segmental width, border strong. ♂ with the basal segment deflexed posteriorly, unifoveate in the middle; the second more convex, impressed at the base on each side, and with a posterior median fovea. Legs long. The ♀ is described by Casey as *B. infinita.*

Habitat. Louisiana, Texas.

B. TEXANA, *Casey.* Uniformly pale reddish-brown, polished, pubescence short, not appressed. Length, 1.3 mm. Plate IX., Fig. 59.

Head small, impunctate, frontal margin nearly straight, sides from the eye more convergent anteriorly than usual; eyes large, prominent, occipital foveæ in a line anterior to the eyes, deep, three times more distant from one another than is either from the eye. Frontal foveæ small, situated inside a conspicuous inter-antennal depression. *Antennæ* half the length of the body, first and second joints cylindrical, the second smaller; the following joints to the seventh are narrower, cylindrical, gradually shorter, the eighth square, ninth and tenth obconical, rapidly increasing in width. The eleventh is oblong-ovate, thicker and equal in length to the three preceding. *Prothorax* wider than long, and in the middle a little wider than the head including the eyes; sides convergent anteriorly, emarginate posteriorly, disk very convex, lateral foveæ one-third from the base, impressed at the sides, median foveæ very near the base which has a row of oblong foveolæ. *Elytra* as long as the head and prothorax, apical width one-fifth greater than the sutural length. Humeral width one-fourth greater than that of the prothorax. Sides just visibly arcuate, disk reticulate, slightly convex, the lines, five, strongly arcuate, convergent, abbreviated one-fourth from the tip; sutural lines very slightly arcuate, rather far apart. ♂ abdomen with only the basal segments visible from above, nearly as long as wide, margin broad, strongly retuse, convergent posteriorly, the disk more convex, behind impunctured. Carinæ very short, including two-fifths of the entire width. Legs long, posterior tibiæ slightly arcuate.

Habitat. West Texas, New Mexico.

B. CANADENSIS, *Brendel.* Piceous-brown or piceous-black, pubescence moderately long, recumbent. Elytra sanguineous. Legs and antennæ ferruginous.

Head as long as wide, the eyes excluded, punctured, more strongly at the sides behind the tempora, the later convergent, little longer than the eyes, feebly arcuate; foveæ large, equal in size, the posterior ones mutually three times as distant as either from the eye; antennal tubercles prominent, with a few coarse punctures; frontal margin convex, the space between the antennal tubercles concave, bearing the frontal fovea, and here more conspicuously pubescent; eyes coarsely facetted, by their own length distant from the frontal margin. *Antennæ* from the first to the eighth joint sub-cylindrical, decreasing gradually in length and thickness, except the fifth, which is a little longer than its neighbors; the eighth smallest, quadrate. *Prothorax* uniformly very conspicuously and deeply punctured, one-third broader than long, widest in the middle, where it is strongly arcuate, from there to the anterior and basal margin straight; anterior margin one-half the length of the base; middle fovea nude, about double as large as the discal punctures; lateral fovea large, fully visible from above and situated with the anterior margin just behind the middle; the base is garnitured with oblong punctures. *Elytra* across the shoulders as broad as the prothorax, sides arcuate, diverging, suture one and one-half times as long as the prothorax and three-fourths as long as the width across the tip; disk strongly punctured, all the impressed lines entire, the sutural ones arcuate near the tip and finely punctured, the discal lines convergent toward the tip; basal foveæ three, large, the sutural one farther from the base than the middle one. *Abdomen* moderately convex, more feebly punctured, the pubescence as long as on the elytra, first segment as long as one-third its width, the lateral reflexed margin not broader and the lateral basal impression much larger than in *B. rubicunda*, the basal striæ strongly divergent more than half as long as the segment, including at base a space not broader than the interval between the sutural striæ of the elytra; behind the intermediate coxæ on the metasternum is a deep, sharply defined fovea. ♂ antennæ longer, elytra less convex, punctuation and pubescence stronger, intermediate tibiæ spurred, first ventral near the posterior margin transversely impressed, last ventral with a somewhat transverse, nearly circular, well defined, but not deep impression. Length, 1.5 mm.

Habitat. Canada. Differentials are: the strong punctuation, the long, divergent and very approximate abdominal striæ.

B. GEMMIFER, *Lec.* Ferruginous to red-brown or darker, pubescence very fine and short. *Head* from base to frontal margin as long as the width across the tempora, impunctate, except on the antennal tubercles, foveæ equal in size, small, mutually twice as distant as either from the eye and in a line with them; frontal margin slightly convex, antennal tubercles small, but well defined, space bearing the frontal fovea slightly concave. Eyes longer than the tempora, gemmate. *Antennæ* half as long as the body, second joint as long as the first, not as thick; third longer than the second, obconical-cylindrical, thinner; third to seventh cylindrical, subequal; eighth as thick as the seventh, of equal dimensions; ninth little longer and thicker, obconical; tenth subglobular, larger; eleventh nearly double as thick as the tenth, in length equal to the three preceding conjointly, from the middle strongly conical and somewhat oblique. *Prothorax* more convex than in *B. rubicunda;* middle foveæ small, deep, conspicuous, lateral ones not larger than the occipital foveæ, not fully in view from above, and situated one-third from the base. Disk conspicuously punctulate (magnified thirty diameters); base double as wide as the anterior margin. *Elytra* across the shoulders wider than the prothorax, sides arcuate behind the middle, where the disk is one-fourth wider than the length of the suture, convex; tip and sides very declivous, posterior margin laterally slightly sinuate. Disk (magnified sixty diameters) scarcely perceptibly punctulate, except on the posterior declivity, where it is distinctly punctured; sutural lines convergent from behind the middle to a spinous sharp point on each elytron; discal lines strictly parallel and but slightly convergent near the tip; basal fovea small and near the base. *Abdomen* not punctured, first segment not longer than one-fourth its width, striæ very short, one-sixth of the length of the segment, very divergent, and not further apart than the elytral sutural lines; last ventral punctured. ♂ last ventral inside of a nearly circular space, rather flattened, but not impressed. Length, 1.4 mm.

There are varieties in color and the strength of the punctuation of the prothorax and elytra.

This seems to be the most common species in Iowa. It differs from *congener* and *rubicunda* by the punctation of the prothorax, the two latter species being impunctate, and in the abdominal striæ, which are farther apart in those two species. *Congener* is much smaller, leather-colored, and does not occur in the West.

B. DIVERGENS, *Lec.* Impunctate, piceous, antennæ, palpi and legs yellowish-red, pubescence short, sparse. Length, 1.3 mm.

Head, including the prominent eyes, nearly as wide as the prothorax, the foveæ of equal size and alike in form. *Antennæ* with the first and second joints larger, the first as thick as the tenth; second as wide as the ninth and as long as the third; third to sixth cylindrical, half as wide as the first, seventh and eighth gradually shorter, eighth as long as wide; eighth, ninth and tenth regularly increasing in length and width, each one as long as wide, the eleventh twice as much so, ovoid-acuminate. *Prothorax* transversely convex, a little wider than long, the lateral foveæ circular, not in full view from above; median puncture oblong. *Elytra* moderately convex, very minutely and confusedly punctured, disk near the tip more than half as wide again as at the humeri, shoulders tumefied but not laterally prominent, the lines sharp, not deep, the discal ones arcuate, approaching the suture and traceable to very near the posterior margin. *Abdomen* short, the first segment not more than one-fourth as long as wide, carinæ very close together, about half as long as the segment and divergent. The male has the elytral sculpture more plainly marked.

Habitat. New York, Iowa.

Judging from the author's description, *B. facilis*, Casey, may be identical with this species.

B. RADIANS, *Lec.* Ferruginous, impunctate, abdominal lines long, ♂ last two ventrals concave, with an elongate medial elevation. Length, 1.5 mm. (Leconte's description).

Sexual variations are found in the elytral punctuation; the coloration is unstable; these facts, together with the vague statement of the carinæ being long, lead us to regard it as a doubtful species.

B. ATLANTICA, *Brendel.* Robust, elongate, impunctate, polished, very thinly pubescent, deep honey-yellow ferruginous throughout; occipital impressed in the middle. Length, 1.5 mm.

Head comparatively smaller than in *B. rubicunda*, narrower in front of the eyes than behind them, occiput triangularly impressed in the middle, antennal tubercles small, prominent, space between them narrow, very concave, foveæ as usual. *Antennæ* shorter than the head and prothorax, rather robust, the last joint more elongate than in *B. rubicunda*. *Palpi* yellow, resembling in form those of the above mentioned species. *Prothorax* one-third longer than the head and one-fifth wider than long, less convex, sides more evenly rounded, the median fovea smaller, punctiform, in some specimens scarcely visible, lateral foveæ large, in full view from above. *Elytra* impunctate but somewhat uneven, the lustre however not being impaired; the shoulders are less prominent and the pubescence inconspicuous, otherwise they are like those of *B. rubicunda*. *Abdomen* rather narrower, transversely less convex than longitudinally, the basal carinæ divergent, nearer together at base and longer than in *B. rubicunda*.

The sexual differences consist of the usual impression on the last ventral, and the more elongate last antennal joint in the ♂. This singular species is easily distinguished by the sulcate occiput, the oblong intermediate basal foveæ of the elytra, and the long, divergent basal abdominal carinæ.

Habitat. Southern States near the sea-coast.

B. GRACILIS, *Casey*. Dark piceous-red, convex, pubescence very long, yellowish-white, elytra blood-red. Antennæ and legs rust-red, palpi yellow. Length, 1.4 mm. Plate IX., Fig. 60.

Head, from the frontal margin to the base, as long as wide, and from the labrum to the base much longer, impunctate, the lateral margin above the eyes wavy, bisinuate, tempora as long as the eye. Frontal margin very slightly arcuate, foveæ deep, equal, vertex and occiput convex. *Antennæ* longer than the head and prothorax, first three joints uniformly decreasing in length and thickness, third to seventh equal, slender, cylindrical; eighth quadrate, smaller, ninth trapezoidal, not transverse, thicker; tenth also trapezoidal, wider than long, eleventh compressed, twice as wide as the ninth and as long as the three preceding, and furnished with long hairs. *Prothorax* wider than long, very convex, more so on the posterior half, and declivous toward the base, impunctate, polished, hairy, sides evenly and strongly arcuate; lateral foveæ large, circular, not in full view from above; median foveæ nude, minute, near the base. *Elytra* as wide across the shoulders as the prothorax, one-eighth longer, and not quite three-fourths wider across the posterior third; they are very convex, sides divergent, arcuate, discal lines sharp, nearly entire. *Abdomen* convex, pubescence longer and denser than on the elytra, basal carinæ one-third the length of the first segment, including nearly one-fourth of its width. Last dorsal with the emargination at tip very small, last ventral transversely oval, slightly impressed.

Varies in the length of the abdominal carinæ.

Habitat. Michigan, Illinois, Iowa, Louisiana.

B. CRIBRICOLLIS, *Brendel.* Piceous-black, elytra dark piceous-red or black, legs, antennæ and palpi red, or darker. The body is punctured all over, more deeply on the pronotum, punctures on the elytra oblong. Pubescence short, appressed. Length, 1.2 to 1.3 mm.

Head, from the frontal margin to the base, equal to the width between the eyes; frontal margin but slightly produced in the middle, foveæ equally distant, the lateral ones half the mutual distance from the eye. Disk punctulate, eyes circular, tempora arcuate, as long as the eyes. *Antennæ* longer than the head and prothorax, first and second joints equal in thickness, the first cylindrical, twice as long as wide, second oval, shorter; third to eighth equal in thickness, much narrower than the basal joints, third and fifth longer, equal, fourth, sixth and seventh equal in length, eighth quadrate, ninth and tenth obconical, truncate at their bases, strongly increasing in thickness, closely united. Last joint twice as long as wide, ovate-acute, truncate at base. *Prothorax* convex, lateral foveæ circular (elliptical when viewed from above), middle fovea oblong. *Elytra* broadly convex, shoulders high, protuberant, discal lines deep, convergent, sutural lines slightly arcuate, the interval roof-shaped elevated, with two rows of punctures on each side of the suture. *Abdomen* regularly punctured, the basal carinæ nearly parallel, half as long as the segment, ventrals punctulate. ♂ last dorsal broadly emarginate, last ventral flattened, with a short, conspicuous, transverse impression at its base. Legs darker in the specimens with darker elytra, second tarsal joint longer than the third. ♂ middle tibiæ with a short terminal spur.

Varies in the strength of the punctuation, especially among the females.

B. SCABRA, *Brendel.* Black, antennæ, palpi and legs red, elytra brownish-black. Length, 1.33 mm. Plate IX., Fig. 62.

Head punctate, large, subquadrate, not very convex, frontal margin arcuate, foveæ equal and equidistant, the occipital ones in a line with the centers of the prominent, finely-facetted eyes; antennal tubercles somewhat oblique, the space between them depressed. *Antennæ* as long as the head and prothorax, first and second joints obconical, nearly equal, third to seventh cylindrical, the fifth longer in the male; seventh quadrate, eighth, ninth and tenth gradually larger, obconical, the last ovate, truncate at the base, as long as the two preceding, two-thirds as wide as long. *Prothorax* very densely covered with coarse, deep punctures, lustreless, broadest in the middle, wider than the head and eyes; base one-half wider than the neck, sides sharply rounded in the middle, sinuate anteriorly, nearly straight behind. Disk convex, the lateral foveæ large, not in full view from above, basal foveæ small, but very conspicuous. *Elytra* similar to those of *B. polita*, polished, as wide across the prominent shoulders as the prothorax, across the tip slightly less than one-half wider, and the suture exceeding by one-fifth the breadth of the prothorax. Disk convex, depressed outside of a line drawn from each shoulder to the outer third of the tip of each elytron. Sutural lines not straight, interval roof-shaped, discal lines more widely separated near the shoulders, then convergent or parallel, with a short divergence near the tip. Basal punctures three, approximate. *Abdomen* short, narrower than the tips of the elytra, the carinæ including one-fifth of the surface, slightly divergent. Legs simple, slender. ♂ with the intermediate coxæ acute, last ventral with the usual impression.

Varies in the color of the elytra, which are reddish-brown in some (probably immature) specimens.

Habitat. Sea-coast of the Northern Atlantic States. Region of the Great Lakes.

B. CONGENER, *Brendel.* Pale brownish-yellow throughout, impunctate, lustreless (on account of the short, appressed, tomentose pubescence). Abdominal carinæ divergent, very short, including one-sixth of the basal width. Length, 1.1 mm. Plate IX., Fig. 61.

Head with the occipital foveæ circular, separated from the eyes by a distance equal to their own width, and mutually four times as distant. *Prothorax* more convex from side to side, the lateral foveæ slightly less in full view from above. *Elytra* with the sutural interval not punctured. *Abdomen* with the first dorsal four times as wide as long. The structure otherwise resembles that of *B. rubicunda.* There are no variations in color.

Habitat. New York, near the sea-shore.

B. RUBICUNDA, *Aubé.* Piceous-black, impunctured, elytra, legs, and antennæ red, palpi yellowish. Length, 1.5 mm.

Head including the eyes, broader than long, and, excluding the eyes, longer than wide from the frontal margin to the base. Clypeus, porrected; foveæ equal, mutually three times as distant as either from the eye, frontal margin roundly produced in the middle. *Antennæ* not half as long as the body, first joint cylindrical, robust, second oblong, nearly as thick as the first. Third to seventh cylindro-obconical, nearly equal, twice as long as wide, eighth globular, not thicker, ninth as long as the third, obconical and twice as wide; tenth subglobular, more than one-half thicker than the ninth; eleventh as long as the seventh, eighth and ninth together, ovate-conical, one-half wider than the tenth. *Palpi* with the second joint clavate, pedunculate by halves, third globular, fourth twice as thick as the third ovate-acuminate, twice as long as wide. *Prothorax* broadly convex, one-third longer than the head, widest in the middle and more than one-fourth wider than long. The lateral foveæ are very large, in full view from above, situated just behind the middle, median fovea punctiform, conspicuous. *Elytra* convex, as wide as the prothorax across the high prominent shoulders; across the tip they are one-half wider, and the sutural length is greater by one-sixth. Base tripunctate, the sutural puncture farther from the base than the others, sutural interval, slightly dilated in the posterior third; discal lines slightly arcuate, convergent, abbreviated at the posterior third. *Abdomen* broadly margined, first segment more than one-fourth as long as wide, last segment broadly emarginated at the tips, last ventral impressed. The abdominal basal carinæ are divergent from the base, never very long including from more than one-sixth to less than one-fourth of the abdominal width. Legs slender, posterior tibiæ of ♂ arcuate.

Bryaxis rubicunda is described as having the prothorax impunctuate, broadly convex with large lateral foveæ fully in view from above, the basal abdominal carinæ divergent from the base and including one-fifth of the width. But on other specimens of the same form, differing slightly in size faint punctures may be detected with a magnifying power of sixty diameters on the pronotal disk. The abdominal carinæ include also from one-sixth to one-fifth of the width. I take them to be all varieties of the same species excluding all others with evenly distributed punctures and less divergent carinæ though not otherwise materially different.

Habitat. Atlantic Coast to Missouri river.

B. TRIGMA. *Lec.* Length, 1.8 mm. Ferruginous, tubercle on first dorsal segment triangular, the carinæ approximate and divergent. ♂ last ventral with a deep sharply defined oval fovea (Leconte's description).

Habitat. Missouri. Unknown to us.

B. BICOLOR, n. sp. Dark red-brown, antennæ, palpi and legs yellowish red, elytra piceous-black, punctulate, moderately long. Length, 1.7 mm.

Head impunctuate, surface between the front and base an equilateral triangle; the foveæ equal; eyes small, not prominent, the lateral limits of the vertex not carinate, clypeus simple, thinly margined in front, labrum entire, twice as wide as long. *Antennæ* robust, hairy, scarcely as long as the head and prothorax together; first and second joints square, not perceptibly longer than wide; third obconical, narrow, as long as the second and equal to the fifth. Fourth, sixth and seventh equal in length and width, as wide as the fifth; eighth lenticular very short, three times as wide as long, ninth and tenth trapezoidal twice as wide as long, increasing in width. Eleventh three-fourths as wide as long, equal in length to the three preceding, truncate at base, acute at tip. *Prothorax* polished, evenly and very obsoletely variolate, transverse, much wider than the head; lateral foveæ small, fully visible from above, the middle one very conspicuous, deep, and naked. *Elytra* piceous-black, punctulate, discal lines deep, converging, humeral callus prominent. *Abdomen* piceous-brown on the dorsum, dark red-brown on the venter where it is darker than the head and prothorax, first dorsal three time wider than long, the basal carinæ very near together, very fine divergent, one-third of the segmental length. Legs brownish-yellow, rather short and slender.

Found under stones near Cedar Rapids, Iowa.

B. PUNCTICOLLIS, *Lec.* Piceous-black, shining, pubescence short, recumbent, elytra, palpi, and legs rust-red. Length, 1.4 mm.

Head from base to frontal margin longer than the width behind the eyes, trapeziform; frontal tubercles strong, margin between them slightly arcuate around the frontal foveæ. Face protruding, occipital foveæ mutually twice as far distant as either from the eye. *Antennæ* as long as the head and prothorax, first and second joints nearly equal in length and width, cylindrical, rounded; third and fourth narrower, more than twice as long as wide; fifth slightly longer, sixth and seventh shorter, obconical, longer than wide. Eighth and ninth gradually wider, shorter than the seventh, rounded, obconical, tenth double the length and width of the ninth; eleventh oblong-oval, one-half wider than the tenth, and as long as that and the ninth together. *Palpi* with the last joint not longer than the second, thick, ovate acuminate. *Prothorax* as long as the head, broader than long, deeply punctuate, lateral foveæ in full view from above. *Elytra* punctulate as broad across the low but prominent shoulders as the suture is long, and across the tips one-third broader. The sutural interval is roof-shaped, punctulate, discal lines deep, slightly convergent nearly entire. *Abdomen* scarcely punctulate, first segment rather flat in the middle, the carinæ distant more than one-third of the segmental width and not one-fifth of the length, slender. ♂ elytra often covering the basal abdominal carinæ, last dorsal emarginate at tip, last ventral with a shallow rounded impression. There are no variations in color in mature specimens, the punctuation of the prothorax in the ♀ often not as strong but evenly distributed.

Habitat. East of the Mississippi from Canada to the Gulf.

B. LITORALIS, *Brendel.* Ferruginous, impunctate, pubescence short, abundant, legs and antennæ slightly paler. Length, 1.3 mm.

Head with regular, short pubescence, disk of the vertex as long as wide, clypeus and mouth protruding, labrum quadrate, eyes large, prominent, tempora rounded, shorter than the eye, foveæ equal, large, the lateral ones only twice as far apart as from the eye. *Antennæ* longer than the head and prothorax, the joints sub-cylindrical, third to seventh three times longer than wide, eighth quadrate, ninth and tenth obconical, as long as thick, the last joint proportionately wider, and twice as long as thick, truncate at the base, ovate-acute. *Prothorax* polished, with a few irregularly scattered, obsolete acu-punctures laterally, sides very evenly arcuate, lateral foveæ in full view. *Elytra* not so much polished, impunctate, the sides strongly divergent, finely and narrowly margined from the base all around to the tip of the suture; disk broadly convex, the lines sharp, not deep, sutural interval darker colored. Abdominal with the basal dorsal segments rather short, one-fourth as long as wide, carinæ one-third of the length and including more than one-fourth of the width. Hind tibiæ slightly arcuate, inferior surfaces somewhat flat, brush-like. ♂ last dorsal truncate, ventral with a longitudinal impression, not circumscribed.

Habitat. Texas to Virginia, more common in the latter state.

B. NEVADENSIS, *Casey.* Piceous-brown, punctulate, elytra red, legs dark brown, antennæ red-brown, pubescence short, coarse. Length, 1.3 mm.

Head with the eyes near the base, tempora short, arcuate to the nearly straight base, occipital foveæ in a line with the anterior part of the eyes, large, twice their own width apart, inter-antennal space transversely depressed and punctured, containing a smaller rounded fovea, supra-antennal tubercles large. Antennæ shorter than the head and prothorax, first and second joints subequal, conic-cylindrical, third to eighth subequal in width, fourth and seventh quadrate, equal; third, fifth and sixth longer than wide; ninth and tenth trapezoidal, transverse, eleventh a little longer than wide, obliquely pointed. *Prothorax* with the sides arcuate on the anterior third, converging to the neck and slightly so towards the base, the posterior part of the sides nearly straight. Base three-fourths as wide as the disk, the latter convex, punctulate, median fovea a small rounded puncture, lateral foveæ pubescent, small. *Elytra* near the tip nearly twice as wide as the prothorax, the length being one-sixth less than the width; sutural lines parallel, discal ones arcuate, sharp. *Abdomen* with the basal carinæ short, slightly divergent, including one-third of the segmental width. Posterior tibiæ clavate, arcuate, in the male; the elytra are longer in the female, and the last ventral simply flattened in the middle.

Habitat. Western Nevada and the adjoining parts of California.

B. POLITA, *Brendel.* Grayish-brown or darker, highly polished, impunctuate, pubescence inconspicuous, fine, sparse, legs and antennæ dark brown. Length, 1.2 mm.

Head very slightly vaulted on the vertex, the disk as long as wide, clypeus and mouth not very much protruding, eyes small, not very prominent, tempora rounded longer than the eyes, occiput evenly convex the base-line straight. Foveæ equal, mutually three times as distant as either lateral one from the eye. *Antennæ* robust, not longer than the head and prothorax, the first two joints strong, sub-equal, sub-cylindrical. Third narrower obconical, fourth small quadrate, fifth and sixth a little thicker than the fourth, slightly longer than wide.

Seventh quadrate, smaller, eighth to tenth transverse, increasing in width, trapezoidal, more loosely jointed than the preceding which are compact; eleventh ovoid, one-half thicker than the tenth and twice as long as wide. *Prothorax* very convex, brightly shining, slightly wider than long, lateral foveæ, not in full view from above. *Elytra* short, one-half longer than the pronotum, as wide as the pronotum across the shoulders, two-thirds of this width near the tip: discal lines deep parallel, turned outward posteriorly. *Abdomen* very convex, the basal segment one-third as long as wide, elevated in the middle posterior carinæ including two-fifths of the width. Last dorsal of the ♂ notched for the reception of a corresponding part of the last ventral which bears on oval impression. Penultimate ventral with a transverse impression. ♀ antennæ more slender, elytra shorter, the divergent carinæ more exposed to view.

Habitat. New York. This species was confounded with *B. propinqua* until the several differences in the antennæ of the latter were recognized. The figure of *B. scabra* (Plate IX., Fig. 62) will give a good idea of the outlines of the species.

B. PROPINQUA, *Lec.* Piceous-brown, abdomen paler, legs and antennæ yellowish-brown. Body elongate, pubescence long. Length, 1.4 mm. Plate IX., Figs. 63, Figs. 66, a, b, c, antennæ.

Head impunctuate, trapezoidal, tempora arcuate, longer than the eye, frontal tubercles oblique, not prominent, rounded, frontal margin slightly arcuately produced in the middle, inter-tubercular space triangularly depressed, containing the circular frontal fovea; lateral foveæ very near the prominent eyes. Y-shaped, elevation pronounced, not contiguous with the frontal tubercles.

Antennæ of female with joints one to four rapidly increasing in width, fifth nearly twice as long as the fourth, the succeeding three equal in width, gradually shorter. Ninth and tenth trapezoidal, the latter at tip double the width of the eighth;

eleventh wider, ovate, as long as the ninth and tenth together. *Antennæ* of male with the first to third joints sub-equal in width, nearly all of the same length, fourth very small, triangular, fifth transverse in some specimens, three times as wide as the length, which equals that of the second. Sixth to ninth of similar form gradually shorter, transverse, tenth wider, one-third as long as wide, eleventh ovate-acuminate as long as the first and second together. The posterior tibiæ of the ♂ are dilated. *Prothorax* impunctuate, widest at or behind the middle, evenly carinate, lateral foveæ somewhat less than in full view from above, median puncture conspicuous. *Elytra* a little more than one-third longer than the prothorax, the same across the high shoulders, and about one-third more across the tips. They are faintly reticulate, uneven, discal lines slightly arcuate, nearly parallel, basal intermediate puncture conspicuous. Sutural lines nearly parallel. *Abdomen* with the basal carinæ one-fourth the length and including one-third the width of the segment.

Habitat. Eastern States. The form with red elytra from the Pacific Coast is described as *albionica* by Motschulsky.

B. INFORMIS, *Casey*. Dark red, elytra brighter, legs and antennæ testaceous, polished, hardly punctulate, pubescence short. Length, 1.4 mm. Plate IX., Fig. 69. Antenna of ♂ after Casey.

Head more visibly punctured at the sides, foveæ not large, equal, eyes prominent, distant about their own length from the base, frontal margin broadly angulate. *Antennæ* not longer than the head and prothorax, the three basal joints longer than wide, nearly equal in length, gradually decreasing in width; fourth wider than long, small, fifth thicker, a little longer than wide, sixth with the length and breadth equal, as wide as the fifth, obliquely truncate; seventh to ninth slightly transverse, as wide as the fifth, tenth twice the width of the ninth, half as long as wide; the eleventh joint is three times as wide as the ninth, not much longer, and truncate at base. *Prothorax* slightly broader than long, transversely convex, lateral foveæ small, impressed on the sides, median fovea elongate. *Elytra* three-fourths longer than the prothorax, wider than the prothorax near the shoulders and twice as wide near the tips; discal lines fine, slightly impressed, sutural lines straight, parallel. *Abdomen* elongate, carinæ divergent, enclosing not quite one-third of the segmental width. Posterior tibiæ slightly dilated.

Habitat. Mendocino county, California. Resembles in description Leconte's *B. subtilis.*

B. DEFORMATA, *Lec.* Dark piceous-brown or black, not conspicuously, very indistinctly punctulate, pubescence very fine, inconspicuous, elytra, legs and palpi red, antennæ dark piceous-red. Length, 1.2 mm.

Head finely pubescent, much wider than long, the disk of the vertex nearly quadrate, eyes coarsely facetted, tempora slightly arcuate, convergent, occiput longitudinally convex, frontal margin straight; between the rectangular, very slightly elevated supra-antennal tuberculations and near the frontal margin, transversely impressed, is the fovea, an indefinite acupuncture in ♂; occipital foveæ small, in a line through the middle of the eyes, mutually more than four times as distant as either from the eye, with a shallow sulcation or opening anteriorly. *Antennæ* not straight (♂), joint first short, quadrate, robust; second sub-quadrate for one-half of the first, thicker, outside nearly straight, inside hemispherical, enlarged, deeply foveate beneath; third and fourth transverse, sub-lenticular, much narrower than the first; fifth, sixth and seventh subequal, decreasing in width; fifth slightly wider than the first joint, all transversely lenticular; eighth smallest, obliquely trapezoid, outside longer, transverse; ninth and tenth gradually larger, regular, trapezoid, connate with the base of the eleventh, which latter is as thick as the second, obliquely pointed inward, externally arcuate, inside sinuate at the base, thence straight to the tip. In the female the antennæ are similar, curved, with simple joints, second joint smaller than first; second to seventh subequal, longer than wide, obconical;

eighth smallest, eighth, ninth and tenth gradually much larger, trapezoidal, the last joint not connate, oblong-ovate. *Prothorax* impunctate, polished, as long as wide, widest through the middle, convex, lateral foveæ small, not in full view from above; the median basal puncture very small. *Elytra* indefinitely punctulate, shoulders not prominent, their width equal to that of the prothorax; suture one-fifth longer, across the tip one-third wider, sutural lines parallel, the interval not punctured, discal lines parallel, obsolete in the posterior fourth, sides and posterior margin of each elytron arcuate. *Abdomen*, punctation doubtful, first segment three times wider than long, the carinæ one-third as long as the segmental length, divergent, and including one-half of the total width. Legs slender, stronger in the male, posterior tibiæ arcuate, ♀ frontal margin produced in a tubercle, behind which is a perceptible acupuncture.

Habitat. California, San Diego, Lake county (Carl Fuchs). Plate IX., Fig. 70, antennæ ♂ and ♀.

B. COMPAR, *Lec.* "*Elongata, punctata, pubescens, thorace subangulata, elytris punctatis, abdominis segmento primo striis nullis*"—Leconte's original description. Front transversely impressed, dark ferruginous, antennæ (♂) stout, joints sixth to eighth narrower than fourth and fifth. Length, 1.2 mm. Unknown to us; may be identical with Casey's *B. franciscana*.

B. FUNDATA, *Casey.* Black, elytra red, darker at the base and posterior limits, antennæ and legs dark piceous, pubescence dense, short. Length, 1.3 mm.

Head convex at the occiput, evenly punctulate, foveæ small, frontal foveæ wanting; front declivous, on the declivity bearing an oval spot with short, dense, erect setæ. *Antennæ* longer than the head and prothorax together, slender, the basal joint irregular, large, truncate, wedge-shaped, transverse; the second, smaller; third, narrower, obconical; fourth, a little smaller and transverse; fifth, longer than wide, regular, more than one-half wider than the fourth; sixth and seventh, of nearly the same size, inside more convex than outside; eighth, narrower, as wide as long; ninth and tenth, larger, truncate, obconical; the last as long as the three preceding together, more than twice as long as its width, *Prothorax* wider than long, convex punctured along the base, lateral foveæ small, median oblong. *Elytra* across the shoulders a little wider than the prothorax, twice as wide near the posterior limits, disk convex, sparsely punctured, discal lines fine, arcuate, sutural ones parallel. *Abdomen* broadly convex, basal segment with the carinæ very short, more than one-third of the segmental width apart. Legs, the posterior tibiæ slightly arcuate. ♀ antennæ shorter, regular. Plate IX., Fig. 72, antennæ, ♂ and ♀.

California (Sonoma Co). Spokane Falls, Washington. Idaho.

B. FRANCISCANA, *Casey*. Slender, black, elytra red; legs and antennæ dark brown, polished; pubescence, dense, short. Length, 1.3 mm.

Head feebly convex, punctuate, genæ shorter than the eye, foveæ small, frontal foveæ wanting, frontal declivity bearing an oval spot with setiform, short hair. *Antennæ* stout, hardly as long as the head and prothorax together, the basal joint short, as thick as the tenth, the second rounded, half as thick, the third narrower, obconical, longer than wide, the fourth like the second, the fifth wider than the fourth and twice as long, the sixth and seventh smaller, as long as wide, eighth very small, transverse, ninth and tenth rapidly increasing in width, trapezious, the last one-half wider than the tenth, as long as the three preceding ones together, truncate at the base, pointed. *Prothorax* very little wider than the head, wider than long, transversely convex, densely punctate, lateral foveæ large, median very small. *Elytra* slightly wider than the prothorax across the shoulders, across the posterior third not quite twice as wide and a little wider than long; sutural lines deep, discal sharp, arcuate. *Abdomen* broadly convex, basal carinæ fine, divergent including one-fourth of the segmental width. Legs short, stout, intermediate, tibiæ with a terminal spur.

Habitat. California (San Mateo Co.,) Plate IX., Fig. 17, antenna. ♂.

This may be identical with *B. compar* of Leconte, which is described as having similar antennæ, densely punctured pronotum and brown color.

B. TUMIDA, *Lec.* Clear brownish-yellow, pubescence fine, very short, plentiful, appressed, elytra and dorsal surface of the abdomen extremely fine, punctulate. Length, 1.2 mm.

Head, exclusive of the eyes, as wide as the length from the tip of the frontal margin to the base; front tubercles not prominent, foveæ in a line through the middle of the eyes about four times as distant as either from the eyes, occiput evenly convex, frontal margin produced to a point, frontal foveæ very small, slightly impressed on the nearly flat inter-antennal space. *Antennæ* ♂ half as long as the entire body, joints one to four rapidly decreasing in size, quadrate; first, one-half the width of the fifth; fourth, one-third of the first; fifth and sixth oval, longer than wide, and as wide as the length of the eye; seventh and ninth, gradually increasing; seventh, equal to fourth, and half as wide as ninth, which is slightly transverse; tenth, larger, not as wide as fifth or sixth, the last as wide as fifth, ovate, one-third longer. Clypeus and labrum prognathous, the latter rounded with a small fovea near the lateral margins. *Prothorax* as long as the head and one-third wider, evenly convex, middle foveæ small punctiform, lateral ones in full view from above, not much larger than the occipital foveæ, base with a transverse row of small punctures. *Elytra* one-half longer than the prothorax and equal to the shoulder width; across the posterior fourth, one-third wider, disk evenly convex, sutural lines straight, parallel, interval not roof-shaped, discal lines arcuate, convergent, obsolete in the posterior fifth. *Abdomen*, first segment one-fourth as long as the width, lateral anterior corner roundly depressed, carinæ including one-third of the segmental width. Legs rather long and robust.

♂. Distinguishing marks are the above mentioned form of the antennæ, and the more dilated tibiæ, the posterior ones arcuate, the last ventral slightly impressed.

♀. Antennal joints longer than wide, the fifth and sixth slightly larger and longer than their neighbors, and the frontal foveæ more conspicuous.

Habitat. Texas. Plate IX., Fig. 73, antennæ, ♂ and ♀.

I can not find any difference between the female and *B. complectens* according to the description of Leconte except the size, which is often deceptive.

[CONTINUED IN BULLETIN, VOL. II, NO. 1.]

PLATE I.

Straparollus lativolvis.

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Fig. 1. View of lower side of a medium-sized specimen.

Bucania cyclostoma.

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Fig. 2, a. Side view.
Fig. 2, b. Front view.

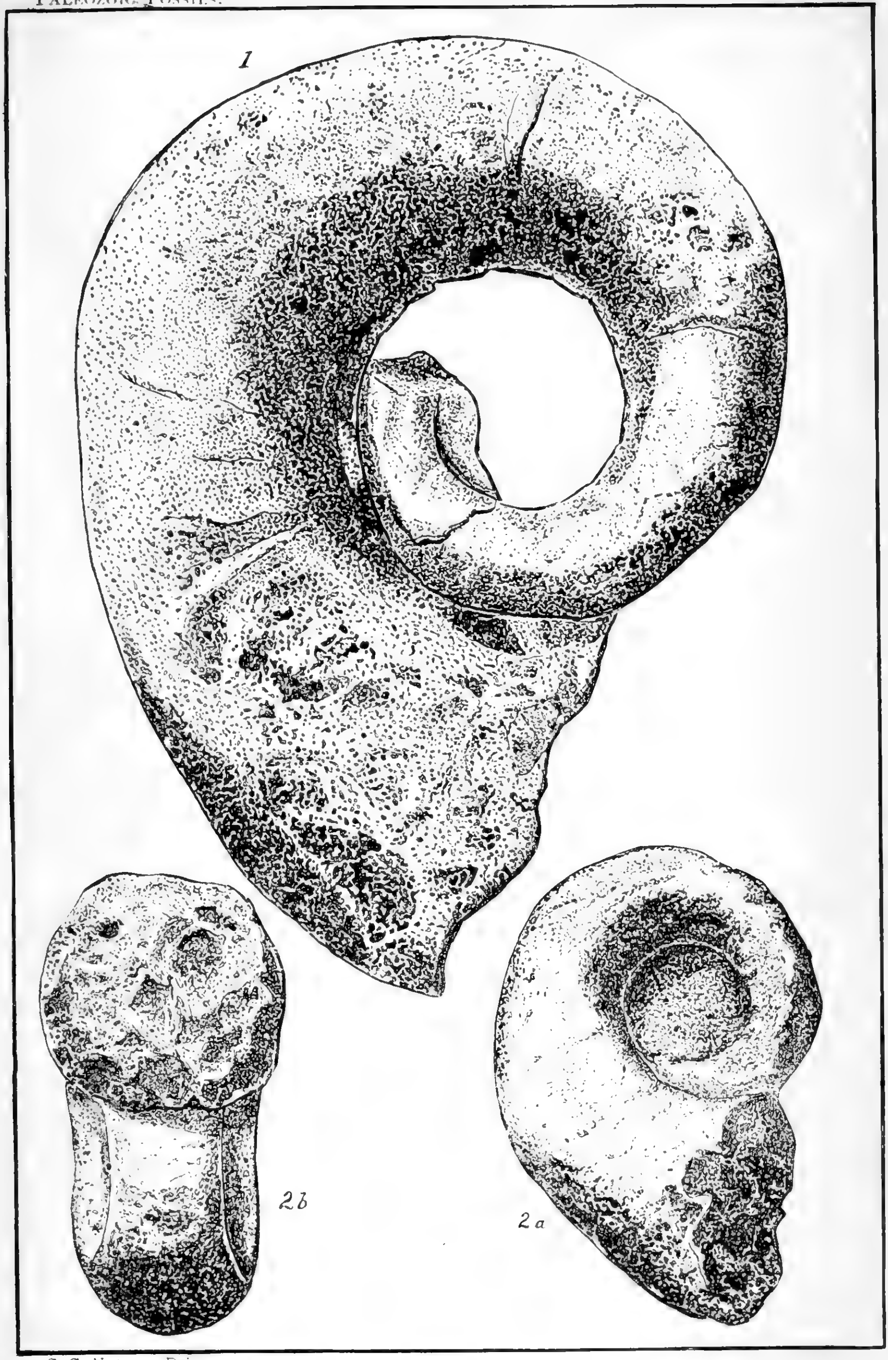

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PLATE II.

STRAPAROLLUS LATIVOLVIS.

Page 178.

Fig. 1. Front view of specimen figured on Plate I., Fig. 1.

STRAPAROLLUS BICARINATUS

Page 179.

Fig. 2, a. Umbilical side.
Fig. 2, b. Front view of a different individual.

SCHIZODUS SYMMETRICUS.

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Fig. 3, a. Cardinal view.
Fig. 3, b. View of right side.

PLATYSTOMA NIAGARENSE, var. MULTILINEATUM.

Page 177.

Figs. 4, a, b, c. Different views of a typical specimen of this variety.

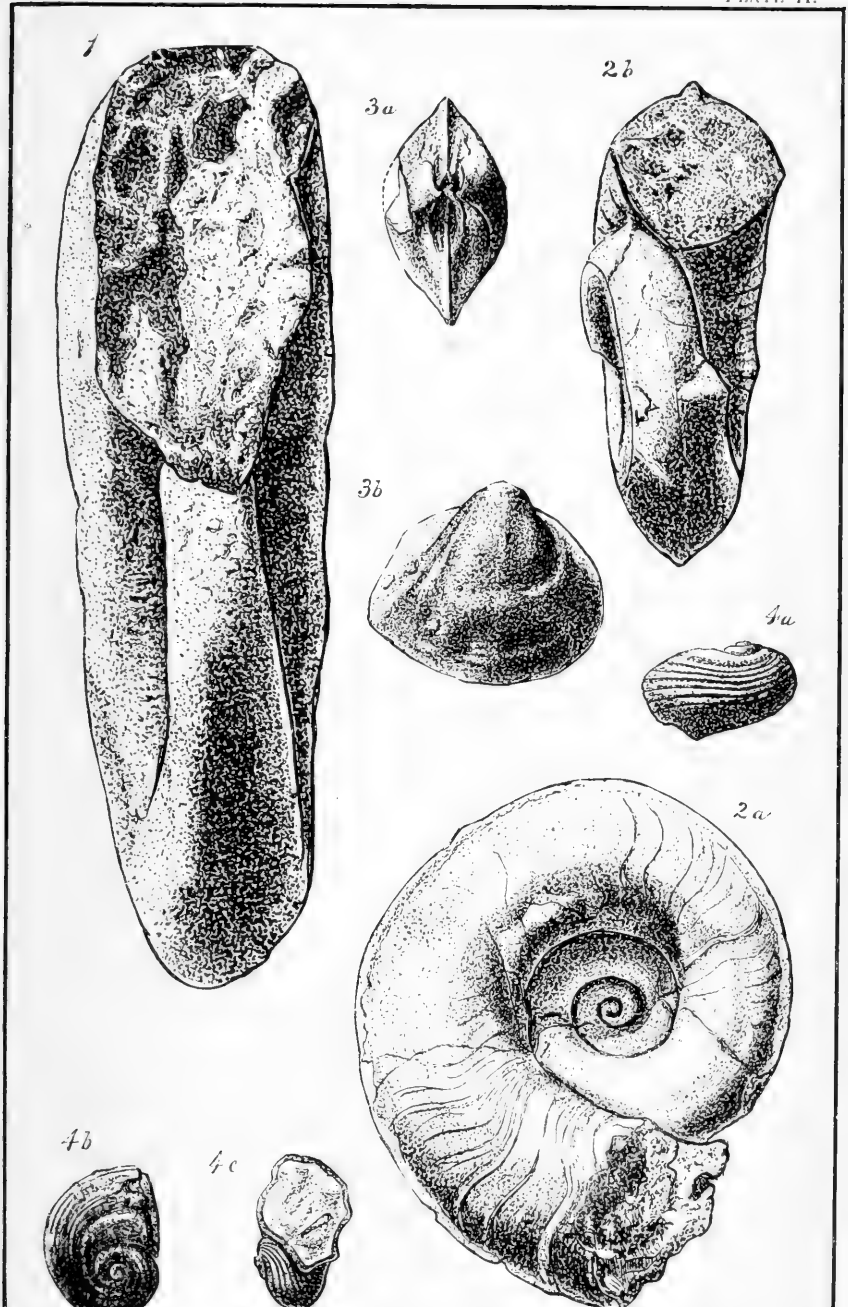

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PLATE III.

HOLOPEA GRANDIS.

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Fig. 1, a. View of spire.

Fig. 1, b. Dorsal view.

STRAPAROLLUS TRICARINATUS.

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Fig. 2, a. Umbilical view.

Fig. 2, b. Front view.

BUCANIA PERORNATA.

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Fig. 3, a. Side view.

Fig. 3, b. Surface ornamentation, enlarged.

TEREBRATULA (CRYPTONELLA) IOWENSIS.

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Fig. 4, a. Dorsal valve.

Fig. 4, b. Ventral valve, partly exposed to show the reverse of the muscular impressions.

ANCYLUS OBLIQUUS.

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Fig. 5. Top view of a typical specimen.

Fig. 5, a. Side view of the same specimen, taken at right angles to the dotted lines in Fig. 5.

Fig. 5, b. Side view of another somewhat larger, less oblique specimen.

Fig. 5, c. Summit view of the specimen 5, b.

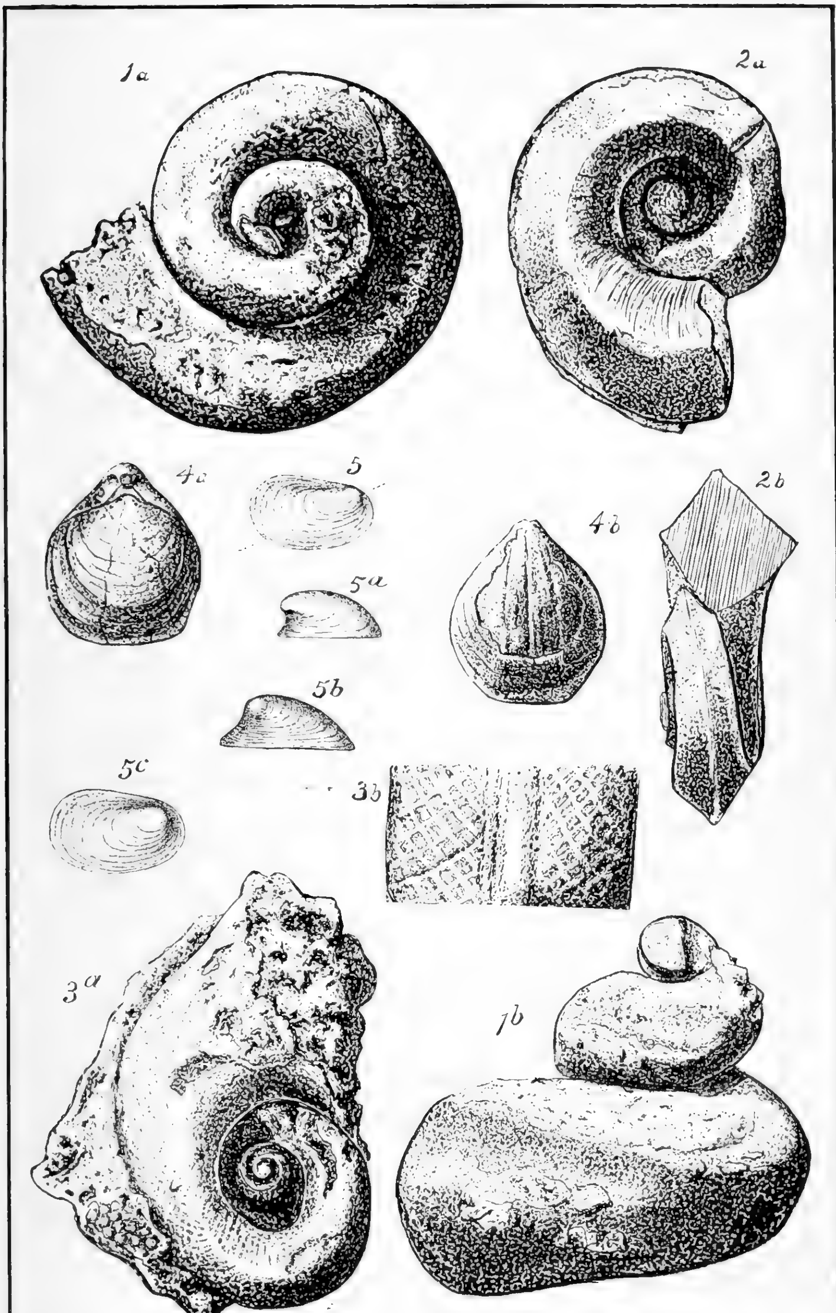

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PLATE IV.

Pages 196 and 199.

Fig. 1. *Agaricus campester*, natural size.

Fig. 2. *Agaricus campester*, vertical section.

Fig. 3. *Agaricus sapidus*, section. Shows paraphyses, basidia, spores and a filamental trama. Highly magnified. See page 43.

Fig. 4. *Russula* ———sp.? Section. Shows "trama vesiculose." Highly magnified. See page 34.

Fig. 5. *Polyporus lacteus*, section. Shows the characters of *Agaricus*, except that the fruiting layer lines tubes, here seen in section (as rings). See Polyporeæ, page 33.

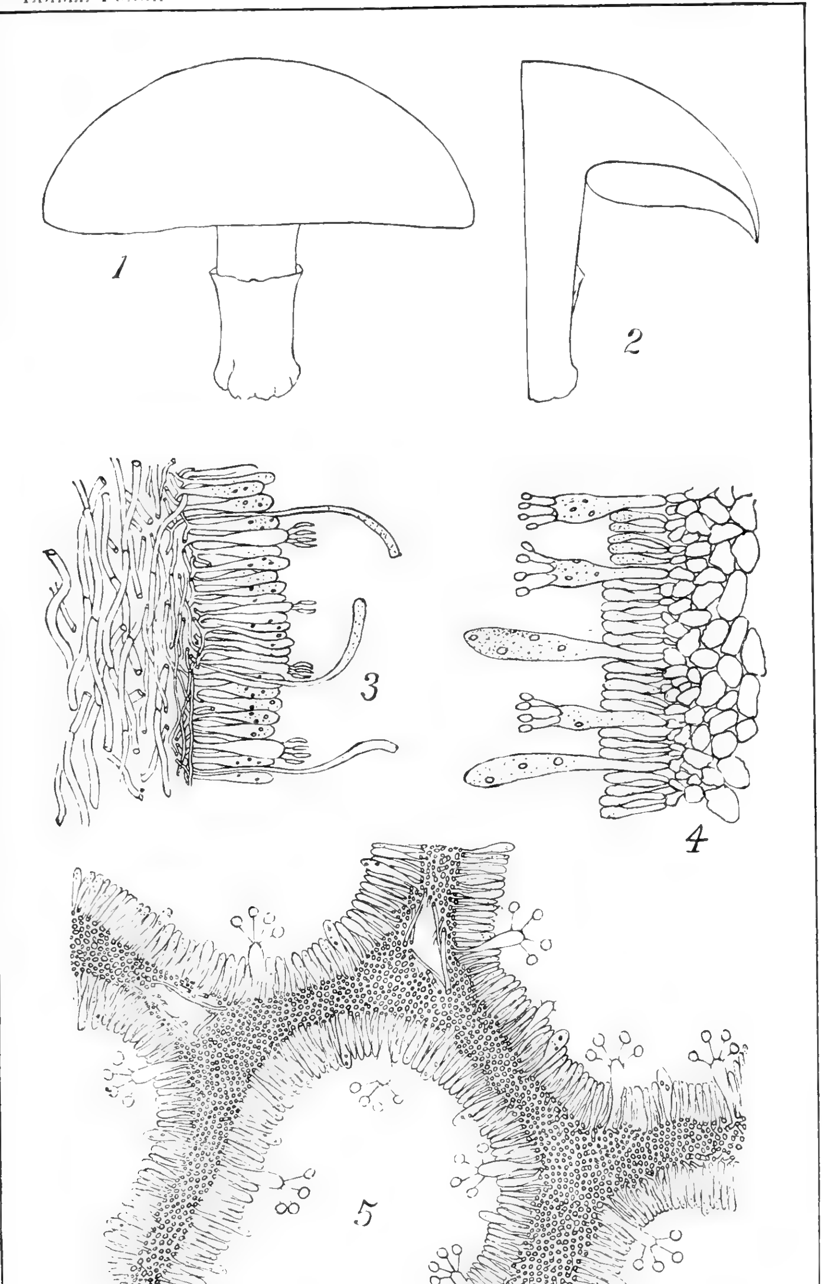

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PLATE V.

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Fig. 1. *Morchella esculenta*, natural size.
Fig. 2. *Morchella esculenta*, section. Shows asci and spores, highly magnified.
Fig. 3. *Lycoperdon cyathiforme*, natural size.
Fig. 4. *Lycoperdon cyathiforme*, section highly magnified. Shows basidia and spores.

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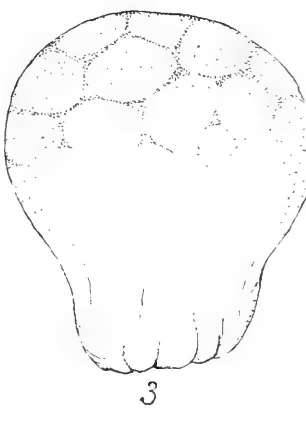

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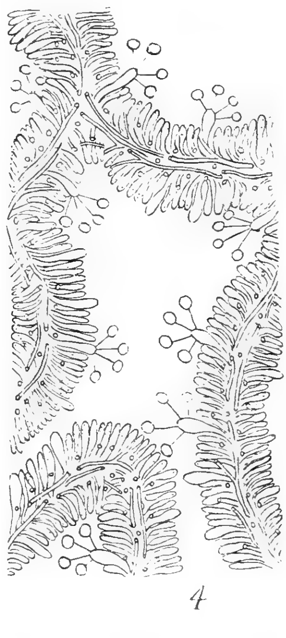

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M. F. Linder. Del.

PLATE VI.[1]

Fig. 1. *Adranes lecontei.*
Fig. 2. Side view of head.
Fig. 3. Ventral view of same.
Fig. 4. *Adranes cæcus.*
Fig. 5. Ventral view of the same.
Fig. 6. *Articerus fuchsii.*
Fig. 7. *Ceophyllus monilis.*
Fig. 8. Female antenna.
Fig. 9. Maxillary palpus of the same.
Fig. 10. *Cedius spinosus*, showing ♂ and ♀.
Fig. 11. *Cedius ziegleri*, ♂ and ♀
Fig. 11, a. Maxillary palpus of the same.
Fig, 12. *Tmesiphorus carinatus*, ♂ and ♀.
Fig. 13. *Tmesiphorus costalis.*
Fig. 14. *Chennium (Biotus) formicarium.*
Fig. 15. *Chennium (Atinus) monilicorne.*
Fig. 16. *Ctenistes pulvereus.*
Fig. 17. *Ctenistes consobrinus.*
Fig. 18. *Ctenistes piceus.*
Fig. 19. *Tyrus humeralis.*

1 Note. All the figures of the Pselaphidæ are highly magnified. For the size of the several species the student must be guided by the dimensions quoted in the text.

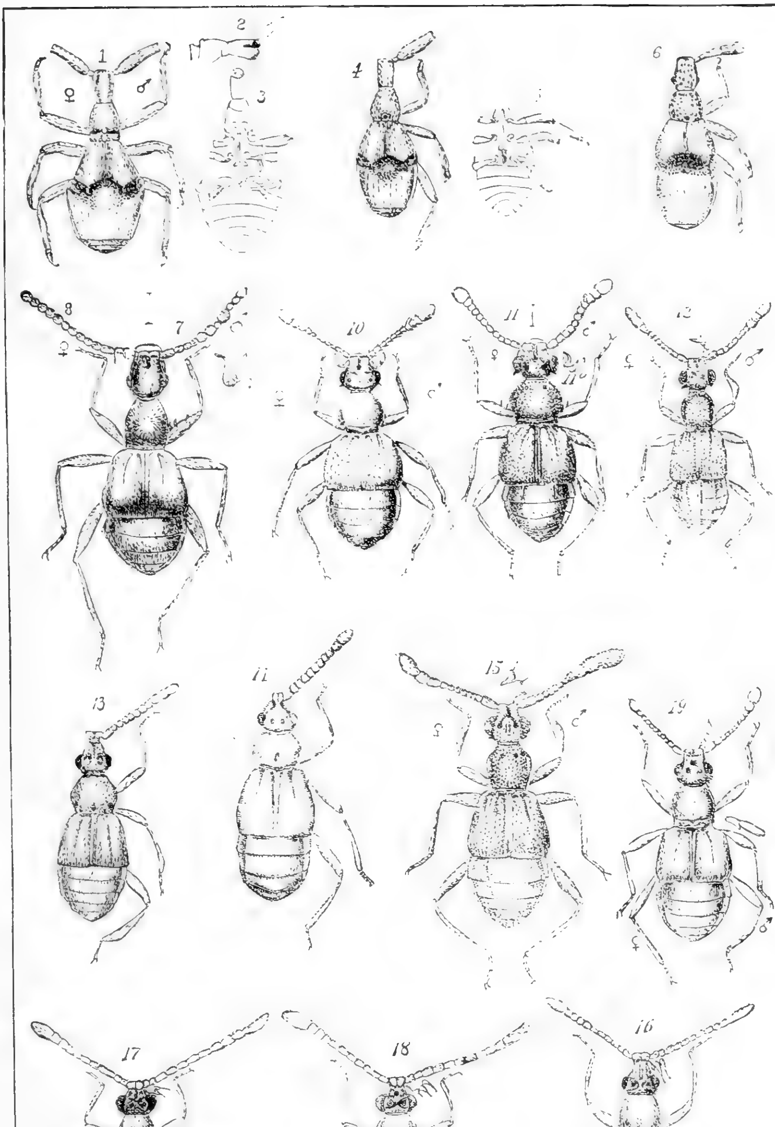
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PLATE VII.[1]

Fig. 20. *Tyrus corticinus.*
Fig. 21. *Tyrus elongatus.*
Fig. 22. *Hamotus (Cercocerus) batrisioides.*
Fig. 23. *Pselaphus erichsonii.*
Fig. 24. *Pselaptricus tuberculipalpus.*
Fig. 25. *Tychus longipalpus.*

Antennæ and maxillary palpi of *Tychus*—

Fig. 26. *longipalpus.*
Fig. 27. *minor.*
Fig. 28. *testaceus.*
Fig. 29. *cognatus.*
Fig. 30. *tenellus.*
Fig. 31. *puberulus.*

Fig. 32. *Rhinoscepsis bistriatus.*
Fig. 33. ♂ of *Machærodes carinatus.*
Fig. 34. ♀ of the same.
Fig. 35. *Machærodes tychoides.*
Fig. 36. *Scalenarthrus hornii.*
Fig. 37. *Entrichites zimmermanni.*
Fig. 38. *Decarthron strenuum.*
Fig. 39. *Decarthron stigmosum.*

1 Note. All the figures of the Pselaphidæ are highly magnified. For the size of the several species the student must be guided by the dimensions quoted in the text.

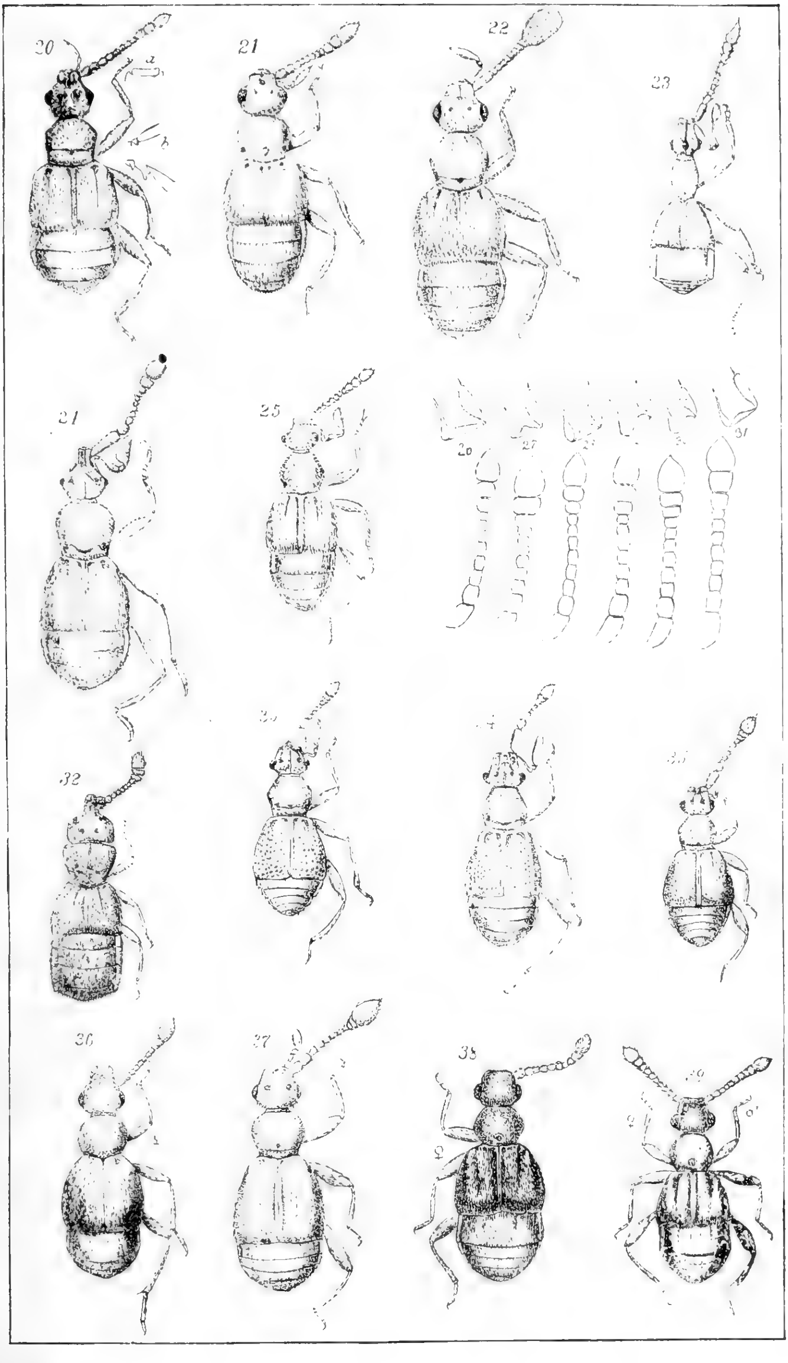
20
a
b
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PLATE VIII.[1]

Fig. 40. *Decarthron abnorme.*
Fig. 41. *Decarthron exsectum.*
Fig. 42. *Decarthron longulum.*
Fig. 43. *Decarthron brendelii.*
Fig. 44. *Decarthron formiceti.*
Fig. 45. *Bryaxis sanguinea* (European).
Fig. 46. *Bryaxis conjuncta.*
Fig. 46, a. Antenna of var.
Fig. 47. *B. brendelii.*
Fig. 48. *B. elegans*
Fig. 49. *B. cavicornis.*
Fig. 50. *B. luniger.*
Fig. 51. *B. abdominalis.*
Fig. 52. *B. intermedia.*
Fig. 53. *B. floridana.*
Fig. 54. *B. ulkei.*
Fig. 55. *B. illinoiensis.*

1 Note. All the figures of the Pselaphidæ are highly magnified. For the size of the several species the student must be guided by the dimensions quoted in the text.

PLATE VIII.

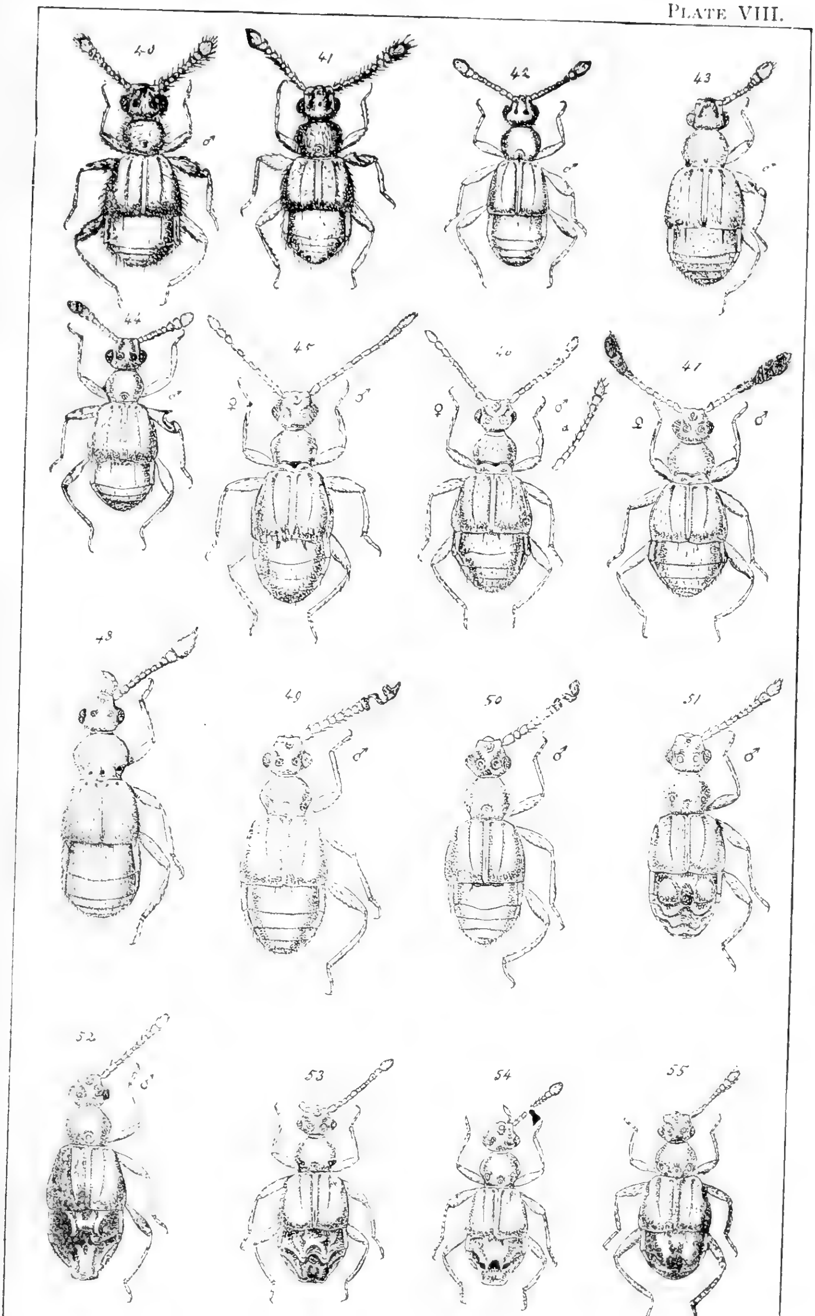

PLATE IX.[1]

Fig. 56. *Bryaxis dentata.*
Fig. 57. *B. belfragei.*
Fig. 58. *B. perforata.*
Fig. 59. *B. texana.*
Fig. 60. *B. gracilis.*
Fig. 61. *B. congener.*
Fig. 62. *B. scabra.*
Fig. 63. *B. propinqua*, ♂
Fig. 64. *B. tumidicornis.*
Fig. 65. *B. tumida.*

Antennæ of *Bryaxis*—

Fig. 66, a, b. Two forms of ♂ *propinqua.*
Fig. 66, c. ♀ *propinqua.*
Fig. 67. *tumorosa.*
Fig. 68. *tumidicornis.*
Fig. 69. *informis.*
Fig. 70, a. ♂ of *deformata.*
Fig. 70, b. ♀ of *deformata.*
Fig. 71. *franciscana.*
Fig. 72, a. ♂ of *fundata.*
Fig. 72, b. ♀ of *fundata.*
Fig. 73, a. ♂ of *tumida.*
Fig. 73, b. ♀ of *tumida.*

Fig. 74. *Verticinotus cornutus*, ♂.
Fig. 75. *Verticinotus cornutus*, ♀.
Fig. 76. *Arthmius globicollis*, ♀
Fig. 77. *Arthmius globicollis*, ♂.
Fig. 76, b. ♀ sexual ventral marks of *Arthmius.*
Fig. 77, a. ♂ sexual marks of the same.
Fig. 77, c. Three different projections of male antenna of *Arthmius.*

1 Note. All the figures of the Pselaphidæ are highly magnified. For the size of the several species the student must be guided by the dimensions quoted in the text.

PLATE IX.