Vol. 4. (NEW SERIES) APRIL, 1906. Nos. 1 and 2

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

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MILWAUKEE, WISCONSIN.

THE EDW. KEOGH PRESS, MILWAUKEE.

The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6, 1857.

OFFICERS AND DIRECTORS.

Edgar E. Teller, President.....165 27th Street, Milwaukee.
Henry L. Ward, Vice-President.....Public Museum, Milwaukee.
Charles T. Brues, General Secretary.....Public Museum, Milwaukee.
William Finger, Treasurer.....297 12th Street, Milwaukee.
Dr. Sigmund Graenicher.....551 7th Street, Milwaukee.

PUBLISHING COMMITTEE.

Henry L. Ward, Geo. W. Peckham,
Chas. E. Monroe.

REGULAR MEETINGS.

These are all held on the last Thursday of each month, except July and August, in the lecture room in the Museum-Library Building, Milwaukee.

PUBLICATION.

The "Bulletin of the Wisconsin Natural History Society."

MEMBERSHIP DUES.

City Members, $3.00 per annum; Non-resident Members, $2.00 per annum; Life Members, one payment of fifty dollars.

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OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 4, New Series. **APRIL, 1906.** **Nos. 1 and 2.**

PROCEEDINGS.

October 26, 1905.

Regular monthly meeting of the society.

President Teller in the chair and about 150 persons present.

The minutes of the last regular meeting were read and approved.

Mr. H. L. Ward reported that the first proof for the forthcoming Bulletin of the society had just been received, having been delayed. He moved that title pages and indices be prepared for the past numbers of the Bulletin of the new series. Motion carried.

Mr. Ward then presented the resignation of Mr. C. E. Monroe as general secretary, which was accepted. Mr. C. T. Brues was elected to fill the vacancy.

The names of Miss M. C. Denton, Mr. N. T. Nichols, and Mr. Herbert Clowes were presented for membership, and subsequently passed upon favorably by the board of directors.

President Teller called the attention of the society to the death of Mr. Adolph Meinecke, and on motion of the society appointed a committee consisting of Messrs. Peckham, Bartlett and Ward to draw up suitable resolutions.

The society then listened to an illustrated talk by Mr. C. T. Brues, of the Public Museum, on "Ant and Termite Guests." The speaker called attention to the peculiar relations which exist between many ants and termites, and various insects which are adapted to live in the nests of these social insects. A classification of such forms based upon the extent of interdependence was reviewed and various characteristic modifications discussed. The matter was then taken up in detail, referring to special species with the aid of lantern slides.

November 23, 1905.

Regular monthly meeting of the society.

President Teller in the chair.

The minutes of the last monthly meeting were read and approved.

Dr. Peckham reported that the committee appointed to draw up resolutions regarding the death of Mr. Meinecke was not yet ready to report.

Mr. Ward proposed the names of Mr. Chas. Doerflinger, Mr. A. Monsted and Mr. George Shrosbree for membership in the society. They were subsequently elected by the board of directors.

There being no further business, the society then listened to a lecture by Dr. S. Graenicher on "The Mutual Relations of Flowers and Insects."

Dr. Graenicher traced briefly the history of the subject and showed the great importance to both flowers and insects of these adaptations. Many plants are absolutely dependent on insects for the fertilization of their flowers, while many insects are no less dependent on nectar and pollen for food. By means of lantern slides he showed many of the remarkable adaptations in members of both groups whereby insects are attracted to plants; how the pollen is transported; and cross-pollination affected; also how some plants are visited only by certain species of insects. The peculiar relations of orchids and yuccas to insects was discussed in detail.

December 28, 1905.

Regular monthly meeting of the society.

President Teller in the chair and about 35 persons present.

A request to exchange publications with the museum of Magdeburg was allowed.

There being no further business, Dr. G. W. Peckham addressed the society on "Some Color Problems in Relation to Natural History."

Dr. Peckham called attention to the inadequacy of the theory of natural selection to account for many remarkable cases of coloration among animals. He outlined briefly the origin and development of the theory of sexual selection, showing the manner in which it acts.

The structure and coloration of a large number of male Attid spiders was discussed at length, and the fact pointed out that in each case the peculiarities of coloration were clearly correlated with the courtship actions of the males during the mating season. This was illustrated by a large series of colored charts of the spiders. After some discussion on the part of the speaker and several members, the meeting adjourned.

January 26, 1906.

Regular monthly meeting of the society.

President Teller in the chair, and about a hundred persons present.

The society voted to exchange publications with the Sociedad Cientifica de Sao Paulo, Brazil.

An invitation from the Academy of Sciences of St. Louis was read, requesting the presence of a delegate from the society to be present at the celebration of the fiftieth anniversary of its foundation.

Dr. George P. Barth was named for membership in the society and subsequently elected by the directors.

Mr. John E. Burton then gave an extended talk on "The Two Alaskas," describing the Eskimo peoples and their customs and industries. The speaker had spent several years in Alaska and described many characteristics of the country and its inhabitants that are not ordinarily known. At the close of the talk a representative collection of Alaskan ethnological specimens was exhibited.

March 1, 1906.

Regular February meeting, which had been postponed one week.

President Teller in the chair and about one hundred persons present.

The name of Mrs. Albert F. Gallun was proposed for membership, and she was subsequently elected by the board of directors.

There being no other business, Dr. E. C. Case addressed the meeting on "The Ancestry of Dogs and Cats," dealing with the origin and differentiation of the various domesticated races from wild species.

Dr. Case referred to the phylogeny of the Canidæ and Felidæ, showing the lines of divergence during past ages, more especially in relation to the skull and dentition. He also described the characteristics of a large number of varieties of dogs and cats and their wild relatives. The discussion was illustrated by stereopticon slides.

March 29, 1906.

Regular monthly meeting.

President Teller in the chair and about fifty persons present. The general secretary not being present, Mr. Carpenter was elected secretary pro tem.

Miss Minna C. Denton, of the Milwaukee-Downer College, gave the talk of the evening on "The Work of Professor Jacques Loeb," a resumé of some recent investigations concerning the physiology of the nervous system, and the artificial parthenogenetic development of animals.

Professor Loeb's book, "Physiology of the Brain," elaborates and enforces the segmental-reflex theory as opposed to the centre-theory, *i. e.*, emphasizes the independence of spinal centers and those in the lower brain, considers that the cerebral hemispheres are probably a mechanism developed for the purpose of associative memory, and disavows theories of localization of function in the cerebral cortex.

The work in artificial parthenogenesis includes experiments with many Echinoderms, a number of Annelid worms, and several mollusks, in which the fertilizing agency was usually either an increase in concentration of the sea-water, or the addition of some specific chemical substance. Experiments which resulted in the fertilization of the sea-urchin's egg by the sperm of various species of starfish, or of a Holothurian, were also mentioned.

A TURTLE PIPE FROM WISCONSIN.

BY HENRY L. WARD.

The Public Museum of the City of Milwaukee has recently obtained by purchase an effigy pipe representing with considerable accuracy a turtle such as may be found in our streams and ponds.

In his important and most interesting monograph on "The Aboriginal Pipes of Wisconsin" Mr. West describes and figures another "turtle pipe" which is also the property of the Public Museum, received by gift in 1883 from the Wisconsin Natural History Society. This pipe was, according to record, collected on the grounds of the House of Correction within the limits of the City of Milwaukee, by Hugh McGarry. The identification of it as a turtle is rather a matter of elimination than because of a close approximation to any known species of turtle.

It is more nearly like a turtle than it is like any other kind of animal, but the number and the disposition of the raised scutes covering the carapace do not agree with those of any turtle and much less do the similar raised scutes, arranged in longitudinal rows alternating with raised bands, covering the head bear a close resemblance to the armature of that portion of a turtle. It is without eyes, limbs or tail, and bears upon its back a shuttle-shaped decoration through the center of which was made the excavation of the bowl. The posterior part of the body is truncated, with no projecting stem, and Mr. West believes that it was "used without the addition of a detachable mouth-piece." The lower surface is left blank. If, as is probably the case, it represents a turtle it is probably a conventionalized figure of a box or wood tortise with feet retracted and tail folded under the carapace. Of it Mr. West writes: "[it] is believed to be the only ceremonial pipe of turtle form, so far found in Wisconsin."*

The pipe now under consideration is unmistakably the representation of a turtle notwithstanding that the plates of the carapace do not agree in arrangement with those of any species; and although their shapes and the general form of the body would indicate that one of the *Emydidæ* was meant the plastron does not approximate the form found in that family but is suggestive of the

* West, Geo. A., Wisconsin Archeologist, Vol. 4, Nos. 3 and 4, p. 101-102 (1905).

Chelydridæ. The entire absence of marginal scutes to the carapace is a noticeable omission. The eyes had been carved; but most of the right one has been lost by a cleavage of part of the head and the surface of this cleavage has been subsequently finished by pecking. The right hind foot shows four toes, the other feet are not digited.

The Indian who carved this pipe was unquestionably familiar in a general way with some turtle and perhaps from the abundance of his knowledge, and with a lack of scientific accuracy united members of two families (probably the Painted turtle or Mud turtle and the Snapping turtle) in one individual.

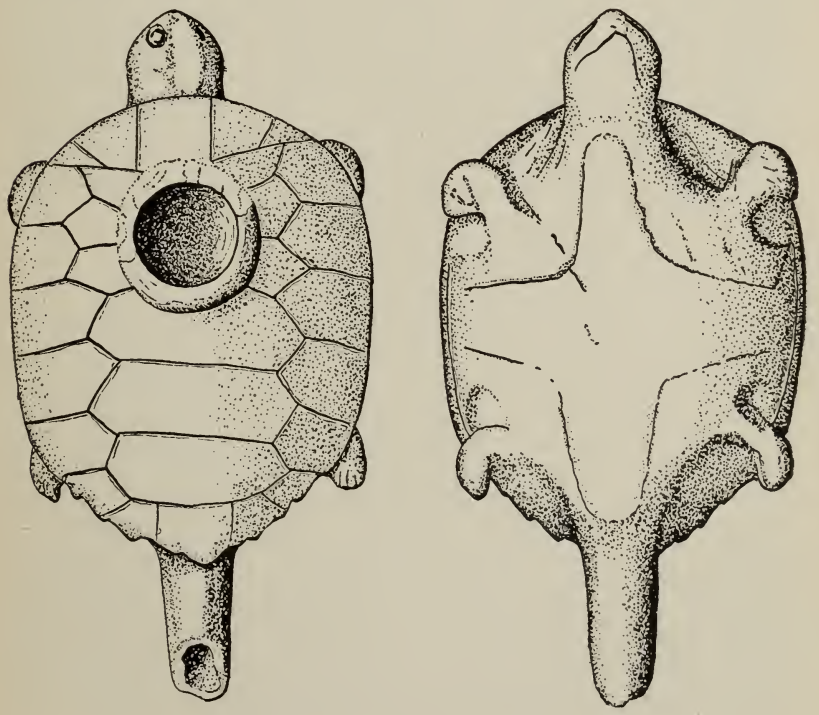
This pipe was recently acquired by purchase, through her son, of Mrs. Merrill of Burnett Junction, Dodge County, Wis., in whose possession it had remained since it was plowed up in 1876 on the A. G. Young farm at that town. It was a surface find, the nearest Indian mounds being about a mile distant.

The accompanying illustrations obviate the necessity of a detailed verbal description. The pipe weighs 9 ounces and is carved from compact reddish brown argellite, finely laminated parallel to the plane of its major diameters. It is 122 mm. ($4\frac{13}{16}$ inches) long, 30 mm. ($1\frac{5}{32}$ inches) in thickness through the body, with a raised rim to the bowl averaging about 5 mm. ($\frac{3}{16}$ inches) in height. The forward half of this rim had been broken away when found. The tail formed the stem and has been broken away leaving its extreme length, from the posterior point of the carapace, 27 mm. ($1\frac{1}{16}$ inch). The original length is indeterminable. The stem hole is 5 mm. ($\frac{3}{16}$ inch) in diameter, practically circular in section, showing longitudinal grooves and pitting the cavity of the bowl close to its bottom on the side opposite to its entrance, showing that it was over-bored. The bowl is 19 mm. ($\frac{3}{4}$ in.) in diameter at the top, practically circular in transverse section, constricting to the hemispherical bottom. It measures 30 mm. ($1\frac{5}{32}$ in.) in depth from the top of the raised rim. The lower two-thirds of the bowl cavity shows both vertical and horizontal scratches not obliterated, apparently because of their depth, by the smoothing and polishing process to which it has evidently been subjected and which has left the upper third quite smooth. The surface of the turtle has been smoothed and polished but not to the extent of removing all traces of the pittings made in pecking it into form.

Since finding, some one has re-scratched the suture lines on the carapace about two of the scutes; but fortunately not to an extent to entirely obliterate the original surfaces of these grooves and render questionable whether any of the lines are recent inter-

polations. On the two scutes of the carapace immediately posterior to the left fore foot, on the lower surface between the left hind foot and the tail and on the right of the neck, are scratches left by a metal tool, probably by a knife in the hands of someone testing the hardness of the stone. These are very evidently blemishes of recent date. The original surface of the pipe shows no indication of the use of metal implements in its manufacture but has very evidently been pecked into shape and then rubbed down. It is a remarkably faithful representation of a generalized turtle with enough departure from any particular kind of turtle to render it characteristic of the careless art of the Indian.

As the turtle was an animal much used by the Sioux both in old and recent times and Burnett Junction is but 25 miles from the shores of Lake Winnebago, where it is known that the Siouan tribe of Winnebagos dwelt, there is much probability that this is a Winnebago pipe.



SOME NOTES ON THE POLLINATION OF FLOWERS.

BY S. GRAENICHER.

JEFFERSONIA DIPHYLLA (L.) PERS. AND SANGUINARIA CANADENSIS L.

The flowers of the twin-leaf (*Jeffersonia diphylla*) and bloodroot (*Sanguinaria Canadensis*) are among the most conspicuous of our early flowers of spring. Although representing two quite distinct families, these flowers have from an ecological point of view several features in common, and for the sake of comparison they are considered together. Sanguinaria is a rather frequent plant in our region, while of Jeffersonia it must be stated with regret that it is gradualy disappearing from the immediate surroundings of Milwaukee. The observations recorded below were made on the southwestern slope of a hill in the Menomonee Valley between Milwaukee and Wauwatosa. In this particular locality the two plants occur close together, the flowers of the bloodroot always appearing two or more days in advance of those of the twin-leaf. In size and general appearance these two flowers resemble each other to such an extent that they are not easily distinguished at a distance. Both are typical pollen-flowers, not a trace of nectar being produced by either of them.

JEFFERSONIA DIPHYLLA (L.) PERS. TWIN-LEAF.

Altogether two species of Jeffersonia are known, one from Manchuria in Eastern Asia, and the other from the eastern part of North America. Nothing has been reported so far concerning the pollination of either of them.

The earliest flowers of our species, *J. diphylla*, make their appearance as a rule during the fourth week in April. In 1900, for example, the flowering season extended from April 26 to May 13. The solitary white flower has a diameter of 4 to 4½ cm., and is situated at the end of an erect scape about 2 dm. in length. The sepals fall off very early, mostly before the spreading of the 8 petals. The latter are about 2 cm. long and pure white, while the sepals and scape have a purplish tint. In the newly opened flower the 8 stamens are directed away from the pistil. They have a length of 11 mm., 8 mm. of which are to be credited to the anthers. The pistil is equally as long as the stamens, and carries a flattened stigma on top of a short style.

The opening of the flower begins late in the forenoon, somewhere between 11 and 12 o'clock, and a short time afterwards one of the anthers begins to shed its pollen. One by one the extrorse anthers open, and on the afternoon of the first day dehiscence has taken place in all of them. The flower is homogamous, the stigma being receptive from the start. The mode of dehiscence is peculiar. The outer wall of the anther represents a valve that at first becomes detached at the base, and gradually becomes separated along the entire length of the anther, but remains connected at the tip. During this process the slender ribbon-shaped valve curls up on itself and turns its inner surface covered with pollen outward. Finally each anther carries such a curl covered with pollen at its tip. Around 4 o'clock in the afternoon the flower closes, the anthers are pressed up against the pistil, and some of the pollen is brought in contact with the stigma. In favorable weather the flower opens again on 2 or 3 consecutive days, always closing for the night or in rainy weather, and from the second day on the withered valves with the remnants of dry pollen surround the stigma. At the end of the third or fourth day the petals are dropped. The flower is devoid of nectar, it possesses a very faint sweet odor, and does not seem, according to my observations, to be as attractive to insects as its neighbor, the bloodroot.

On the first day cross-pollination may be effected by the visits of insects, but if this fails to take place self-pollination is insured by the closing of the flower in the evening.

The following insects have been noticed on the flowers:

A. BEES. *

Apidæ: (1) *Ceratina dupla* Say female, c. p.; Andrenidæ: (2) *Andrena hippotes* Rob. female, c. p.; (3) *Halictus coriaceus* Sm. female, c. p.; (4) *H. foxii* Rob. female, c. p.; (5) *H. zephyrus* Sm. female, c. p.; (6) *H. tegularis* Rob. female, c. p.; (7) *H. nearcticus* Vach. female, c. p.; (8) *H. anomalus* Rob. female, c. p.; (9) *Augochlora confusa* Rob. female, c. p.

B. FLIES.

Syrphidæ: (10) *Syrphus ribesii* L., alighting on the middle of the flower, not f. p.

The most regular visitors are small bees of the genus *Halictus*.

* For present purposes I prefer to retain the previous classification of bees and divide them into *Apidæ* (long-tongued bees), and *Andrenidæ* (short-tongued bees).

While collecting pollen they usually do not come in contact with the stigma, and for this reason are not likely to bring about self-pollination. When proceeding from flower to flower and landing in the middle of a flower on the stigma their visits are apt to result in cross-pollination.

SANGUINARIA CANADENSIS L. BLOODROOT.

Loew (1) published the results of his observations on specimens cultivated in the Botanical Garden of Berlin, and Robertson (2) gave an account of the pollination of this flower growing under natural conditions in Southern Illinois. The flowers of this species as observed in our surroundings agree in a general way with those described by Robertson. The two sepals fall off quite early, and the 8 or exceptionally 9 petals spread and form a showy white flower with a diameter ranging between 4 and 5 cm. These flowers often grow together in small groups and this adds considerably to their conspicuousness. Each flower is borne by a scape 12 cm. high. The two-parted stigma becomes receptive as soon as the flower opens, but the anthers empty their pollen only from the second or third day on (proterogyny). The numerous stamens are directed outwardly. They differ in length, the outer ones being rather short while those next to the pistil are of sufficient length to reach the stigma. In the older flowers the stigma assumes a brownish color and withers.

No nectar is produced, but insects find an ample supply of pollen. The larger among the visitors (bees and Syrphid-flies) when alighting on the flower often come in contact with the stigma. Such a visit during the first 2 or 3 days results in cross-pollination in most instances. The flower closes towards the evening, and by forcing the dehiscent anthers of the inner row against the stigma self-pollination may be accomplished as a last resort if the stigma be still receptive. But in our region the flowers are sufficiently visited to make cross-pollination, or at least self pollination through insect agency the probable outcome. Visitors were taken as follows:

A. BEES.

Apidæ: (1) *Bombus separatus* Cr. female, c. p.; (2) *Nomada*

1. Loew. Bluetenbiologiche Beitraege 1. Pringsh. Jahrb. XXII. 1891, pp. 453-454.

2. Chas. Robertson. Flowers and Insects, VIII. Bot. Gaz., XVII., 1892, pp. 175-176.

sayi Rob. female, searching for honey; (3) *Ceratina dupla* Say female, c. p.; (4) *Zadontomerus tejonensis* Cr. male, searching for honey; Andrenidæ: (5) *Andrena vicina* Sm. male, female in cop., female, c. p.; (6) *A. milwaukeensis* Græn. female, c. p.; (7) *Halictus lerouxii* Lep. female, c. p.; (8) *H. nearcticus* Vach. female, c. p.; (9) *H. zephyrus* Sm. female, c. p.; (10) *H. sparsus* Rob. female, c. p.

B. FLIES.

Bombyliidæ: (11) *Bombylius major* L., probing around the bases of the filaments for nectar; Syrphidæ: (12) *Syrphus americanus* Wied., f. p.; (13) *Mesogramma marginata* Say, f. p.; (14) *Crioprora cyanogaster* Loew, f. p.

C. BUTTERFLIES.

Rhopalocera: (15) *Pontia rapae* L., 1 specimen alighting on the flower. An exceptional visitor.

In Southern Illinois the honey-bees visit these flowers in such numbers as to drive the other visitors away, and for this reason Robertson was not able to observe more than 3 bees (Halictus), 1 Syrphid-fly, and 1 beetle, at the flowers. He considers bees of the genera Andrena and Halictus, and flies of the family Syrphidæ as the normal visitors. Our observations around Milwaukee support his views. In our neighborhood the honey-bee is not of so frequent occurrence as to interfere to any extent with the native visitors of our flowers.

The flowers of Jeffersonia, as also of Sanguinaria appear before the green leaves of these plants are fully developed, and before the leaves of the surrounding plants have become visible. For this reason the large white flowers stand out very prominently against the background of the woodlands in early spring. They are in competition with each other for the attention of the same set of visitors, mainly Andrenidæ and Syrphidæ, and to these they offer pollen only. Wherever these flowers occur in sufficient numbers to be attractive to those insects they undoubtedly succeed in obtaining cross-pollination for the majority. If in Jeffersonia insects fail to effect cross-pollination or at least self-pollination on the first day, then the flower closing for the night insures spontaneous self-pollination by the aid of a characteristic contrivance. In Sanguinaria spontaneous self-pollination is not brought about so early, it is resorted to rather late after the visitors have had ample time to transport pollen to the stigma.

HAMAMELIS VIRGINIANA L. WITCH-HAZEL.

This shrub is a common inhabitant of our woods, and is remarkable from the fact that late in the fall the flowers appear together with the mature seeds of the previous year. It begins its flowering season later than any of our plants, and, as a rule, after the leaves have fallen, although the first flowers on some specimens may appear at the end of September when the leaves are still present. It has been noticed in blossom from September 26 on. The latest flowers are usually destroyed by the advent of cold weather around the beginning of November.

Meehan (3) has given a description of the flowers with their long, slender, yellow petals. They are very numerous, and emit a peculiar resinous odor. The shape of the flower represents a small cup formed by the 4 rigid sepals. Alternating with these the 4 ribbon-shaped petals protrude from the cup, and the 4 stamens alternating with the petals are very short. The wall of the anther-cell (valve) splits open below, and turns upward and somewhat inward thereby exposing the pollen. Inside of the stamens and alternating with them are the 4 oblong staminodia, scale-like organs bending outward towards the petals, and secreting fine drops of nectar on their upper surface, especially near the apex. The two styles with their red-tipped stigmas are directed outward.

Meehan states that the flower is homogamous, and that the stigma becomes receptive on the second day at the same time that the anthers begin to dehisce. In the specimens examined in our region the stigma was receptive already on the first day, and remained so for a day or two after dehiscence had taken place. We are therefore dealing with proterogyny.

Two anthers situated diagonally opposite to each other are only 2 mm. apart, but they do not touch the stigma, and consequently spontaneous self-pollination can hardly occur in this manner. The only way it can take place is by the falling of pollen on the stigma of flowers in a vertical position. Meehan did not witness any insect visits, and the question was left open whether the pollen was transported from flower to flower through insects (entomophilous) or through currents of air (anemophilous). The structure of the flower seems to me to leave no doubt as to its entomophilous character. The conspicuousness of the enormously

3. Thomas Meehan. Contributions to the Life Histories of Plants. No. V, Proc. Ac. Nat. Sc., Phil., 1890, pp. 273-274. Cited by Loew in Knuth's Handbuch d. Bluetenbiologie III, Part 1, pp. 333-334.

developed yellow petals, the distinct odor, and above all the nectar-secreting staminodia (not mentioned by Meehan as cited by Loew point to an adaptation to insects. The list of visitors offered below gives evidence of a rather numerous and varied gathering of insects at the flowers, and shows the prominent part taken by flies, since 75% of the 44 visiting species belong to this order.

A. HYMENOPTERA.

Vespidæ: (1) *Vespa germanica* Fabr. s.; Braconidæ: (2) *Microgaster* sp.; Chalcididæ: (3) *Elachistus cacœciæ* How., s.: (4) *Eutelus* (*Pteromalus*) *onerati* Fitch., s.

B. DIPTERA.

Bibionidæ: (5) *Bibio gracilis* Walk.; Phoridæ: (6) *Hypocera femorata* Meig.; Platypezidæ: (7) *Platypeza tæniata* Snow; Syrphidæ: (8) *Chrysogaster nitida* Wied.; (9) *Syrphus americanus* Wied.; (10) *S. ribesii* L.; (11) *Allograpta obliqua* Say.; (12) *Mesogramma geminata* Say; (13) *Sphœrophoria cylindrica* Say; (14) *Eristalis tenax* L.; (15) *E. transversus* Wied.; (16) *Syritta pipiens* L.; Tachinidæ: (17) *Phorantha occidentis* Walk.; (18) *Oestrophasia ochracea* Bigot; (19) *Frontina* sp.; Sarcophagidæ: (20) *Sarcophaga helicis* Town.; (21-22) *Sarcophaga spp.;* Muscidæ: (23) *Pollenia rudis* Fabr.; (24) *Chrysomyia macellaria* Fabr.; (25) *Lucilia cæsar* L.; (26) *Morellia micans* Macq.; (27) *Pseudopyrellia cornicina* Fabr.; (28) *Musca domestica* L.; (29) *Stomoxys calcitrans* L.; Anthomyidæ: (30) *Phorbia fusciceps* Zett.; (31-32) *Phorbia* spp.; (33) *Cœnosia fuscopunctata* Macq.; Scatophagidæ: (34) *Scatophaga squalida* Meig.; Sepsidæ: (35) *Sepsis violacea* Meig.; Oscinidæ: (36) *Chlorops assimilis* Macq.; Sapromyzidæ: (37) *Lonchœa polita* Say—all s. or f. p.

C. LEPIDOPTERA.

Heterocera: (38) *Laphygma obscura* Riley; (39) *Heliophila unipuncta* Harv.; (40) *Cucullia asteroides*, Gn.; (41) *Autographa brassicæ* Riley; (42) *Heliothis obsoleta* Fabr.—all s.

D. COLEOPTERA.

Carabidæ: (43) *Lebia scapularis* Dej.; Chrysomelidæ: (44) *Diabrotica vittata*, Fabr.—all s.

The pollen is deposited mostly on the mouth-parts of the visitors. At the beginning of the blooming period before the

leaves have fallen, the few flowers are not likely to attract much attention, and in fact are poorly visited. Besides, competition is decidedly severe at this time on account of the multitude of other flowers (Compositæ, etc.). But later on, especially in the latter half of the month of October, when most of the leaves of the witch-hazel have disappeared, there is a very pronounced contrast in color between the numerous yellow flowers of this plant and its environment. And this is the time when the flies pay the most attention to the flowers. On two different occasions in the evening following a warm day, and soon after sunset, quite a number of moths appeared on the flowers, as represented by the 5 species of the list.

By coming at the end of the season after the leaves have fallen the flowers of the witch-hazel secure a similar advantage as do the flowers of the bloodroot, twin-leaf and some other species by appearing early in the spring ahead of the leaves.

PARNASSIA CAROLINIANA, MICHX. CAROLINA GRASS OF PARNASSUS.

A widely distributed representative of the genus *Parnassia, P. palustris,* a plant inhabiting Europe, Asia and the northern portion of North America, has been studied by many ecologists of Europe on account of the peculiar structure of certain parts of its flower. Inside of, and opposite to each of the showy white petals a staminodium is present with a flattened and widened basal portion, and numerous (7 to 13 or even 25) slender processes protruding from its outer margin. Nectar is contained in two shallow depressions on the basal part, but the shining knob-shaped tips of the processes, although appearing as drops of nectar are entirely dry. These latter have been explained by Hermann Mueller as organs of glandular structure serving no other purposes than to attract visitors to the flowers. According to H. Mueller (4) "we have thus in *Parnassia palustris* a very well-marked example of a *deceptive flower,* which deludes the foolish flies by displaying a multitude of conspicuous but sham drops of honey; and which, after thus alluring them, affords them indeed some easily accessible honey, which repays their trouble, but is quite incommensurate with the apparently bountiful display." Mueller also informs us that his son witnessed a fly (a species of *Eristalis*) licking these drop-like glands in search of

4. H. Mueller. The Fertilisation of Flowers, transl. by D'Arcy W. Thompson.

honey. Knuth (5) does not consider it appropriate to call such a flower a deceptive flower, since it does not deceive its visitors, but offers them at least as much nectar as the average umbelliferous flower.

Parnassia Caroliniana, the species represented in the flora of Milwaukee County, blooms from about August 20 to October 4. It may be met with in damp localities throughout our region, but nowhere have I seen it growing in such profusion as in some places on the bluffs along the shore of Lake Michigan, as for example in the vicinity of Whitefish Bay, at South Milwaukee, etc. There is in this species a solitary flower at the top of a smooth scape of 3 to 4 dm. length, and the parts of the flower are all white, except the dark-green ovary. The newly opened flower has a diameter of 2½ cm., but by gradual growth this is increased to 4 cm. in the older flower. We are presented here, as in *P. palustris,* with a typical example of proterandy. When the flower opens the 5 stamens in different stages of growth lean up against the conical ovary, the latter is not full grown, and very little is to be seen of the undeveloped stigma. The most advanced stamen becomes longer, and places its extrorse anther on top of the ovary immediately above the stigma. After it has discharged its pollen the stamen is bent outward between the two corresponding petals, and another anther takes its place on top of the ovary. One by one the 5 anthers get rid of their pollen, and move out of the way. This period of the flower's existence represents the first or staminate stage, and is succeeded by the second or pistillate stage in which the stigma with its 4 or 5 divisions reaches its full development, and becomes receptive. Five staminodia are also present as in *P. palustris,* but they are more simple in structure than in that species. Each staminodium has a smaller basal part, and sends off only 3 knob-tipped processes of equal length. There are no depressions serving as nectaries, and only a scant supply of nectar is secreted on the basal part, and in the lower region of the processes. The yellow shining glands at the tips of the processes resemble drops of liquid, and are arranged in a circle of 8 to 12 mm. diameter (according to the size of the flower) around the ovary. The staminodium in *P. palustris* represents a higher degree of development than that in *P. Caroliniana,* as demonstrated by the greater number of glandular tips, and the more complex nectar-secreting

5. P. Knuth. Blumen und Insekten auf den Nordfriesischen Inseln, 1892, pp. 34-35.

apparatus. Otherwise the flowers of both species agree very closely. Proterandry to such an extent as it exists in both of them makes cross-pollination the only probable outcome.

I have taken the following insects on the flowers of *Parnassia Caroliniana*:

A. HYMENOPTERA.

Apidæ: (1) *Apis mellifera* L. worker, s.; (2) *Bombus affinis*, Cr. worker, s.; Andrenidæ: (3) *Andrena parnassiæ* Ckll., female, s. and c. p.; (4) *Halictus zephyrus* Sm. female, s. and c. p.; Ichneumonidæ: (5) *Lampronota frigida*, Cr. s.; (6) *L. americana* Cr., s.

B. DIPTERA.

Bombyliidæ: (7) *Anthrax alternata* Say; Syrphidæ: (8) *Paragus bicolor* Fabr.; (9) *Melanostoma mellinum* L.; (10) *Syrphus americanus* Wied;. (11) *Allograpta obliqua* Say; (12) *Mesogramma polita* Say; (13) *Sericomyia chrysotoxoides* Meig.: (14) *Eristalis tenax* L.; (15) *E. dimidiatus* Wied.; (16) *Helophilus similis* Macq.; (17) *Syritta pipiens* L.; Tachinidæ: (18) *Exorista nigripalpis* Town;. (19) *Phorocera doryphoræ* Riley; Muscidæ: (20) *Lucilia cæsar* L.; (21) *Musca domestica* L.; Anthomyidæ: (22) *Leucomelina garrula*, Gig.—Tos.; (23) *Anthomyia* sp.; (24) *Phorbia fusciceps* Zett.—all s. or f. p.

C. LEPIDOPTERA.

Rhopalocera: (25) *Pyrameis huntera* Fabr. s.; (26) *Pontia rapæ* L. s.

The most important pollinators are large flies, especially Syrphidæ, and an oligotropic bee *Andrena parnassiæ* Ckll. A fly by landing in the middle of a flower in the first stage becomes dusted with pollen on the lower side of its body, and afterwards brings the same part of its body in contact with the receptive stigma when visiting a flower in the second stage. *Andrena parnassiæ* the bee specially adapted to *Parnassia Caroliniana* (6) always alights on the middle of the flower and bends the front part of its body (head and thorax) down on one side of the ovary, and the abdomen on the other side, thereby collecting pollen and nectar in the staminate stage, and nectar alone in the pistillate stage.

6. S. Graenicher. The Relations of the Andrenine Bees to the Entomophilous Flora of Milwaukee County. Trans. Wis. Acad., XV, Part I, pp. 94-95.

Of the 26 visitors enumerated in the foregoing list, 18 or 69% are flies. For *Parnassia palustris* we find the following records (7): H. Mueller and P. Knuth observed 75% flies in Germany among 28 visitors; H. Mueller 73% in the Alps among 59 visitors; Alfken and Leege 63% on the Island of Juist among 19 visitors; Burkill 70% on the eastern coast of Scotland among 23 visitors, and MacLeod 80% in the Pyrenees among 10 visitors. The average for *P. palustris* obtained from these figures amounts to 72%, and it is interesting to note that our *P. Caroliniana* with 69% of flies agrees rather closely with the first named species. The difference in the development of the staminodia in the two considered species does not seem to be of any influence on the visitors if we are entitled to draw conclusions from the number of species or the percentage of flies, but after all there might be a difference in the number of individuals attracted to the flowers.

7. Cited by Knuth in Handbuch der Bluetenbiologie, II, pp. 458-459.

THE CHEMICAL NATURE OF SOME INSECT SECRETIONS.

BY A. L. MELANDER AND C. T. BRUES.

In this paper we have attempted to give in addition to some original observations, a brief resumé of what is definitely known regarding the general chemistry of the odors of insects and myriapods.

Most of the odorous secretions of insects are the products of highly specialized glands which derive from the blood the foundation for their work. An exception to this, however, is seen in the fat occurring associated with the chitinous skeleton of insects. Of the glandular secretions one may define two categories: those used by the insect directly in its own metabolism, and those of more indirect use as an odorous character and developed to suit peculiar conditions of environment or habits. As the first group includes products found elsewhere throughout the animal kingdom, *e. g.,* the salivary, digestive, and excretory fluids, all secreted by portions of the alimentary tract, we shall pass them by to consider those substances more or less peculiar to insects themselves. These products are of two kinds: defensive, malodorous, highly volatile liquids developed principally to repel predaceous enemies; and alluring, sweet-scented or sweet-tasting fluids used to attract the two sexes of a species or the individuals of a community, or even to insure protection by other species as is the case with many myrmecophilous insects.

We are not aware that anyone has ever attempted to classify insect odors, but Kerner and Oliver ('95) p. 199, have divided the odors of flowers into the following groups: indoloid, aminoid, paraffinoid, benzoloid and terpenoid. As other scents seem to be developed in insects and some to be lacking, this classification is not wholly suited to our purpose. Accordingly, we have used the following outline in the absence of a more satisfactory one. It includes six rather heterogeneous groups: Ethereal and Benzoloid, Indoloid, Isonitrile, Vegetable extracts, Acid, Alkaline.

ETHEREAL AND BENZOLOID.

The European bugs of the genus *Pyrrhocoris* secrete a sweet smelling and pleasant tasting etheral liquid, according to Mayer ('74). The Texan ant, *Camponotus maculatus sansabeanus,* has a marked scent resembling a combination of butyric and valer-

ianic ethers. This we have treated more fully in the sequel, likewise the odor of *Forelius fœtidus.* The odor of the latter, as well as that of many members of the ant subfamily Dolichoderinæ, is very similar to that of rancid cocoanuts. The Harlequin bug has an odor resembling essence of *Gaultheria* or wintergreen. Many Coreidæ, notably the Squash-bug (*Anasa tristis*) possess a very characteristic odor closely resembling that of isoamylacetic ether, while the whole family Pentatomidæ have a weaker disagreeable and probably nearly related ethereal smell. Other bugs possess rather agreeable odors. The giant waterbug (*Belostoma*) gives rise to a pear or banna-like smell according to Locy. *Syromastes* also resembles a fine bergamot pear (Siebold, '48).

The water bettles belonging to the genus *Dineutes* possess the characteristic odor of apple skins, while certain Cicindelidæ are suggestive of hyacinths. The following Lepidoptera have also been described by Packard as being pleasantly odorous ('98): *Pontia napi* yields a scent like citrons, *Callidryas* gives the odor of musk, and *Dircenna* is suggestive of vanilla. Many Cerambycidæ are strongly odorous, for example the European *Aromia moschata* has a powerful smell of musk, while the closely related American *Callichroma plicatum* has a strong honey-like smell, as we have often observed, a fact first mentioned by Wheeler ('90a). The characteristic odor of the Scarabæid beetle *Osmoderma* is evidently of similar composition.

The osmateria of some Papilio larvæ secrete an etheral melon-like fluid, although this scent is usually concealed by stronger disagreeable ones. The leaf beetle, *Lina populi,* produces a secretion with an odor of oil of bitter almonds (dinitrobenzene) (Claus, '61). Candèze has suggested the presence of free hydrocyanic acid in this secretion. The large fly, *Cœnomyia ferruginea,* has a very permanent and strong odor which has been compared by Wheeler ('90a) to the juice of a species of Hypericum.

INDOLOID.

Under this grouping we find a number of insects with a fecal odor, varying greatly in intensity and modification. Of the half a dozen species belonging to the Neuropterous genus Chrysopa with which we are familiar in nature, all possess the odor of human excrement to an excessive degree. A similar odor occurs in the neotropical group of the foraging or driver ants, Eciton. We have treated in detail with the secretions of the Texan species in the second part of this paper.

ISONITRILES.

Both sexes of the large Tarantula-hawk (*Pepsis spp.*) produce a distinct isonitrile odor when first captured. This is quite noticeable, although often modified by the scent of the honey that they have eaten.

The nasutes of an African species of Ptyotermes eject a pungent stream from the head, the nature of which is thus treated by Cook ('90): "The fluid is clear and watery and does not stain the hands. A smarting sensation in the eyes and nose is also distinctly appreciable. The odor is even more disagreeably pungent and penetrating than that of Spirotreptus [a myriapod mentioned below] and has an almost nauseating quality which pervades the nests and galleries of the species and can readily be detected in houses attacked by this termite [isonitriles]. Like the secretion of Polyzonium [another myriapod referred to below] the liquid becomes sticky on exposure to the air, and the insect enemies upon which it is squirted have their antennæ stuck to their bodies and are otherwise disabled."

VEGETABLE EXTRACTS, ETC.

Large numbers of phytophagous insects acquire odors or tastes derived from their food plants, but these hardly come in line with the present discussion.

Many of the Darkling beetles, and especially those belonging to the genus *Eleodes* secrete from anal glands a fluid of an intensely disagreeable odor, which some of the species can forcibly eject for a distance of ten centimeters or more. The liquid stains the skin brown, besides having a very penetrating odor and thus resembles the secretion of *Spirobolus* (see special part). According to Williston ('84) it is soluble in water, alcohol and ether, has an acid reaction, and can be esterified to an agreeably smelling ether by means of alcohol and sulphuric acid. He suggests from this the presence of organic acids other than formic or acetic, which latter he could not detect. Our commonest species, when extracted with ether furnishes an extremely malodorous compound, suggesting extract of *Taraxicum* or opium.

The exuded blood of many Coccinellidæ has an opium-like odor (Packard '98). The species of the ant genus *Cremastogaster*, squirt from their anus a white liquid which recalls the juice characteristic of the shelf-fungi. This odor is much more intense in another ant, *Pachycondla* (*v.* special portion).

The myriapod "*Petaserpes rosalbus* secretes a considerable quantity of a milky substance which has the perfume of gum camphor." (Cope '70) (see also Banks, Science, '00, p. 649) Cook ('90) noted camphor also in *Polyzonium,* a closely related form. These seem to be the only recorded occurrences of camphor in the animal kingdom, but in the absence of chemical evidence must of course remain doubtful. The occurrence of cantharidine in members of the Meloidæ may be mentioned in this connection.

MISCELLANEOUS.

Finally, the assertion that free iodine in present is the gaseous secretion of the Paussid Beetle, *Cerapterus quadrimaculatus* must be noticed. (Loman '87). The close similarity between the purely organic secretion of the Spirobolus described in the sequel and the physical characteristics of free iodine in solution cause us to doubt Loman's observation.

ACID.

A small leaf beetle (*Notodonta*) is stated to secrete hydrochloric acid. (Denham '88). Another leaf beetle, (*Lina*) supposedly secretes Hydrocaynic acid according to Candèze ('74). It has long been known that ants produce formic acid in great quantity, while this acid is probably present in the poison of all wasps (Forel '78). The relative amount in various species of ants will be tabulated in the special part of this paper. Butyric acid as well as formic occurs in nearly all the Carabidæ associated with other substances. The whip scorpion (*Thelyphonus*) secretes acetic acid (Marx. '86) in such quantity that a stream is ejected from each side of the body which fact has earned its Mexican name of "viñagron". According to Claus ('87) the myriapod *Fontaria* secretes a fluid which contains free hydrocyanic acid. Cope ('70) and Wheeler ('90) have both demonstrated that the allied *Polydesmus virginiensis* secretes free hydrocyanic acid.

ALKALINE.

The only recorded case of a strong alkali being found in the animal kingdom is in *Dicranura,* and some other moths, which produce potassium hydroxide at the last moult in order to soften the silk of the cocoon (Latter '92 and '95). Strangely enough the larva of this same insect produces formic acid in quantity (Meldola '92).

The carrion beetles of the family Silphidæ emit from the mouth and anus a fetid liquid with an ammoniacal odor (Packard '98 p. 375) as we have frequently noticed. This is probably derived from the decomposition of its food and is not a glandular product at all.

SPECIAL PART.

Experiments with Myriapods.

For many years the repugnatorial secretion of the Julidæ has been referred to by various writers, although even yet nothing definite is known of its chemical composition. As long ago as 1870 Prof. E. D. Cope ('70) remarked that "the species of *Spirobolus* and *Julus* discharge a yellowish juice having much the smell of aqua regia and a very acrid taste. The *Spirostrephon lactarius* exudes from a series of lateral pores a fluid which has in its odor a close resemblance to creasote." Wheeler ('90) has "frequently seen our common Julus,* when irritated, emit from its repugnatory glands a brown liquid with a pungent odor not unlike bromine." More recently Cook ('00) has treated in greater detail the question of this secretion.

We quote the following from his observations: "When the liquid comes in contact with the skin a yellowish green stain results, which gradually deepens to a dull purple. * * * The alcohol in which these large diplopods are collected takes on similar colors, yellowish green at first, changing to a very deep purplish red, and has a characteristic disagreeable odor different from that of the living animal, but still in some respects suggesting it. This odor Loew considered similar to that of pyridine. * * * Direct exposure to the light and heat of the sun is also speedily fatal to many diplopoda, the heavily armored Spiroboli are often quite dead after ten or fifteen minutes' exposure. That this susceptibility may prove to be the result of some chemical change or dissociation of the stored repugnatorial fluid is apparently indicated by the fact that animals killed by exposure to the sun do not stain the alcohol as described above, the repugnatorial fluid having oozed out and having been evaporated from the surface of the segments. This suggests a further possibility that the material elaborated in the repugnatorial glands may not attain its final and effective composition until directly or indirectly acted upon by the air."

* Probably identical with the species of *Spirobolus* here considered.

Our experiments were carried on with about a hundred large specimens of *Spirobolus marginatus* Say. Although largely negative we deem our results of interest, as they seem to be somewhat at variance with the conclusions arrived at by Dr. Cook.

The animals were forced to secrete by roughly shaking them in tepid water. By this means the *Spirobolus* were not injured and could be reserved for a future experiment. After some ten extractions they were unable to elaborate any further secretion, although they were carefully fed in the meantime. The water thus acquired a strong pungent odor and a dull yellowish color, as the secretion is very readily soluble in water. On heating for a moment to about 80 or 90 degrees the yellow completely changes to brown and the odor is greatly modified, losing its pungency. The addition of a small amount of alcohol effects a similar change, and even on exposure to the air for a few hours the water-solution undergoes the same color-changes. If the solution be shaken with ether, chloroform, benzene, or carbon disulphide while it is still in the yellow stage, the secretion readily passes into the added solvent, tinging it intense yellow, and leaving the water colorless. The extraction by ether may even be hastened by the addition of some salt.

It readily diffuses into the lower alcohols, while less rapidly into the higher, *e. g.,* amyl alcohol acquires the same tint as the water-layer above only after twenty-four hours, and never absorbs more of the secretion than the water does. After decomposition has takn place (*i. e.,* when the liquid is in the brown stage), a separation of the secretion cannot be effected by any of the named solvents.

When an ether extraction is carefully evaporated, the secretion can be obtained in its original concentration. It is then extremely volatile and pungent, irritating the eyes causing them to lachrymate, much like bromine; it has an atrociously acrid taste; stains paper, cloth, and the skin a deep yellow, which passes to a permanent brown; it is neither acid nor alkaline to indicators; it gives no reaction with $PtCl_4$, $FeCl_3$, nor concentrated HNO_3. When saponified with KOH the color changes to the greenish red noticed in the decomposed aqueous extract, while the odor disappears. The original odor can be brought back by the addition of HCl, although faintly at times. When dried in a sulphuric acid desiccator on a watch glass the secretion is absorbed by the acid, thus suggesting in connection with its peculiar odor, a nitrile; but so far all tests for nitrogen and sulphur have proved negative. If the secretion be placed in a nearly

closed pipette and kept for an extended time at an exhaustion of about 300 mm., a number of small metallic, bluish-purple, spurred and acidulated scales and needles appear in the upper bulb of the tube. These lamellæ appear pink by transmitted light. Although by their luster and volatile character they suggest iodine, they give no test for this element, and are probably a polymerisation product, as they increase in number with time, even when kept at the ordinary pressure.

Unfortunately, although our *Spirobolus* were very active at first—on one occasion a large specimen ejected a decided stream a distance of ten inches—they soon showed signs of weakening, and after about ten extraction, which gradually diminished in amount during the four months of experiment, their glands refused to reproduce their secretion, although the animals seemed otherwise in good condition, and we were forced to discontinue the interesting study.

Although Loew suggested pyridine it was with the understanding that this odor might have come from the German alcohol used as the preservative. This must obviously be its source, as *Spirobolus* has quite a different odor. The facts brought forth by Dr. Cook as to the action of the air we have duplicated during our tests, and these can all be explained upon the idea of saponification. It is not the final composition that is effective as the repelling agent, as he has suggested, but the condition that obtains just before decomposition. The unstable nature of the secretion gives it great reducing power, as can be shown with alkalinated silver iodide. Its staining effects recall the secretions of Brachynus, Platynus, and their related forms among the beetles, which insects Julus greatly resembles in smell, but in addition to the staining principle these Carabidæ produce formic and butyric acids, so the secretions cannot be identical.

Experiments with Ants.

A. The relative Amount of Formic Acid present in different Species.

It has long been known that certain species of ants, *e. g.*, Formica and Lasius, secrete a considerable amount of free formic acid. This is stored up in the sac which contains the acid part of the stinging fluid in those species of Ants which have well-developed stings, while in those devoid of stings it is retained in a special sac in the posterior part of the abdomen. The following experiments were conducted with a view towards determining

what amount of formic acid is present in different forms, and if the amount is constant for each species.

The ant selected for preliminary experiments was *Formica fusca,* var. *gnava* Buck., as it was evident from its strongly acid odor that formic acid was here present.

A counted number of the ants were collected in weak ethyl alcohol, and then subjected to distillation in a small flask with steam. After the distillate had ceased to show an acid reaction, a few cubic centimeters of dilute sulphuric acid were added to the flask and the distillation continued, in order to ascertain if any of the formic acid in the ants had combined with any small particles of calcareous earth that might have been present adhering to their bodies or in the alimentary tract. After removing any trace of sulphuric acid from the second distillate by means of barium chloride, it was tested for formic acid by the method given below, but not even an acid reaction could be obtained.

The first distillate was then titrated with semi-normal potassium hydroxide and its acidity noted. The solution of potassium formate thus obtained was then heated for several hours at 100 C. on a water bath with an excess of mercuric chloride solution and the amount of reduced calomel weighed. This method with mercuric chloride was found, however, to be very unsatisfactory, as it gave widely divergent results with distillates whose titration determinations were very nearly equal. The poor results thus obtained were probably due to the presence of organic matter other than formic acid, and perhaps in some cases to an incomplete reaction of the alkaline formate. But as no other acid, e. g., acetic, butyric, hydrochloric, etc., could be detected, titration with semi-normal potassium hydroxide was selected as the most reliable method.

The following table, compiled from a large series of determinations, shows the amount of formic acid in a number of species of Formicidæ. As the agreement is in most cases so close, only a few determinations are given for each species, besides several widely divergent ones that seem worthy of notice.

TABLE I.

Weight in Grams of Formic Acid Present in Ants of Different Species.

	Mercuric chloride.	Titration.	Titration.	Titration.
Formica fusca. var.gnava Bkly.				
worker.	.0004960	.0006342	*.0001854	§.0003986
female.		.0003285		
Camponotus maculatus, var sansabeanus Bkly.				
worker major.	.0005443	.002150	.002230	
worker minor.		.000448		
Camponotus fumidus Roger.				
worker major.	.0008401	.001725	.001533	.001744
worker minor.		.000414	.000418	*.000158 §.000368
Componotus americanus. Mayr.	.00009766	.0002668	.0002390	
Cremastogaster lineolata, var.clara Mayr.	trace	trace		
Pachycondyla harpax.		.000208		
Forelius foetidus. Bkly.	none	none		
Atta fervens, Say.		none		
Pheidole several spp.		none		
Pogonomyrmex barbatus. Sm.		none		
Eciton spp.		none		

* These ants were kept for a considerable time in a cloth bag in the laboratory.

§ Collected in very dry weather.

As these data are wholly independent of the size of the ants they give a poor idea of the relation between the amount of acid and the weight of the ant. This is obviated in the following table, which is derived from the one given above by dividing the actual amount per ant by the weight of the ant itself in grams.

TABLE II.

Table Showing Relative Amount of Formic Acid Per Weight of Ant in Various Species.

Formica fusca		
worker	.005	.1268
female	.030	.0109
Camponotus sansabeanus		
worker major	.041	.0534
worker minor	.009	0506
Camponotus fumidus		
worker major	.020	.0814
worker minor	.005	.0832
Camponotus americanus	.005	.0478
Pachycondyla harpax	.013	.0160

It is seen that Formica heads the list, containing more than twice as much acid relative to its size as the species of *Camponotus* examined and which follow it in the list. We believe, however, that when *Myrmecocystus* is tested in a similar way, it will show a still greater amount, as its acid odor is much more intense.

It should be noticed here that the females and males never gave any test for acid, except in a single form (female of *Formica*); also that as a rule only the species of genera which are not provided with stings showed any considerable amount of acid other than that which could be attributed to acid in the alimentary tract or in the small acid sting gland. *Cremastogaster* may prove to be an exception, but in this case most likely some other acid is present. Forelius is a stingless ant and we should expect to find it provided with acid, but it is neutral, probably because of the substitution of a peculiar ethereal secretion to take the place of the acid (see below). Pachycondyla, one of the Ponerinæ, although provided with a powerful sting, shows the presence of a considerable amount of acid. The males of no species secrete any acid, and as a general rule the females scarcely ever more than a trace.

THE DISTINCTIVE ODORS OF SOME SPECIES.

No one who has ever collected ants extensively can have failed to notice the very strong and distinctive odors possessed by many species. Other species also, which are not particularly odorous, yield peculiar scents when carefully examined.

I. ECITON.

All the species of this genus of ants which we have examined (viz: *E. cœcum, E. schmitti, E. sumicrasti, E. opacithorax, E. californicum, E. pilsoum*) possess a strikingly similar and very disagreeable odor. This odor, or one barely distinguishable from it, is secreted in even a more marked degree by species of the Neuropterous genus *Chrysopa*. In the latter insect it was long ago described by Say ('59) as closely resembling human feces.

The specimens of *Eciton* examined were subjected to distillation with steam and the first few cubic centimeters of the distillate collected. In this was found almost all the volatile odorous substance. When isolated in this manner the fecal or indoloid odor is even more pronounced than when the worker ants are crushed between the fingers. As the odor strongly suggested indol or some of its numerous disagreeably smelling derivatives, tests were made for indol by crushing some of the ants on a piece of plantinum foil with concentrated nitric acid, then evaporating to a yellow residue which turned to a yellow-brown upon the addition of a small quantity of potassium hydroxide solution. The

color seems to be produced not by indol, however, but rather by the burnt chitin or animal fat, as other insects which did not have an indoloid odor gave the same result. The very delicate and characteristic test with strong hydrochloric acid and a pine splinter was also tried, but with negative results, as no red or purple color was developed. As it is not an indol and yet has a fecal odor it would seem that it must contain a leucin. Its solubility also indicates the presence of this substance since it is readily extracted from the ants by water or ether, but not at all by absolute alcohol. When an ethereal extraction of the ants is rapidly evaporated under reduced pressure a few pearly fat globules are obtained, which are in part soluble in water, while the addition of alcohol causes a globule to separate for a few moments (leucin and fat?), later to disappear. After evaporation of the alcohol from this and freezing the residue, some crystals very much resembling leucin could be observed under the microscope, although contaminated greatly and rendered somewhat obscure by the large amount of fat present in the mixture. These crystals were very distinct when the flask was cold, but as it became warmed up to the room temperature they melted or dissolved in the fat.

The original ether extraction is neither acid nor alkaline to indicators, and on saponification with potassium hydroxide gives no odor of amonia, but a smell resembling œnanthol, which most probably arises from the fat and not from the odorous principle. Thus although there is no positive evidence that the substance present in Eciton is actually leucin, nothing seems to oppose such a conclusion.

That the Eciton odor has considerable biological significance is very probable. These ants are totally blind, and migratory in their habits, so that they must depend almost entirely upon a sense of smell to follow one another about. Thus it can easily be seen how much a strong odor might be developed through the action of natural selection, from the small trace of leucin that is usually present in insect feces. (Concerning the normal presence of leucin in the alimentary tract of insects see Plateau ('73).)

II. FORELIUS FŒTIDUS.

The Texan species of this monotypical genus, like the species of Tapinoma and a few other closely related ants, has a very strong and peculiar odor which has been very aptly described by Buckley ('66), and later by Forel, as closely resembling "rotten cocoanuts."

These ants are very small and cannot be conveniently picked up by the forceps, but may be collected in almost any number by placing pieces of filter paper soaked in sugar solution near the nests. They collect on the paper to feed upon the sugar and may be easily shaken into a bottle.

When distilled with steam the odor passes over and remains dissolved in the aqueous distillate. Thus freed it retains the very evident odor of rancid cocoanuts. By saponification with potassium hydroxide solution it loses all odor, but on adding dilute sulphuric acid to excess an odor closely resembling that of *fresh* cocoanuts is developed. From this it is quite evident that the odorous principle is an ether of some sort. Attempts to identify the free acid were not successful; its odor is too pleasant to associate with any of the lower straight chain fatty acids, but may possibly be due to a forked chain one, or to a higher fatty acid. It does not seem likely that it is an aromatic acid.

III. CAMPONOTUS MACULATUS, VAR SANSABEANUS.

All the castes of this ant, and more especially the males, possess a strong, sweet pelargonic smell which very closely resembles a bouquet of valerianic and butyric ethers. The odor is at first concealed by the stronger smell of formic acid, but is very pronounced when an aqueous distillate from the ants has been neutralized with an alkali. This physiological peculiarity readily serves to separate it from *Camponotus fumidus,* an allied form which often greatly resembles it in the worker major caste, for the latter species is wholly devoid of the geranium-like odor.*

IV. FORMICA FUSCA VAR. GNAVA.

This ant, too, has its own distinctive odor, which can be readily recognized after the aqueous distillate has been neutralized with an alkali. The odor is exactly that of the mixture of sodium palmitate and oleate, which give to ordinary soap its odor.

V. CREMASTOGASTER LINEOLATA, VAR. CLARA.

The odor associated with this ant is one of the most unpleasant that we have encountered in the course of our work. At first the fresh ants have quite a strong odor strikingly similar to chlorine.

* We are thus enabled to repeat on a small scale in the animal kingdom, the physiological separation of species by olfactory means, a thing which has often been effected by botanists with plant species, more notably among the roses (cf. Kerner and Oliver, '95).

This soon passes away, leaving an after odor suggestive of the large shelf fungus (*Polyporus.*)

VI. PACHYCONDYLA HARPAX.

Here the odor is hardly distinguishable from the fungoid smell of *Cremastogaster,* although it is not evident until the ants have been crushed.

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OBSERVATION ON A PIED RAT.

BY HENRY L. WARD.

Somewhat over a year ago I made the following notes which although very fragmentary may have some interest to those giving attention to animal psychology. My intention at the time was to carry these observations farther and to that purpose I made some apparatus to test the rats' appreciation, if any, of the relationships between less obvious causes and effects, but a suddenly evinced fondness of the rat to nest in the mechanism of the piano created a domestic condition unfavorable to farther scientific inquiry and so the animal was given away and the experiments abruptly terminated.

NOTES MADE MARCH 12, 1905.

There lately came into my possession a tame pied rat; with head, neck and part of back dark reddish brown and the rest of the body and extremities white; eyes black. It is said, upon what authority I do not know, to be a Japanese breed. Its general appearance would indicate that it is a variety of the Black Rat, *Mus rattus*. When first taken to my home it had been in close confinement for some time and was very tame. It was put into a wire bird cage having a lift door sliding upon the vertical bars at either side; the door itself being made of similar vertical bars connected at the top and bottom by a strip of metal. For a week the rat has been kept in this cage with frequent taking out for handling by my children. Occasionally it has been allowed the liberty of the rooms for some hours and yesterday evening secreted itself and was not returned to the cage nor discovered until late this afternoon. It was noticed that this unusual amount of liberty had resulted in a considerable degree of wildness. The rat was not timid but did not wish to be confined. It was caught and returned to its cage where it drank, ate and cleaned its fur. After about a half hour's confinement I observed it turn its head so that its horizontal plane was vertical, seize one of the bars of the door in its teeth, raise it about an inch, drop it and place its nose at the bottom. It repeated this operation two or three times, then inserted its paws under the door when raised, let lose with its teeth, placed its nose under the bottom, raised the gate and came out.

It was allowed a few minutes liberty and was again placed in the cage at 5:44 when it spent a few moments cleaning its coat, then seized one of the bars as before except that it took hold of a bar on the side of the gate at which its body was. Upon lifting the gate the immovable wires interfered with its placing its paws under the gate. It released its hold, seized one of the bars near the center, raised the gate, apparently slipping and letting it fall, an action which was repeated two or three times before it raised it again, placed both feet under it, inserted its nose in the opening and escaped at 5:45.

After a few minutes I again placed it in the cage and it began eating a cube of sugar. I busied myself in an adjoining room and after some minutes heard the rat's teeth on the wire and within ten seconds saw it on the floor. Shortly afterwards I returned it to the cage placing the lump of sugar upon the floor outside and opened my watch. The rat turned around, seized one of the middle wires and as above described made its exit and seized the lump of sugar in 8 seconds.

The family returning, I questioned them as to whether they had known of the rat's previously escaping from the cage and was assured that it had not done so. To show them what it could do I confined it and we waited for a few moments while it drank and ate, then it turned its attention to the gate but instead of turning its head sideways and seizing one of the vertical bars as I expected it would do, it grasped the lower horizontal metal strip connecting them, raised the gate at one endeavor and came out. The children put it back a number of times and on each occasion it adopted this latter, more convenient and more certain method of accomplishing its object.

The sudden discovery of a means of release and the rapid improvement on this both in time and details seem worthy of note.

LIST OF LEPIDOPTERA OCCURRING IN MILWAUKEE COUNTY.

BY VALENTINE FERNEKES.

The present list is based on one previously published in the Bulletin of this society in 1900 by F. Rauterberg. Changes in nomenclature during the past few years have rendered the old list obsolete in form, and further studies have revealed the necessity of a considerable number of changes and emendations as well as the addition of numerous species not hitherto listed from this locality.

The nomenclature adopted by Dyar in his recent catalogue has been strictly followed with one or two exceptions, and the numbers there used are also added for convenience in reference.

SUPERFAMILY PAPILIONOIDEA.

PAPILIONIDÆ.

IPHIDICLES Hbn.

5 *ajax* Linn. Rare.

PAPILIO Linn.

11 *glaucus* Linn. Rare.
11*a* *turnus* Linn. Rare.
13 *troilus* Linn. 1 sp.
14 *thoas* Linn. Very Rare.
22 *polyxenes* Fabr. Very Common.

PIERIDÆ.

PONTIA Fabr.

37 *protodice* Bsdv. LeC. Very Common.
38*g* *virginiensis* Edw. Very Common.
40 *rapæ* Linn. Very Common.
40*a* *novangliæ* Scud. Rare.
40*b* *immaculata* S. & A. Rare.

NATHALIS Bsdv.

41 *iole* Bsdv. Very Rare.

ZERENE Hbn.

61 *cæsonia* Stoll. Common.
61*a* *rosa* McNeil. Rare.

EURYMUS Swain.

65 *eurytheme* Bsdv. Common.
65*a* *ariadne* Edw. Rare.
65*b* *eriphyle* Edw. Very Rare.
66 *philodice* Gdt. Very Common.

PYRISITA Butl.

81 *mexicana* Bsdv. 1 sp.

EUREMA Hbn.

85 *euterpe* Méné. Common.

NYMPHALIDÆ.

EUPTOIETA Dbld.

92 *claudia* Cram. Rare.

SPEYERIA Scudd.

95 *idalia* Dru. Rare.

ARGYNNIS Fabr.

99 *cybele* Fabr. Common.
100 *aphrodite* Fabr. Common.
100*a* *alcestis* Edw. Common.

BRENTHIS Hbn.

131 *myrina* Cram. Common.
141 *bellona* Fabr. Common.

EUPHYDRYAS Scud.

146 *phaeton* Dru. Very Rare.

CHARIDRYAS Scud.

185 *nycteis* D. & H. Common.

PHYCIODES Hbn.
189 *tharos* Drn. Common.

POLYGONIA Hbn.
205 *interrogationis* Fabr. Common.
205*a* *umbrosa*. Lintn. Common.
206 *comma* Harr. Common.
206*a* *dryas* Edw. Common.
214 *progne* Cram. Common.

EUGONIA Hbn.
215 *j-album* Bsdv. Rare.

EUVANESSA Scud.
217 *antiopa* Linn. Very Common.

AGLAIS Dalm.
218 *milberti* Gdt. Very Rare.

VANESSA Fabr.
219 *atalanta* Linn. Very Common.
220 *huntera* Fabr. Very Common.
221 *cardui* Linn. Very Common.

JUNONIA Hbn.
223 *cœnia* Hbn. Rare.

BASILARCHIA Scud.
236 *astyanax* Fab. Common.
237 *arthemis* Drn. Common.
237*a* *proserpina* Edw. Common.
239 *archippus* Cram. Common.
240 *floridensis* Strck. Common.

AGAPETIDÆ.

CERCYONIS Spey.
258 *alope* Fabr. Common.
258*a* *texana* Edw. Very Rare.
258*c* *nephele* Kirby. Rare.

CŒNONYMPHA Hbn.
285 *haydenii* Edw. Rare.

SATYRODES Scud.
288 *canthus* Linn. Common.

CISSIA Dbld.
299 *eurytus* Fabr. Very Common.

LYMNADIDÆ.

ANOSIA Hbn.
308 *plexippus* Linn. Very Common.
309 *berenice* Cram. Rare.

LIBYTHEIDÆ.

HYPATUS Hbn.
311 *bachmani* Kirt. Very Rare.
312 *carinenta* Cram. Very Rare.

RIODINIDÆ.

CALEPHELIS G. & R.
321 *borealis* G. & R. Rare.

LYCÆNIDÆ.

EUPSYCHE Scud.
330 *m-album* Bd. & LeC. Very Rare.

THECLA Fabr.
339 *acadica* Edw. Common.
347 *calanus* Hbn. Rare.

CHRYSOPHANUS Hbn.
393 *thoe* Bsdv. Very Common.

HEODES Dalm.
399 *hypophleas* Bsd. Very Common.

CYANIRIS Dalm.
440 *ladon* Cram. Common.
440*a* *lucia* Kirby. Common.
440*c* *violacea* Edw. Common.
440*f* *neglecta* Edw. Common.

EVERES Hbn.
442 *comyntas* Gdt. Common.

HEMIARGUS Hbn.
447 *hanno* Stoll. Very Rare.

LEPTOTES Scud.
452 *theonus* Luc. Rare.

HESPERIIDÆ.

AMBLYSCIRTES Scud.
463 *samoset* Scud. Common.

ANCYLOXYPHA Feld.
472 *numitor* Fabr. Common.

OARISMA Scud.
480 *powescheik* Parker. Common.

ATRYTONE Scud.
483 *zabulon* Bd. & Lec. Very Common.
484 *hobomok* Harr. Common.
484*a* *pocahontas* Scud. Common.

ERYNNIS Schrank.
487*e* *manitoba* Scud. Rare.

ANTHOMASTER.
504 *leonardus* Harr. Rare.

THYMELICUS Hbn.
519*a* *egeremet* Scud. Rare.
520 *mystic* Scud. Rare.
523 *cernes* Bd. & Lec. Common.

POLITES Scud.
526 *peckius* Kirby. Common.

EUPHYES Scud.
529 *vestris* Bd. Common.

LIMOCHROES Scud.
557 *manataaqua* Scud. Common.

EPARGYREUS Hbn.
584 *tityrus* Fabr. Common.

ACHLARUS.
591 *lycidas* S. & A. Common.

THORYBES Scud.
600 *mexicana* H. & S. Rare.
601 *pylades* Scud. Common.

THANAOS Bsdo.
618 *icelus* Lint. Rare.

HESPERIA Fabr.
642 *tessellata* Scud. Rare.

SUPERFAMILY SPHINGOIDEA.

SPHINGIDÆ.

HEMARIS Dalm.
653 *diffinis* Bsdv. Common.
653*a* *axillaris* G. & R. Common.
653*b* *tenuis* Grt. Common.
656 *thysbe* Fabr. Common.

DEILEPHILA Ochs.
670 *gallii* Rott. Rare.
671 *lineata* Fabr. Very Common.

ARGEUS Hbn.
674 *labruscæ* Linn. Very Rare.

PHOLUS Hbn.
678 *pandorus* Hbn. Rare.
679 *achemon* Dru. Common.

AMPELOPHAGA Brem & Grey.
681 *chærilus* Cram. Very Rare.
6o2 *myron* Cram. Common.

PHLEGETHONTIUS Hbn.
696 *quinquemaculata* Haw. Common.
697 *sexta* Johans.
699*a* *cingulata* Fabr.

SPHINX Linn.
700 *kalmiæ* S. & A. Very Rare.
701 *drupiferarum* S. & A. Rare.
703 *gordius* Stoll. Very Rare.
706 *chersis* Hbn. Common.
706*a* *libocedrus* Hy. Edw.

CERATOMIA Harr.
721 *amyntor* Hbn. Rare.
722 *undulosa* Walk. Common.

MARUMBA Moore.
728 *modesta* Harr. Rare.

SMERINTHUS Satr.
729 *jamaicensis* Dru. Rare.
730 *cerysii* Kirby. Common.
730*b* *ophthalmicus* Bsdv. Rare.

PAONIAS Hbn.
731 *excæcatus* S. & A. Common.
732 *myops* S. & A. Common.

CRESSONIA G. & R.
734 *juglandis* S. & A. Rare.

ARCTONOTUS Bsdv.
735 *lucidus* Bsdv. Rare.

SUPERFAMILY SATURNOIDEA.

SATURNIIDÆ.

PHILOSAMIA Grt.
736 *cynthia* Drn. Very Rare.

SAMIA Hbn.
739 *cecropia* Linn. Common.
740 *gloveri* Strck. Very Rare.

CALLOSAMIA Pack.
744 *promethia*. Drn. Very Common.

AGAPEMA N. & D.
746 *galbina* Clem. Rare.

TROPÆA Hbn.
747 *luna* Linn. Rare.
747*a* *dictynna* Walk. Very Rare

TELEA Hbn.
748 *polyphemus* Cram. Common.

AUTOMERIS Hbn.
753 *io* Farb. Rare.

HEMILEUCA Walk.
757 *maia* Dru. Common.
758 *nevadensis* Strck. Common.

CERATOCAMPIDÆ.

ANISOTA Hbn.
770 *virginiensis* Dru. Rare.
771 *rubicunda* Fabr. Common.

CITHERONIA Hbn.
776 *regalis* Fabr. Rare.

BASILONA Bsdv.
778 *imperialis* Dru. Very Rare.
778*a* *didyma* De B. Very Rare.

SUPERFAMILY BOMBYCOIDEA.

SYNTOMIDÆ.

SCEPSIS Walk.
787 *fulvicollis* Hbn. Common.

LYCOMORPHA Harr.
792 *pholus* Dru. Rare.

CTENUCHA Kirby.
798 *virginica* Charp. Rare.

LITHOSIIDÆ.

CRAMBIDIA Pack.
800 *pallida* Pack. Common.

LEXIS Wall.
806 *bicolor* Grt. Rare.

HYPOPREPIA Hbn.
807 *miniata* Kirby. Rare.
808 *fucosa* Hbn. Common.

CLEMENSIA Pack.
817 *albata* Pack. Rare.

ARCTIIDÆ.

EUBAPHE Hbn.
833 *immaculata* Reak. Very Rare.
834 *aurantiaca* Hbn. Common.
834*d* *quinaria* Grt. Rare.

UTETHEISA Hbn.
836 *bella* Linn. Common.
836*a* *hybrida* Butl. Rare.
837 *ornatrix* Linn. Rare.

HAPLOA Hbn.

840 *lecontei* Bsdv. Common.
840*c* *militaris* Harr. Common.
840*d* *harrisii* Dy. Common.
840*e* *smithii* Dy. Rare.
840*f* *vestalis* Pack. Common.
842 *contigua* Walk. Rare.

ESTIGMENE Hbn.

851 *acræa* Dru. Very Common.
854 *congrua* Walk. 1 sp.

HYPHANTRIA Harr.

855 *cunea* Dru. Common.

ISIA Walk.

859 *isabella* S. & A. Very Common.

PHRAGMATOBIA Steph.

860 *fuliginosa*. Common.

DIACRISIA Hbn.

862 *virginica* Fabr. Very Common.
863 *latipennis* Strck. Rare.

MÆNAS Hbn.

866 *vestalis* Pack. Rare.

APANTESIS Walk.

874 *virgo* Linn. Common.
875 *virguncula* Kirby. Common.
875*a* *otiosa* N. & D. Common.
879*a* *rectilinea* Frch. Common.
880 *anna* Grt. Common.
880*a* *persephone* Grt. Common.
882 *arge* Dru. Common.
894 *nais* Dru. Common.
895 *vittata* Fabr. Very Rare.
895*b* *phalerata* Harr. Common.

AMMALO Walk.

905 *tenera* Hbn. Common.

EUCHÆTIAS Lynn.

911 *oregonensis* Strch. Very Rare.

HALISIDOTA Hbn.

919 *tesselaris* S. & A. Common.
922 *maculata* Harr. Common.
922*b* *agassizii* Pack. Rare.
923 *caryæ* Harr. Rare.

AGARISTIDÆ.

ALYPIA Hbn.

949 *octomaculata* Hbn. Very Common.

COPIDRYAS Grt.

956 *gloveri* G. & R. Rare.

NOCTUIDÆ.

SUBFAMILY NOCTUINÆ.

PANTHEA.

960 *acronyctoides* Walk. Very Rare.

CHARADRA Walk.

964 *deridens* Gn. Rare.

RAPHIA Hbn.

968 *frater* Grt. Common.
970 *abrupta* Grt. Common.

APATELA Hbn.

972 *americana* Harr. Common.
975 *dactylina* Grt. Common.
983 *populi* Ril. Common.
984 *lepusculina* Gn. Common.
985 *innotata* Gn. Rare.
989 *betulæ* Riley. Common.
990 *morula* Grt. Common.
991 *interrupta* Gn. Common.
993 *lobeliæ* Gn. Common.
1002 *clarescens* Gn. 1 sp.
1003 *hamamelis* Gn. Common.
1004 *superans* Gn. Rare.
1005 *lithospila* Grt. Rare.
1009 *fragilis* Gn. Rare.
1018 *afflicta* Grt. Very Rare.
1026 *brumosa* Gn. Rare.
1028 *retardata* Walk. Common.
1041 *oblinita* S. & A. Common.

ARSILONCHE Led.

1049 *albovenosa* Goeze. Common.

HARRISIMEMNA Grt.

1053 *trisignata* Walk. Very Rare.

MICROCŒLIA Gu.

1054 *dipteroides* Gn. Rare.
1054*a* *obliterata* Grt. Rare.

JASPIDIA Hbn.

1055 *lepidula* Grt. Rare.
1059 *teratophora* H. & S. Rare.

CHYTONIX Grt.

1067 *palliatricula* Gn. Rare.

BAILEYA Grt.

1073 *ophthalmica* Gn. Common.
1075 *doubledayi* Gn. Rare.

CRAMBODES Gu.

1087 *talidiformis* Gn. Common.

BALSA.

1092 *malana* Fitch. Rare.

CARADRINA Ochs.

1109 *miranda* Grt. Common.

PERIGEA Gu.

1117 *vecors* Gn. Rare.
1119 *sutor* Gn. Very Rare.

OLIGIA Hbn.

1138 *versicolor* Grt. Very Rare.
1141 *grata* Hbn. 1 sp.

HADENA Schrank.

1152 *leucoscelis* Grt. Rare.
1158 *modica* Gn. Common.
1166 *mactata* Gn. Rare.
1205 *semicana* Walk. Common.
1205*a* *fractilinea* Grt. Common.
1210 *niveivenosa* Grt. Common.
1211 *stipata* Morr. Rare.
1212 *passer* Gn. Common.
1217 *remissa* Hbn. 1 Sp.
1219 *suffusca* Morr. Rare.
1220 *vultuosa* Grt. Common.
1221 *apamiformis* Gn. 1 Sp.
1224 *finitima* Gn. Rare.
1227 *dubitans* Walk. Common.
1231 *impulsa* Gn. Common.
1232 *devastatrix* Brace. Very Common.
1235 *arctica* Bsdv. Very Common.
1240 *cuculliformis* Grt. Common.
1241 *verbascoides* Gn. Common.
1243 *cariosa* Gn. Rare.
1244 *vulgaris* G. & R. Rare.
1250 *lignicolor* Gn. Common.

MACRONOCTUA Grt.

1255 *onusta* Grt. Common.

POLIA Hbn.

1268 *medialis* Grt. Rare.

HYPPA.

1278 *xylinoides* Gn. Common.

EUPLEXIA Steph.

1288 *lucipara* Linn. 1 sp.

TRACHEA Hbn.

1289 *delicata* Grt. Common.

DIPTERYGIA Steph.

1290 *scabriuscula* Linn. Rare.

ACTINOTIA Hbn.

1291 *ramosula* Gn. Very Rare.

PYROPHILA Hbn.

1295 *pyramidoides* Gn. Very Common.

HELIOTROPHA Led.

1297 *reniformis* Grt. Rare.
1297*a* *atra* Grt. Rare.

PRODENIA Gu.

1300 *ornithogalli* Gn. Common.
1300*a* *eudiopta* Gn. Common.

LAPHYGMA Gu.

1302 *frugiperda* S. & A. Common.
1302*a* *obscura* Riley. Common.

MAGUSA Walk.

1305 *dissidens* Feld. Rare.

HOMOHADENA Grt.

1312 *badistriga* Grt. Rare.

RHYNCHAGROTIS Smith.

1389 *gilvipennis* Grt. Very Rare.
1390 *rufipectus* Morr. Common.
1391 *brunneicollis* Grt. 1 sp.

1393 *anchocelioides* Gn. Common.
1395 *placida* Grt. Common.
1397 *alternata* Grt. Common.

ADELPHAGROTIS Smith.

1415 *prasina* Fabr. Common.

PLATAGROTIS Smith.

1418 *pressa* Grt. Rare.

EUERETAGROTIS Smith.

1422 *sigmoides* Gn. Common.
1423 *perattenta* Grt. Rare.

AGROTIS Ochs.

1451 *badinodes* Grt. Rare.
1454 *ypsilon Rott.* Very Common.

PERIDROMA Hbn.

1462 *occulta* Linn. Rare.
1467 *margaritosa* Haw. Common.
1467*a* *saucia* Hbn. Common.

NOCTUA Linn.

1475 *smithii* Snell. Common.
1476 *normaniana* Grt. Common.
1478 *bicarnea* Gn. Common.
1479 *treatii* Grt. Very Rare.
1481 *c-nigrum.* Very Common.
1484 *phyllophora* Grt. Rare.
1489 *fennica* Tausch. Common.
1490 *plecta* Linn. Common.
1493 *haruspica* Grt. Common.
1496 *clandestina* Harr. Common.
1511 *cynica* Smith. Very Rare.

RHIZAGROTIS Smith.

1532 *apicalis* Grt. Rare.

FELTIA Walk.

1538 *subgothica* Haw. Common.
1540 *jaculifera* Gn. Common.
1540*a* *herilis* Grt. Common.
1544 *gladiaria* Morr. Common.
1545 *venerabilis* Walk. Common.
1549 *volubilis* Harvey. Common.
1550 *annexa* Treitsch. Common.

POROSAGROTIS Smith.

1552 *vetusta* Walk. Common.
1553 *catenula* Grt. Common.
1556 *mimallonis* Grt. Common.
1558 *tripars* Walk. Common.
1559 *rileyana* Morr. Common.

PARAGROTIS Pratt.

1620 *scandens* Riley. Rare.
1623 *detersa* Walk. Rare.
1649 *messoria* Harr. Common.
1655 *fulda* Smith. 1 sp.
1707*a* *verticalis* Grt. Common.
1711 *tesselata* Harr. Common.
1737 *redimicula* Morr. Common.
1735 *lucindus* Bsdv. Rare.

FOCILLA.

sytis Gn. 1 sp. New to U. S.

ANYTUS Grt.

1753 *privatus* Walk. Common.

MAMESTRA Ochs.

1771 *discalis* Grt. Rare.
1773 *nimbosa* Gn. Rare.
1774 *imbrifera* Gn. Rare.
1781 *meditata* Grt. Rare.
1782 *lustralis* Grt. Common.
1783 *detracta* Walk. Rare.
1796 *subjuncta* G. & R. 1 sp.
1801 *trifolii* Rott. Rare.
1803 *rosea* Harv. Rare.
1807 *picta* Harr. Common.
1808 *cristifera* Walk. Common.
1810 *latex* Gn. Rare.
1812 *adjuncta* Bsdv. 1 sp.
1822 *ligitima* Grt. 1 sp.
1823 *lilacina* Harv. Rare.
1827 *obscura* Smith. Common.
1829 *renigera* Steph. Common.
1832 *olivacea* Morr. Common.
1832*c* *rectilinea* Smith. Rare.
1842 *lorea* Gn. Common.
1850 *vicina* Grt. Rare.

XYLOMIGES Gu.

1892 *simplex* Walk. Rare.

NEPHELODES Gu.

1950 *minians* Gn. Common.
1950*a* *violans* Gn. Common.

HELIOPHILA Hbn.

1953 *unipuncta* Haw. Very Common.
1954 *pseudargyria* Gn. Common.
1957 *luteopallens* Smith. Common.
1962 *rubripennis* G. & R. Very Rare.
1963 *albilinea* Hbn. Common.
1975 *insueta* Gn. Common.
1979 *commoides* Gn. Common.
1980 *phragmitidicola* Gn. Rare.

ORTHODES Gu.

1996 *crenulata* Butl. Rare.
1997 *cynica* Gn. Common.
1998 *vecors* Gn. 1 sp.

CROCIGRAPHA Grt.

2009 *normani* Grt. 1 sp.

GRAPHIPHORA Hbn.

2026 *peredia* Grt. Common.
2040 *alia* Gn. Common.
2043 *subterminata* Smith. Common.
2046 *planalis*. Very Rare.

STRETCHIA Hy. Edw.

2048 *plusiiformis* Hy. Edw. Rare.

TRICHOLITA Grt.

2060 *signata* Walk. Rare.

LITHOMOIA Hbn.

2077 *germana* Morr. Rare.

XYLINA Ochs.

2078 *disposita* Morr. 1 sp.
2090 *antennata* Walk. Rare.
2091 *laticinerea* Grt. Rare.
2092 *grotei* Riley. Rare.
2094 *signosa* Walk. 1 sp.
2095 *innominata* Smith. Rare.
2097 *bethunei* G. & R. Rare.
2100 *fagina* Morr. Rare.
2107 *tepida* Grt. Very Rare.
2108 *baileyi* Grt. 1 sp.
2112 *pexata* Grt. Very Rare.

CALOCAMPA Steph.

2118 *nupera* Lint. Rare.
2120 *cineritia* Grt. Rare.

CUCULLIA Schrank.

2122 *convexipennis* G. & R. Rare.
2127 *asteroides* Gn. Common.

BELLURA Walk.

2147 *gortynoides* Walk. Very Rare.
2148 · *diffusa* Grt. Rare.

SPHIDA Grt.

2149 *obliqua* Walk. Rare.

NONAGRIA Ochs.

2150 *permagna* Grt. Common.
2153 *subcarnea* Kell. Common.

ACHATODES Gu.

2158 *zeæ* Harr. Common.

GORTYNA Ochs.

2161 *velata* Walk. Common.
2162 *nictitans* Borkh. Common.

PAPAIPEMA Smith.

2173 *speciosissima* G. & R. Rare.
2178 *purpurifascia* G. &. R. Rare.
2179 *nitela* Gn. Common.
2179*a* *nebris* Gn. Common.
2187 *cataphracta* Grt. Common.
2190 *rutila* Gn. Rare.
2192 *marginidens* Gn. Rare.

PYRRHIA Hbn.

2197 *umbra* Hfn. Common.
2197*a* *exprimens* Walk. Common.

XANTHIA Hbn.

2199 *flavago* Fabr. Common.

JODIA Hbn.

2202 *rufago* Hbn. Common.

BROTOLOMIA Led.

2203 *iris* Gn. Common.

TRIGONOPHORA Hbn.

2204 *periculosa* Gn. Common.
2204*a* *v. brunneum* Grt. Rare.

EUCIRRŒDIA Grt.

2206 *pampina* Gn. Rare.

SCOLIOPTERYX.
2207 *libatrix* Linn. Common.

PSEUDOGLÆA Grt.
2210 *blanda* Grt. Rare.

ANCHOCELIS Gu.
2211 *digitalis* Grt. Rare.

COSMIA Ochs.
2217 *paleacea* Esp. Common.

ORTHOSIA Ochs.
2222 *bicolorago* Gn. Rare.
2222*a* *ferruginoides* Gn. Very Common.
2230 *helva* Grt. Common.
2231 *lutosa* And. Common.

PARASTICHTIS Hbn.
2235 *discivaria* Walk. Rare.

SCOPELOSOMA Curt.
2236 *indirecta* Grt. Common.
2240 *tristigmata* Grt. 1 sp.
2242 *sidus* Gn. 1 sp.
2243 *morrisonii* Grt. Common.
2244 *devia* Grt. Common.

GLÆA Hbn.
2247 *inulta* Grt. Common.
2249 *sericea* Morr. Very Rare.

HOMOGLÆA Morr.
2256 *hircina* Morr. Rare.

CALYMNIA.
2259 *orina* Gn. Common.

IPIMORPHA.
2261 *pleonectusa* Grt. Common.

CHLORIDEA West.
2296 *virescens* Fab. Rare.

HELIOTHIS Ochs.
2300 *obsoleta (armigera)* Hbn. Very Common.
2300*a* *umbrosa* Grt. Very Common.
2301 *phlogophaga* G. & R. Rare.
2301*a* *lutcitincta* Grt. Very Rare.
2302 *scutosa* Fabr. Rare.

RHODODIPSA Grt.
2312 *miniana* Grt. Rare.

PORRIMA Grt.
2320 *gloriosa* Strck. Very Rare.

SCHINIA Hbn.
2332 *trifascia* Hbn. Common.
2339 *nundina* Dru. Rare.
2351 *tertia* Grt. Common.
2354 *arcifera* Gn. 1 sp.
2361 *marginata* Haw. Common.
2362 *imperspicua* Strck. Rare.
2366 *atrites* Grt. Very Rare.

EUTHISANOTIA Hbn.
2429 *brevipennis* Strach. Common.
2430 *grata* Fabr. Rare.

PLUSIODONTA Gu.
2464 *compressipalpis* Gn. Rare.

PANCHRYSIA Hbn.
2469 *purpurigera* Walk. Rare.

PLUSIA.
2474 *œrea* Hbn. Common.
2475 *œroides* Grt. Rare.
2476 *balluca* Gey. Common.

EUCHALCIA Hbn.
2478 *contexta* Grt. Common.
2479*a* *putnami* Grt. Rare.
2480 *venusta* Walk. Very Rare.

EOSPHOROPTERYX Dy.
2481 *thyatiroides* Gn. Rare.

AUTOGRAPHA Hbn.
2485 *biloba* Steph. Rare.
2486 *verruca* Fabr. Rare.
2487 *rogationis* Gn. Common.
2488 *precationis* Gn. Very Common.
2493 *ou* Gn. Rare.
2496 *brassicæ* Riley. Common.
2498 *oxygramma* Gey. Rare.
2502 *octoscripta* Grt. Very Rare.
2505 *rectangula* Kirby. Very Rare.
2509 *sclecta* Walk. Rare.
2517 *ampla* Walk. Very Rare.
2519*a* *simplex* Gn. Very Common.

ABROSTOLA Ochs.
2536 *urentis* Gn. Rare.

OGDOCONTA Butl.
2540 *cinereola* Gn. Rare.

ALABAMA Grt.
2555 *argillacea* Hbn. Very Common.

ANOMIS Hbn.
2556 *erosa* Hbn. Rare.

AMOLITA Grt.
2567 *fessa* Grt. Common.

RIVULA Gu.
2568 *propinqualis* Gn. Common.

EUSTROTIA Hbn.
2601 *albidula* Gn. Common.
2604 *concinnimacula* Gn. Very Rare.
2605 *synochitis* G. & R. Very Rare.
2607 *muscoscula* Gn. Common.
2612 *apicosa* Haw. Common.
2613 *carneola* Gn. Very Common.

GALGULA Gu.
2618 *hepara* Gn. Rare.
2618*a* *partita* Gn. Common.

XANTHOPTERA Gu.
2631 *nigrofimbria* Gn. Rare.

CHAMYRIS Gu.
2656 *cerintha* Tr. Rare.

TARACHE Hbn.
2676 *crastrioides* Gn. Common.
2691 *candefacta* Hbn. Common.

METATHORASA Moore.
2714 *monitifera* Gn. Rare.

EUHERRICHIA Grt.
2716 *mollissima* Gn. Rare.

HYAMIA Walk.
2727 *sexpunctata* Grt. 1 sp.

HOMOPYRALIS Grt.
2734 *contracta* Walk. Rare.

SUBFAMILY CATOCALINÆ.

CISSURA Walk.
2743 *spadix* Cram. Rare.

DRASTERIA Hbn.
2754 *erechtea* Cram. Very Common.
2755 *crassiuscula* Haw. Common.

EUCLIDIA Ochs.
2760 *cuspidea* Hbn. Common.

MELIOPOTIS Hbn.
2767 *nigrescens* G. & R. Rare.
2769 *limbolaris* Gey. Very Rare.

CIRRHBOLINA Grt.
2778 *mexicana* Behr. Rare.

SYNEDA Gu.
2781 *graphica* Hbn. Common.

CATOCALA Schrank.
2813 *vidua* S. & A. 1 sp.
2819 *obscura* Strck. Common.
2820 *residua* Grt. Rare.
2821 *insolabilis* Gn.
2826 *relicta* Walk. Common.
2826*a* *bianca* Hy Edw. Rare.
2826*b* *phrynia* Hy Edw. Rare.
2827 *cara* Gn. Common.
2827*b* *carissima* Hulst. Common.
2828 *amatrix* Hnbn. Rare.
2829 *marmorata* Edw. Common.
2830 *concumbens* Walk. Common.
2848 *unijuga* Walk. Common.
2850 *meskei* Grt. Rare.
2851 *mariana* Hy Edw. Rare.
2854 *briseis* Edw. Common.
2857 *parta* Gn. Common.
2857*a* *perplexa* Strck. Common.
2857*b* *petulans* Hulst. Common.
2864 *ultronia* Hbn. Common.
2864*a* *celia* Hy Edw. Common.
2864*b* *mopsa* Hy Edw. Common.

2870 *neogama* S. & A. Very Rare.
2871 *subnata* Grt. 1 sp.
2872 *cerogama* Gn. Rare.
2873 *palæogama* Gn. Rare.
2882 *serena* Edw. Common.
2884 *antinympha* Hbn. Very Rare.
2887 *habilis* Grt. Common.
2892 *polygama* Gn. Rare.
2902 *grynea* Cram. Common.
2907 *amica* Hbn. Rare.
2907*a* *lineella* Grt. Common.

EUPARTHENOS Grt.
2911 *nubilis* Hbn. Common.

PANAPODA Gu.
2920*b* *roseicosta* Gn. Rare.

PARALLELIA Hbn.
2921 *bistriaris* Hbn. Rare.

REMIGIA Gu.
2923 *repanda* Fabr. Very Common.

POAPHILA Gu.
2928 *quadrifilaris* Hbn. Rare.

ANTICARSIA Hbn.
2948 *gemmatilis* Hbn. Rare.

ANTIBLEMMA Hbn.
2950 *inexacta* Walk. 1 sp.

ZALE Hbn.
2977 *horrida* Hbn. Rare.

YPSIA Gu.
2983 *undularis* Dru. 1 sp.

HOMOPTERA Bdv.
2986 *lunata* Dru. Very Common.
2986*a* *edusa* Dru. Very Common.
2991 *calycanthata* S. & A. Rare.
3000 *unilineata* Grt. Rare.

EREBUS Latr.
3006 *odora* Linn. Very Rare.

THYSANIA Dal.
3007 *zenobia* Cram. Very Rare.

SUBFAMILY HYPNINÆ.

EPIZEUXIS Hbn.
3008 *americalis* Gn. Common.
3009 *æmula* Hbn. Common.
3012 *lubricalis* Gey. Rare.
3016 *rotundalis* Walk. Common.

ZANCLOGNATHA Led.
3019 *lævigata* Grt. Common.
3019*a* *modestalis* Fitch. Common.
3019*b* *reversata* Dy. Common.
3019*c* *obsoleta* Smith. Common.
3024 *ochreipennis* Grt. Common.
3025 *marcidilinea* Grt. Rare.

HORMISA Walk.
3031 *absorptalis* Walk. Common.

PHILOMETRA Grt.
3036 *metonalis* Walk. Common.
3037 *eumelusalis* Walk. Common.

CHYTOLITA Grt.
3039 *morbidalis* Gn. Very Common.
3039*a* *petrealis* Grt. Common.

RENIA Gu.
3048 *flavipunctalis* Gey. Very Common.

BLEPTINA Gu.
3049 *caradrinalis* Gn. Common.

HETEROGRAMMA Gu.
3054 *pyramusalis* Walk. Common.

GABERASA Walk.
3055 *ambigualis* Walk. Common.

PALTHIS Hbn.
3058 *angulalis* Hbn. Common.

LOMANALTES Grt.
3063 *eductalis* Walk. Common.

BOMOLOCHA Hbn.

3065 *baltimoralis* Gn. Rare.
3066 *bijugalis* Walk. Rare.
3067 *scutellaris* Grt. Common.
3068 *abalinealis* Walk. 1 sp.
3070 *sordidula* Grt. Common.
3073 *deceptalis* Walk. Common.
3074 *edictalis* Walk. 1 sp.

PLATHYPENA Grt.

3079 *scabra* Fabr. Very Common.

HYPENA Schrank.

3080 *humuli* Harr. Rare.

NYCTEOLIDÆ.

NYCTEOLA Hbn.

3083*a* *lintnerana* Spey. Rare.

NOTODONTIDÆ.

MELALOPHA Hbn.

3092*a* *ornata* G. & R. Common.
3094 *inclusa* Hbn. Rare.
3094*a* *inversa* Pack. Rare.
3096 *albosigma* Fitch. Rare.

DATANA Walk.

3098 *ministra* Dru. Common.
3100 *angusi* G. & R. Rare.
3106 *perspicua* G. & R. Rare.
3108 *integerrima* G. & R. Common.
3110 *contracta* Walk. Common.

HYPERÆSCHRA Butl.

3111 *stragula* Grt. Rare.

PHEOSIA Hbn.

3118 *dimidiata* H-S. Rare.

LOPHODONTA Pack.

3121 *angulosa* S. & A. Rare.

NADATA Walk.

3123 *gibbosa* S. & A. Common.
3123*a* *doubledayi* Pack. Rare.
3123*b* *rubripennis* N. & A. Very Rare.

SYMMERISTA Hbn.

3125 *albifrons* S. & A. Com-

HETEROCAMPA Doub.

3137 *manteo* Doub. Common.
3140 *biundata* Walk. Very Rare.
3141 *guttivitta* Walk. Common.

IANASSA Walk.

3145 *lignicolor* Walk. Rare.

SCHIZURA Doub.

3148*b* *cinereofrons* Pack. Rare.
3149 *concinna* S. & A. Rare.
3150 *semirufescens* Walk. 1 sp.
3151 *unicornis* S. & A. Rare.

CERURA Schrank.

3160 *occidentalis* Lint. Rare.

HARPYIA Ochs.

3162 *cinerea* Walk. Common.

FENTONIA Butl.

3165 *marthesia* Cram. Rare.

GLUPHISIA.

3166 *septentrionalis* Walk. Common.
3166*a* *ridenda* Hy Edw. Common.

ELLIDA Grt.

3170 *caniplaga* Walk. Very Rare.

THYATIRIDÆ.

HABROSYNE Hbn.

3173 *scripta* Gosse. Rare.

PSEUDOTHYATIRA Grt.

3176 *cymatophoroides* Gn. Rare.
3177 *expultrix* Grt. Common.

LIPARIDÆ.

HEMEROCAMPA Dy.

3190 *leucostigma* S. & A. Very Common.
3192 *definita* Pack. Very Common.

LASIOCAMPIDÆ.

TOLYPE Hbn.

3208 *velleda* Stoll. Common.
3211 *laricis* Fitch. Rare.

MALACOSOMA Hbn.

3214 *americana* Fabr. Common.
3221 *disstria* Hbn. Common.

EPICNAPTERA Ramb.

3223 *americana* Harr. Com-
3223*a* *ferruginea* Pack. Common.

PLATYPTERYGIDÆ.

ORETA Walk.

3226 *rosea* Walk. Rare.
3226*a* *marginata* Walk. Rare.

DREPANA Walk.

3229 *arcuata* Walk. Very Rare.

FALCARIA How.

3231 *bilineata* Pack. Very Rare.

GEOMETRIDÆ.

SUBFAMILY DYSPTERIDINÆ.

DYSPTERIS Hbn.

3232 *abortivaria* H. & S. Rare.

SUBFAMILY HYDRIOMENINÆ.

PALEACRITA Riley.

3245 *vernata* Peck. Very Common.

ALSOPHILA Hbn.

3247 *pometaria* Harr. Rare.

EUDULE Hbn.

3248 *mendica* Walk. Very Common.
3251 *unicolor* Rob. Common.

TALLEDEGA Hulst.

3255 *montanata* Pack. Rare.

NANNIA Hulst.

3260 *refusata* Walk. Very Com-

HETEROPHLEPS H. S.

3262 *triguttaria* H-S. Very Common.

TEPHROCLYSTIS.

3271 *implicata* Walk. Very Rare.
3294 *absynthiata* Clerck. Common.

EUCYMATOGE Hbn.

3327 *intestinata* Gn. Common.

VENUSIA Curt.

3330 *duodecemlineata* Pack. Rare.
3331 *comptaria* Walk. Rare.

EUCHŒCA Hbn.

3332 *albovittata* Gn. Common.
3335 *lucata* Gn. Rare.
3336 *albifera* Walk. Very Common.

HYDRIA Hbn.

3340 *undulata* Linn. Common.

EUSTROMA Hbn.

3348 *diversilineata* Hbn. Common.
3349 *testata* Linn. Very Rare.
3352 *prunata* Linn. Very Rare.

RHEUMAPTERA Hbn.

3359 *hastata* Linn. Rare.
3361 *sociata* Bork. Common.

PERCNOPTILOTA Hulst.

3370 *fluviata* Hbn. Very Common.

MESOLEUCA Hbn.

3371 *ruficilliata* Gn. Common.
3374 *lacustrata* Gn. Very Common.
3375 *implicata* Gn. Rare.
3376 *intermediata* Gn. Common.
3383 *hersiliata* Gn. Rare.

HYDRIOMENA Hbn.

3388 *autumnalis* Ströh. Very Rare.
3401 *multiferata* Walk. Rare.
3402 *latirupta* Walk. Very Common.

TRIPHOSA Steph.

3416 *dubitata* Linn. Common.

CŒNOCALPE Hbn.

3418 *aurata* Grt. Rare.
3419 *magnoliata* Gn. Very Rare.
3426 *gibbocostata* Walk. 1 sp.
3431 *formosata* Strck. Common.

GYPSOCHROA Hbn.

3438 *designata* Hnfn. Common.

PETROPHORA Hbn.

3457 *ferrugata* Clerck. Common.

SUBFAMILY MONOTAXIINÆ.

HÆMATOPSIS Hbn.

3468 *grataria* Fabr. Very Common.

SUBFAMILY STERRHINÆ.

DEPTALIA Hulst.

3477 *insularia* Gn. Common.

COSYMBIA Hbn.

3480 *lumenaria* Hbn. Common.

SYNELYS Hulst.

3487 *ennucleata* Gn. Common.

CINGLIS Gu.

3497 *similaria* Walk. Common.

EOIS, Hbn.

3546 *inductata* Gn. Common.

SUBFAMILY GEOMETRINA.

CHLOROCHLAMYS Hulst.

3561 *chloroleucaria* Gn. 1 sp.

NEMORIA Hbn.

3563 *pistaceata* Gn. Rare.
3564 *subcroceata* Walk. Common.

EUCROSTIS Hbn.

3568 *incertata* Walk. Rare.

APLODES Gu.

3587 *mimosaria* Gn. Rare.

SUBFAMILY ENNOMINÆ.

ORTHOFIDONIA Pack.

3605 *exornata* Walk. Rare.
3608 *vestaliata* Gn. Common.

PSYSOSTEGANIA Warren.

3618 *pustularia* Gn. Rare.

GUENERIA Pack.

3619 *basiaria* Walk. Common.

DEILINIA Hbn.

3623 *variolaria* Gn. Common.

SCIAGRAPHIA Hulst.

3651 *heliothidata* Gn. Com-
3653 *respersata* Hulst. Rare.
3662 *continuata* Walk. Rare.
3664 *mellistrigata* Grt. Common.

PHILOBIA Dupon.

3667 *enotata* Gn. 1 sp.

MACARIA Curt.

3678 *prætomatia* Harvey. Rare.
3682 *septemfluaria* Grt. Common.
3683 *glomeraria* Grt. 1 sp.

CYMATOPHORA Hbn.

3690 *ribearia* Fitch. Common.
3703 *inceptaria* Walk. 1 sp.
3704 *evagaria* Hulst. Common.

3705 *subcessaria* Walk. Common.
3708 *wauaria* Linn. Rare.

HOMOCHLODES Hulst.
3748 *fritillaria* Gn. Common.

APÆCASIA Hulst.
3755 *defluata* Walk. Rare.

NEPYTIA Hulst.
3780 *semiclusaria* Walk. Common.

ALCIS Curt.
3786 *dislocaria* Pack. 1 sp.

PARAPHIA Gu.
3803 *subatomaria* Wood. Rare.
3803*a* *unipuncta* Haw. 1 sp.

CLEORA Curt.
3850 *pampinaria* Gn. Common.
3855 *larvaria* Gn. Rare.

MELANOLOPHIA Hulst.
3858 *canadaria* Gn. Common.

ÆTHALOPTERA Hulst.
3859 *intextata* Walk. Rare.

ECTROPIS Hbn.
3862 *crepuscularia* D. & S. Very Common.

LYCIA Hbn.
3865 *ursaria* Walk. Rare.
3867 *cognataria* Gn. Common.

PHÆOURA Hulst.
3868 *mexicanaria* Grt. Rare.

NACOPHORA Hulst.
3873 *quernaria* S. & A. Rare.

PHIGALIA Dup.
3881 *titea* Cram. 1 sp.

ERANNIS Hbn.
3884 *tiliaria* Harr. Very Common.

CINGILIA Walk.
3886 *catenaria* Dru. Common.

NEOTERPES Hulst.
3901 *edwardsata* Pack. Very Rare.

SICYA Gu.
3902 *macularia* Harr. 1 sp.

THERINA Hbn.
3907 *pellucidaria* G. & R. Common.

METROCAMPA Latr.
3913 *praygrandaria* Gn. Rare.

EUGONOBAPTA Warren.
3916 *nivosaria* Gn. Very Common.

ENNOMOS Tr.
3922 *subsignarius* Hbn. Rare.
3923 *magnarius* Gn. Common.

XANTHOTYPE Warr.
3925 *crocataria* Fabr. Very Common.

PLAGODIS Hbn.
3927 *scrinaria* H-S. Rare.
3928 *keutzingi* Grt. Very Rare.
3930 *alcoolaria* Gn. Common.

HYPERITIS Gu.
3934 *amicaria* H. S. Common.
3934*a* *alienaria* H. S. Common.

ANIA Steph.
3939 *limbata* Haw. Common.
3939*a* *expunctaria* Grt. Rare.

GONODONTIS Hbn.
3941 *hypochraria* H. S. Rare.
3944 *duaria* Gn. Common.

EUCHLÆNA Hbn.
3954 *serrata* Dru. Rare.
3960 *johnsonaria* Fitch. Rare.
3963 *astylusaria* Walk. Common.
3965 *pectinaria* D. & S. Rare.

METANEMA Gu.
3981 *inatomaria* Gn. Common.
3982 *determinata* Walk. Common.
3986 *quercivoraria* Gn. Common.

PRIOCYCLA Gu.
3990 *armantaria* H. & S. Rare.

AZELINA Gn.
4001 *ancetaria* Hbn. Rare.

CABERODES Gu.
4007 *confusaria* Hbn. Common.
4007*a* *metrocamparia* Gn. Common.

TETRACIS Gu.
4011 *crocallata* Gn. Common.

SABULODES.
4016 *lorata* Grt. Common.
4026 *transversata* Dru. Common.

ABBOTANA Hulst.
4028 *clemataria* S. & A. Very Rare.

SUBFAMILY SPHÆCELODINÆ.

SPHÆCELODES Gu.
4033 *vulneraria* Hbn. Very Rare.

SUBFAMILY MELANCHROIINÆ.

MELANCHROIA Hbn.
4035 *cephise* Cram. Very Rare.

EPIPLEMIDÆ.

CALLEDAPTERYX Grt.
4044 *dryopterata* Grt. Very Rare.

SUPERFAMILY TINEOIDEA.

NOLIDÆ.

RŒSELIA Hbn.
4055 *minuscula* Zell. 1 sp.
4056 *fuscula* Grt. Common.

LACOSOMIDÆ.

CICINNUS Blanch.
4059 *melsheimeri* Harr. Rare.

COCHLIDIIDÆ.

ADONETA Clem.
4085 *spinuloides* H. S. Rare.

LITHACODES Pack.
4097 *fasciola* H. S. Rare.

PACKARDIA G. & R.
4100*a* *ocellata* Grt. Very Rare.

TORTRICIDIA Pack.
4106 *testacea* Pack. Rare.

COSSIDÆ.

PRIONOXYSTUS Grt.
4147 *robiniæ* Peck. Common.

SESSIDÆ.

SESIA Fabr.
4208 *tipuliformis* Clck. Common.
4221 *ascerni* Clem. Very Common.

PYRALIDÆ.

SUBFAMILY PYRAUSTINÆ.

DESMIA Westw.
4277 *funeralis* Hbn. Common.

PILOCROCIS Led.
4291 *ramentalis* Led. Rare.

BLEPHAROMASTIX Led.
4302 *ranalis* Gn. 1 sp.
4304 *stenialis* Gn. 1 sp.

PANTOGRAPHA Led.
4307 *limata* G. & R. Common.

DIAPHANIA Hbn.
4321 *quadristigmalis* Gn. Common.

EVERGESTIS Hbn.
4336 *straminalis* Hbn. Common.

CROCIDOPHORA Led.

4337 *serratissimalis* Zell. Common.
4339 *tuberculalis* Led. Rare.

NOMOPHILA Hbn.

4342 *noctuella* D. & S. Very Common.

PACHYZANCLA Meyr.

4344 *bipunctalis* Fab. Very Rare.

LOXOSTEGE Hbn.

4346 *coloradensis* G. & R. Rare.
4347 *chortalis* Grt. Rare.
4349 *obliteralis* Walk. Common.
4350 *mancalis* Led. 1 sp.
4354 *similalis* Gn. 1 sp.
4358 *sticticalis* Linn. Common.

THOLERIA Hbn.

4386 *reversalis* Gn. Rare.

PHLYCTÆNIA Hbn.

4401 *ferrugalis* Hbn. Common.
4409 *acutella* Walk. Common.
4410 *terrealis* Tr. Common.
4411 *extricalis* Gn. Common.
4413 *tertialis* Gn. Common.

CINDAPHIA Led.

4414 *bicoloralis* Gn. Common.

EPICORSIA Hbn.

4415 *mellinalis* Hbn. Rare.

PYRAUSTA Schrank.

4417 *pertexalis* Led. Common.
4419 *æglealis* Walk. 1 sp.
4420 *thestealis* Walk. Very Common.
4421 *theseusalis* Walk. Very Common.
4426 *orphisalis* Walk. Common.
4436 *fumalis* Gn. Rare.
4437 *illibalis* Hbn. Rare.
4439 *penitalis* Grt. Common.
4441 *futilalis* Led. Very Rare.
4442 *fumoferalis* Hulst. 1 sp.
4443 *unifascialis* Pack. Common.
4445 *fodinalis* Led. Rare.
4452 *tatalis* Grt. Rare.
4461-1 *signatalis* Walk. Common.
4472 *funebris* Ström. Common.

SUBFAMILY NYMPHULINÆ.

NYMPHULA Schrank.

4487 *icciusalis* Walk. Common.
4489 *gyralis* Hulst. Rare.
4490 *ekthlipsis* Grt. Common.
4491 *allioncalis* Walk. Common.
4492 *badiusalis* Walke. Common.
4493 *obscuralis* Grt. Common.
4495 *maculalis* Clem. Rare.
4496 *obliteralis* Walk. Common.

ELOPHILA Hbn.

4499 *bifascialis* Rob. Very Common.
4500 *fulicalis* Clem. Very Common.

DIATHRAUSTA.

4503 *reconditalis* Walk. Rare.

SUBFAMILY SCOPARIINÆ.

SCOPARIA.

4507 *basalis* Walk. Common.
4510 *centuriella* D. & S. Common.

SUBFAMILY PYRALINÆ.

HYPSOPYGIA Hbn.

4513 *costalis* Fabr. Common.

PYRALIS Linn.

4516 *farinalis* Linn. Very Common.

HERCULIA Walk.

4520 *intermedialis* Walk. Rare.
4521 *olinalis* Gn. Common.
4523 *himonialis* Zell. Common.

SUBFAMILY SCHŒNOBINÆ.

SCHŒNOBIUS Dupon.

4543 *unipunctellus* Rob. Rare.
4545 *melinellus* Clem. Rare.
4545*b* *albicostellus* Fern. Common.
4546 *clemensellus* Rob. Common.
4547 *forficellus* Thunberg. Common.

SUBFAMILY CRAMBINÆ.

CRAMBUS, Fabr.

4558 *hastiferellus* Walk. Common.
4560 *hamellus* Thun. Common.
4564 *girardellus* Clem. Common.
4565 *leachellus* Zinck. Common.
4566 *unistriatellus* Pack. Common.
4567 *præfectellus* Zinck. Rare.
4573 *laqueatellus* Clem. Common.
4574 *alboclavellus* Zell. Very Common.
4575 *agitatellus* Clem. Very Common.
4577 *albellus* Clem. Very Common.
4579 *hortuellus* Hbn. Rare.
4580 *perlellus* Scop. Common.
4581 *turbatellus* Walk. Rare.
4585 *vulvivagellus* Clem. Very Common.
4587 *ruricolellus* Zell. Very Common.
4601 *mutabilis* Clem. Very Common.
4604 *trisectus* Walk. Rare.
4607 *caliginosellus* Clem. Rare.
4608 *zeëllus* Fern. Rare.

THAUMATOPSIS Morr.

4612 *pexella* Zell. Common.

ARGYRIA Hbn.

4620 *nivalis* Dru. Common.
4622 *auratella* Clem. Common.

DIATRÆA Guild.

4624 *saccharalis* Fab. Rare.

SUBFAMILY EPIPASCHIINÆ.

EPIPASCHIA Clem.

4637 *superatalis* Clem. Rare.

BENTA Walk.

4648 *asperatella* Clem. Rare.

SUBFAMILY PHYCITINÆ.

ACROBASIS Zell.

4692 *rubrifasciella* Pack. Common.
4695 *hebescella* Hulst. Rare.

MEROPTERA Grt.

4746 *pravella* Grt. Common.

SALEBRIA Zell.

4756 *lævigatella* Hulst. Common.

LAODAMIA Rag.

4776 *fusca* Haw. Common.

LÆTILIA Rag.

4842 *coccidivora* Comst. Rare.

HULSTEA Rag.

4849 *undulatella* Clem. Rare.

HOMŒOSOMA Curt.

4865 *electellum* Hulst. Rare.

SUBFAMILY ANERASTINÆ.

SALURIA Rag.

4905 *tetradella* Zell. Common.

PEORIA Rag.

4911 *approximella* Walk. Common.

PTEROPHORIDÆ.

OXYPTILUS Zell.

4932 *periscelidactylus* Fitch. Common.
4934 *ningoris* Wals. 1 sp.
4935 *tenuidactylus* Fitch. Rare.

PLATYPTILIA Hbn.

4941 *carduidactyla* Ril. Rare.
4944 *fragilis* Wals. Common.

PTEROPHORUS Geof.

4962 *homodactylus* Walk. Common.
4964 *elliottii* Fern. Common.
4973 *paleaccus* Zell. Common.
4981 *monodactylus* Linn. Common.

TORTRICIDÆ.

SUBFAMILY OLETHREUTINÆ.

EXARTEMA Clem.

5015 *permundanum* Clem. Common.
5019 *punctanum* Wals. 1 sp.
5021 *fasciatanum* Clem. Common.
5023 *exoletum* Zell. Common.

OLETHREUTES Hbn.

5031 *nimbatana* Clem. Common.
5034 *dimidiana* Sod. Common.
5047 *chionosema* Zell. Common.
5056 *coruscana* Clem. Common.
5071 *bipartitana* Clem. Common.

EUCOSMA Hbn.

5090 *albiguttana* Zell. Rare.
5101 *gigantcana* Ril. 2 sp.
5104 *fulminana* Wals. 1 sp.
5106 *bipunctella* Walk. 1 sp.
5115 *canana* Wals. 1 sp.
5129 *strenuana* Walk. 1 sp.
5139 *scudderiana* Clem. Common.
5140-1 *obfuscana* Cleni. Rare.
5142 *otiosana* Clem. Common.
5144 *dorsisignatana* Clem. Common.

THIODIA Hbn.

5165 *formosana* Clem. Rare.
5177 *striatana* Clem. Rare.

PROTEOPTERYX Wals.

5213 *deludana* Clem. Common.
5214 *spotiana* Clem. Very Common.
5217 *costomaculana* Clem. Rare.

PROTEOTERAS Ril.

5219 *æsculanum* Ril. Common.

HEMIMENE Hbn.

5289 *simulana* Clem. 1 sp.

MELISSOPUS Ril.

5295 *latiferreanus* Wals. 1 sp.

CYDIA Hbn.

5296 *pomonella* Linn. Common.

SUBFAMILY TORTRICINÆ.

ALCERIS Hbn.

5309 *hastiana* Linn. Common.

EPAGOGE Hbn.

5331 *sulfurcana* Clem. Rare.

CENOPIS Zell.

5335 *reticulatana* Clem. Common.
5336 *pettitana* Rob. Rare.
5339 *groteiana* Fern. 1 sp.

CŒLOSTATHMA Clem.

5344 *discopunctana* Clem. Very Rare.

SPARGANOTHIS Hbn.

5349 *xanthoides* Walk. Rare.

ARCHIPS Hbn.

5356 *rosaceana* Harr. Common.
5357 *purpurana* Clem. Common.

5362 *paralella* Rob. Common.
5365 *argyrospila* Walk. Rare.
5368 *fervidana* Clem. Common.
5375 *virescana* Clem. Common.
5377 *clemensiana* Fern. Common.
5380 *melaleucana* Walk. Common.

PLATYNOTA Clem.
5387 *sentana* Clem. Rare.

TORTRIX Linn.
5401 *bergmanniana* Linn. Rare.
5404 *fucana* Wals. Common.
5406 *fumiferana* Clem. 2 sp.

EULIA Hbn.
5418 *ministrana* Linn. Rare.

AMORBIA Clem.
5429 *humerosana* Clem. Rare.

GELECHIIDÆ.

GNORIMOSCHEMA Busck.
5620 *gallæsolidaginis* Riley. Common.

TRICHOTAPHE Clem.
5655 *flavocostella* Clem. 1 sp.
5664 *setosella* Clem. 1 sp.

GELECHIA Hbn.
5744 *discoocellella* Chamb. 1 sp.

XYLORICTIDÆ.

STENOMA Zell.
5834 *schlægeri* Zell. Rare.

ŒCOPHORIDÆ.

MACHIMIA Clem.
5853 *tentoriferella* Clem. Rare.

DEPRESSARIA How.
5854 *atrodorsella* Clem. 1 sp.
5858 *pulvipennella* Clem. 1 sp.
5889 *heracliana* De Geer. 1 sp.

SEMIOSCOPSIS Hbn.
merricella Dy. Very Rare.

ETHMIA Hbn.
5907 *semilugens* Zell. Very Common.
5912 *longimaculella* Chamb. Common.
5913 *zelleriella* Chamb. Rare.

BLASTOBASIDÆ.

HOLOCERA Clem.
5979 *glandulella* Clem. 1 sp.

ELACHISTIDÆ.

SCYTHRIS Hbn.
6107 *basilaris* Zell. 1 sp.

TINEIDÆ.

ARGYRESTHIA Hbn.
6455 *andereggiella* Dup. Rare.

XYLESTIA Clem.
6476 *pruniramiella* Clem. 1 sp.

TINEA Linn.
6515 *misella* Zell. 1 sp.

IN MEMORIAM.

ADOLPH MEINECKE.

Mr. Adolph Meinecke, the subject of this sketch, was born on August 16, 1830, in Burhave, Grand Duchy of Oldenburg, on the German Sea. His father, Dr. Ferdinand Meinecke, was a physician and a man of liberal culture, who had traveled widely and who frequently entertained visitors from foreign lands, the recipients of his hospitality being often scientific men of high reputation. Brought up amid such surroundings there was aroused in the boy an interest in travel, and an enthusiasm for science and art. The love for the higher things of life, which ever remained a part of his character, probably had its beginnings in these early influences.

When very young he attended the village school, but in his thirteenth year he entered the Gymnasium at Oldenburg. Later, we find him taking a business course at the Commercial College of Osnabruck, Westphalia. Even at this early date, the English language was taught in the business colleges of Germany. At the age of seventeen the boy was working in the office of a ship chandler, but he was now pondering upon his future career and before his next birthday he left Germany for America, beginning life in his new home in 1847, with twenty six dollars in his pocket. For the ensuing year he earned two dollars a week, and thereafter, for some time, three dollars a week, in an importing house; and in 1851 he was left in entire charge of the business, when the owner went abroad, at the munificent salary of four dollars a week.

In 1854 he was married to Miss Maria Louise Kraft of New York, and in 1855 they moved to Milwaukee. Mr. Meinecke, after looking over the field, decided to engage in the toy business. His former employer gave practical proof of his confidence by lending him $6,000 with which to lay the foundations of his enterprise. From being confined to a small retail store on East Water St. his business gradually increased until it occupied an entire block and, in time, it became a large wholesale importing house. As early as 1864 he began the manufacture of willow baskets and bamboo furniture. The supply of material in this state being limited, it became necessary for him to introduce the growing of willows by the farmers and it was through him that the manufacture of willow ware became common throughout Wisconsin.

From 1854 until 1893 he was occupied with the active affairs of business life. When ill health compelled him to retire he was succeeded by his eldest son, Ferdinand Meinecke.

However greatly Mr. Meinecke may have contributed to the commercial activity of the state, a still greater claim to our respect is found in his warm interest in the more ideal side of the life of our city, as shown by his active interest in its educational institutions. He was one of the foremost in establishing, maintaining and developing the Englemann museum, which subsequently became the foundation of the Milwaukee Public Museum; and after this transfer had been made he was one of the most intelligent and devoted members of the Board of Trustees. His interest, moreover, was not limited to attendance at the meetings of the Board since the list of his various donations to the Museum is a long one. His hatred of cruelty and injustice led him to participate in the work of the Humane Society which he served for some time as Vice-President. His lively interest in Natural History brought him into this Society and he was for many years a constant attendant at its meetings.

It is in men like Mr. Meinecke, who are surrounded by the solid and tangible rewards of industry and practical power, but who, looking over and beyond these, are mindful of the broader aspects of life upon which real progress depends, that the community finds its surest hope for the days to come.

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Vogel, Fred. Jr.	583 Cass St.
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Vol. 2, No. 3, "Spiders of the Homalattus Group of the Family Attidæ," G. W. & E. G. Peckham, Dec., 1895.

Vol. 3, "Spiders of the Family Attidæ from Central America and Mexico," G. W. & E. G. Peckham, April, 1896.

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This publication is now issued by the Wisconsin Archeological Society.

Vol. 4. (NEW SERIES) JULY, 1906. No. 3

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

CONTENTS.

MILWAUKEE, WISCONSIN.

THE EDW. KEOGH PRESS, MILWAUKEE.

The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6, 1857.

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Henry L. Ward, Vice-President.....Public Museum, Milwaukee.
Charles T. Brues, General Secretary.....Public Museum, Milwaukee.
William Finger, Treasurer.....297 12th Street, Milwaukee.
Dr. Sigmund Graenicher.....551 7th Street, Milwaukee.

PUBLISHING COMMITTEE.

Henry L. Ward, Geo. W. Peckham,
Chas. E. Monroe.

REGULAR MEETINGS.

These are all held on the last Thursday of each month, except July and August, in the lecture room in the Museum-Library Building, Milwaukee.

PUBLICATION.

The "Bulletin of the Wisconsin Natural History Society."

MEMBERSHIP DUES.

City Members, $3.00 per annum; Non-resident Members, $2.00 per annum; Life Members, one payment of fifty dollars.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 4, New Series. **JULY, 1906.** **No. 3.**

PROCEEDINGS.

April 26, 1906.

Regular monthly meeting of the society and annual meeting.

President Teller in the chair and about 75 persons present.

Owing to the considerable amount of business to be transacted, the lecture of the evening was given before the business meeting.

Mr. H. L. Ward spoke on "Some Factors in Bird Study," a popular exposition of some of the underlying principles of ornithology.

The speaker referred first to the peculiarities of ancient birds, referring to the Archæopteryx, or earliest known bird, found fossil in the rocks of the Jurassic period. It had a long cat-like tail, teeth, and three separate fingers ending in claws. Another fossil bird, the Hesperornis, from the Tertiary rocks, more like modern forms, with shortened tail and teeth was also described.

Among modern birds the difference in development and condition at birth were shown in relation to the habits of different birds. The evolution of different parts of the body, such as feathers, bills, and feet, as adapted to environment, and the formation of sub-species by climate revealed the constant changes brought about by adaptation to different sorts of surroundings.

Especially interesting is the question of protective coloration of eggs and the birds themselves, whereby they escape their enemies on account of being colored like surrounding objects. In this connection the bright colors of males of some species in which the females are of inconspicuous appearance was mentioned as was also the varying coloration at different ages and seasons.

Special adornments of birds, particularly during the breeding season, were described, and the speaker made an appeal against the barbarity of using these for hat ornaments and otherwise.

The lecture was illustrated by colored steropticon views of the specimens referred to. It closed with a consideration of the nests and nesting habits of birds.

The business meeting followed after five minutes' intermission.

The minutes of the last monthly meeting were read and approved.

Mr. Ward read a letter from the Archeological Society asking if the Natural History Society would be willing to transfer volumes I and II of the Wisconsin Archeologist to them, as they now publish this journal.

Mr. Ward was asked by the chair to see what arrangement could be made with the Archeological Society.

Mr. Otto J. Habbegger was proposed for membership and elected by the Board of Directors.

The Treasurer's report was read by the Secretary and accepted.

Mr. C. L. Mann renominated the present incumbents in office to serve in their respective positions for the ensuing year. Seconded.

Mr. Finger requested that another name be substituted for his as Treasurer, and Mr. Thal was nominated. Mr. Ward suggested that this would be placing the society in too close connection with the museum, as two members of the Board of Directors were at present on the staff of the Public Museum. After some discussion and persuasion Mr. Finger consented to serve, and all were unanimously elected as follows:

President, Mr. E. E. Teller.
Vice-President, Mr. H. L. Ward.
Treasurer, Mr. Wm. Finger.
Secretary, Mr. C. T. Brues.
Member of Board of Directors, Dr. S. Graenicher.

The Secretary reported that the first number of the Bulletin for 1906 was ready to go to press and complained of the difficulty of obtaining articles sufficient to keep the Bulletin filled.

There being no further business the meeting adjourned.

Milwaukee, May 30, 1906.

Regular monthly meeting of the society.

President Teller in the chair.

The mnutes of the April meeting were read and approved.

Mr. Ward reported that he had not yet heard regarding the proposed transfer of the Wisconsin Archeologist to the Archeological Society.

The Secretary reported that the April number of the Bulletin was in the hands of the printer and would be ready for distribution within a few days.

There being no further business, Prof. I. N. Mitchell spoke on "Birds and Their Values." The speaker referred especially to the value of birds in destroying noxious insects. His talk was illustrated by a number of lantern slides of the species mentioned.

Dr. S. Graenicher then spoke on "The Economic Importance of Insects as Cross-fertilizers of Flowers." He referred to the great value of insects to fruit growers, on account of their necessary presence to secure pollination of fruit trees. He also described the introduction of Red Clover into New Zealand and the subsequent introduction of European bumble bees as fertilizers of the clover. He outlined briefly the factors necessary to be considered in selecting a suitable species of bee.

Mr. H. L. Ward followed with an account of the organization of the "Association of American Museums." He outlined the origin and hopes of the new association which he said was primarily intended to facilitate the exchange of ideas between museum men for mutual benefit. He referred also to the great changes recently inaugurated in museums all tending to make the museum an institution of greater value to those not especially interested in scientific subjects.

The meeting then adjourned.

June 28, 1906.

Regular monthly meeting of the Society.

In the absence of President Teller, Vice-President Ward presided.

Mr. Doerflinger called the attention of the society to the fact that the 6th of May, 1907, would be the fiftieth anniversary of the founding of the society, and suggested that some suitable celebration be planned. The matter was referred to the Executive Committee.

There being no further business, Mr. C. T. Brues, of the Public Museum, spoke on "The Wingless Condition of Certain Insects in Relation to Current Theories of Evolution and Variation." The speaker reviewed briefly the conceptions of variation and mutation and their relation to the origin of new species. He outlined the causes generally accepted to account for the origin of variations. The condition of the wings in a number of subapterous genera of beetles was described and the possibility of applying the theory of mutation to them. The correlation between the wing-length in subapterous species and climate was also mentioned.

Dr. Graenicher asked the society for expressions of opinion as to the effects of introducing squirrels into city parks on the nesting of song birds in these places. Considerable discussion followed by various members.

The meeting then adjourned.

NOTES ON WISCONSIN MOLLUSCA.

BY GEORGE H. CHADWICK.

During the summer of 1902, the writer was engaged in rearranging the shell collections of the Milwaukee Public Museum. With the encouragement of the custodian (now the director) of the museum and the active assistance of the members of the Wisconsin Natural History Society, an effort was made to commence a collection of the shells of Wisconsin. The greater part of the local collecting was carried on outside of working hours, in company with Mr. Charles E. Brown of the museum staff, and numerous accessions were received from other members and friends who became interested in the work. Many of these voluntary contributors brought specimens from distant or out-of-the-way points reached on business or pleasure trips, thus materially extending our knowledge of the distribution of the species. These localities and contributors are specified beyond. The results of this ten weeks' occasional collecting, in a season not the most favorable for shell-hunting, are summarized in the present paper. It is hoped that they may be the beginning of a complete census of the Wisconsin mollusca.

The names of those who added, often most generously and unremittingly, to the growth of this collection are these, the numeral following each indicating the total number of accessions by species credited to that name:

Charles E. Brown	306	Benno Meyer	1
Ernest Bruncken	22	Chas. E. Monroe	43
William H. Ellsworth	9	Henry Nesbitt	38
G. H. Chadwick	153	William Orth	3
William Finger	8	H. Rossebo	5
Valentine Fernekes	31	Mr. Selle	11
G. Friend	5	E. E. Teller	6
Dr. S. Graenicher	23	Miss Alice Ward	1
Henry P. Hamilton	8	Philip Wells	44
Simon Heller	2	Miss Olive C. Wheeler	21
H. A. Kirchner	1	Lee R. Whitney	6
Adolph F. Laue	4	Mrs. E. C. Wiswall (exchange)	3
Hon. Publius V. Lawson	10		
Hugo Lutz	1		

The figures given in this list are open to some correction, especially since, when collectors collaborated, the full tally of

species jointly obtained has been credited separately to each. A grateful acknowledgment is due to all the above named, and to some others, but especially to Miss Wheeler, Dr. Graenicher, Mr. Fernekes, Mr. Bruncken, Mr. Wells and Mr. Monroe. Above all, the untiring efforts of Mr. Brown and the kindly interest of Mr. Henry L. Ward, director of the museum, have made the undertaking successful.

In our tramps around the City of Milwaukee, which was the only area explored at all thoroughly, the following were the favorite collecting grounds—the Menomonee valley, and its slopes, westward from the Wells street viaduct to Wauwatosa; the valley of the Milwaukee river, from Coney Island to and above Lindwurm; the lake bluffs at Whitefish Bay and southward; the shore of Lake Michigan northward from the pumping stations; the Menomonee marshes below Mitchell park; and Johnson's woods, west of the Soldiers' Home.

A single expedition along the valley of Mud Creek yielded abundant returns, especially *Sphæriidæ*, while the Kinnickinnic, Honey Creek, the city parks and greenhouses, and the woods south and southwest of the city proved good soil, worthy of further cultivation.

Other locality records within the county of Milwaukee are Oak's farm, Cudahy, Mr. E. E. Teller; County line, Ernest Bruncken; Oak Creek, near South Milwaukee, G. Friend; towns Greenfield and Franklin, several records, C. E. Brown. The more remote general locality records throughout the state are:

Kenosha County, Kenosha, Mrs. E. C. Wiswall.
" " Sand Ridge Creek, C. E. Brown.

Waukesha County, Big Bend, C. E. Brown.
" " Delafield, Lee R. Whitney.
" " Okauchee, V. Fernekes.
" " Okauchee Lake, Miss O. C. Wheeler.
" " Golden Lake, William Finger.

Washington County, Cedar Lake, Dr. S. Graenicher.
" " Little Cedar Lake, William Orth.

Sheboygan County, Elkhart Lake, A. F. Laue.

Winnebago County, Menasha, Hon. P. V. Lawson.
" " Winneconne, Hon. P. V. Lawson.
" " Boom, A. F. Laue.

Calumet County, Lake Winnebago, C. E. Monroe.

Manitowoc County, Jambo Creek, C. E. Brown.
" " Molas Creek, C. E. Brown.
" " Kika, C. E. Brown.
" " Mishicot, C. E. Brown.
" " Two Rivers, C. E. Brown.
" " Two Rivers, C. E. Brown.

Oneida County, Maple Lake, W. H. Ellsworth.
" " Clear Water Lake, W. H. Ellsworth.

La Crosse County, La Crosse, H. Nesbitt.

Additional localities from museum specimens and citations in the literature include Humboldt and Smithville, Milwaukee County; Racine; Nashotah, Waukesha County; Lake Koshkonong; Aztalan, Jefferson County; Rock River; Sheboygan; Sugar River at Broadhead, Green County; Madison and Four Lakes, Dane County; Dodgeville, Iowa County; Baraboo, Sauk County; Oshkosh, Winnebago County; Clem and Junction Lakes and She-she-pe-comeo Park, Waupaca County; Green Bay, Brown County; Oconto; Richland City, Richland County; Mississippi river, between Prairie du Chien and De Soto (Crawford County); Wisconsin river, and Lakes Ellen and Leota.

It will be seen that large areas in the state remain to be canvassed, particularly in the northern and western portions.

Local material already in the museum collections has been freely drawn upon and is listed fully under each species, with its museum number and the name of the collector. A considerable part of this material consists of polished "Unios", purchased from Mrs. E. C. Wiswall, and bearing, almost without exception, the very indefinite locality, "Wisconsin." Despite the small value of such data for purposes like the present, the species will be found admitted to the list on their own recognizance, as all are likely to occur within the borders of the state. Additional records have been derived from an exchange list of Kenosha shells submitted by Mrs. Wiswall during her residence there, and from lists of further accessions, later received through Mr. Brown, including that of the Bunde & Upmeyer collection of Mississippi river bivalves from Crawford County. All these are accompanied in the lists by the name of their sponsor.

Lastly, all citations of Wisconsin localities in the authorities consulted have been incorporated, with page reference. This has been done in spite of some repetition, and all the available literature (up to 1902) has been searched in order to have the record historically complete. Many important papers have no doubt

been neglected through lack of acquaintance with them, but for such omissions no one will feel greater regret than the writer.

The works actually consulted, and which will be found of service to all students of the local mollusc fauna, are the following:

"The Mollusca of the Chicago Area," by F. C. Baker, published in two parts as Bulletin No. III of the Chicago Academy of Sciences. This very complete monograph, with its excellent half tone illustrations, covers nearly all the species found around Milwaukee and well serves the needs of the local student. In it are given full directions for collecting and cleaning shells, a glossary of terms, and other helps.

The Smithsonian "Miscellaneous Collections," including Binney's "Land and Fresh Water Shells of North America," in Vols. VII and VIII, Tryon's "Monograph of the Strepomatidæ," in Vol. XVI, and Prime's "Monograph of the Corbiculadæ," in Vol. VII. Binney's "American Land Shells" is a revision of a portion of the above.

Pilsbry and Johnson's "Land Shells of America north of Mexico," a classified check-list with localities, which costs twenty cents.

Simpson's "Synopsis of the Naiades," published as Proceedings No. 1205 of the U. S. National Museum, is a complete systematic and synonymic catalogue of the Unionidæ and allied forms.

Tryon's "Manual of Conchology," a monographic descriptive work appearing annually, includes at present our land shells.

"The Nautilus," the official American conchological journal. Condensed lists of the material which forms the subject of this paper have recently appeared in its pages.

All of the above are available in the public library of the city, or in the library of the museum. In addition, the writer has had recourse to Vols. 1 to 4 of the American Journal of Conchology, Gould's "Invertebrata of Massachusetts" (Binney's reprint), DeKay's "Mollusca" in the New York State Natural History series, Call's "Mollusca of Indiana," Hartman's "Conchologia Cestrica," and certain bulletins of the Smithsonian Institution.

Bryant Walker's "Mollusca of Michigan" ought also to be of assistance to the Wisconsin collector.

In the lists which follow, no attempt has been made to put forth a scientific classification of the species, as that is not germane to the purpose of the paper. The record is primarily that of faunal distribution, and the various forms have therefore been grouped for convenience as "land shells," "fresh water univalves"

and "bivalves," the genus *Carychium* being included with the first named. In the order of arrangement, Pilsbry and Johnson's list has been followed for the land shells and Simpson's Synopsis for the Unionidæ. The arrangement of the fresh water univalves is mainly that of Baker's Chicago Area Mollusca.

Under each species there is given, first, the localities furnished by our own collecting, beginning with those in and about Milwaukee, from the north around westward to the south, then the more remote accessions throughout the state, commencing with the southern and nearest; second, material previously in the museum; third, records from lists submitted and accessions since reported to me; lastly, citations from the literature, notes and comments. The numbered species are those authenticated by our own collecting, as recently published in the Nautilus.

For assistance in the identification of species the writer's thanks are gratefully tendered to Dr. Victor Sterki of New Philadelphia, Ohio, who has examined all the Sphæriidæ and Pisidiidæ; to Mr. Frank C. Baker of the Chicago Academy of Sciences, who made a rapid preliminary survey of the smaller fresh water forms; and to Messrs. Bryant Walker of Detroit, and Chas. T. Simpson of Washington, as acknowledged beyond. Further assistance has recently been rendered by Mr. Brues of the museum.

It should be explained, finally, that the present paper is written from the standpoint of 1902, such later information being included only as came readily to hand. The extensive collections since made by the museum, and the more recent literature, will furnish the basis for a supplementary notice, which it is intended shall be prepared in the autumn.

The material collected is all in the Public Museum of the City of Milwaukee.

I. LAND SHELLS.

1. **Helicina occulta** Say.

Lake bluffs at and south of Whitefish Bay resort. "Sheboygan, Wis. (fossil), I. A. Lapham," Smith Misc. Coll., VII, 112 "Brown Co., Wis.," Nautilus, III, 113. "Sheboygan, Whitefish Bay, near Milwaukee, and near De Pere, Wis. * * Distribution markedly discontinuous and local," Pilsbry and Johnson, catalogue, p. 2. See also Naut., III, 18, 20, for notes on distribution of this species.

The rediscovery of this interesting little operculate land shell at Whitefish Bay is due to Dr. Graenicher. The species was found to be moderately abundant under stumps and in the leaves and grass on the wooded slope of the bluffs, especially about half a mile south of the resort. It was here associated with a dozen other species of snails and slugs. The reddish color, shoe-button like shape, and above all, the presence of the operculum, will enable Helicina to be readily recognized on sight.

In the public library copy of the Smithsonian Miscellaneous Collections (VII, 112) above referred to, is the following interesting note written in pencil after the description of the present species:

"Finding a number of *living* specimens of this shell at Milwaukee, I submitted them to Mr. W. G. Binney for examination. He reported that without doubt they were *Helicina occulta*, thus satisfactorily settling a long mooted point. E. R. L."

The initials stand, I am told, for E. R. Leland, but the date of the annotation is unknown.

2. **Helix pomatia** Linné.

This, the large edible snail of Europe, is reported by Philip Wells as taken alive in a vacant lot on the northeast corner of State and Fifteenth streets. One of the two specimens secured was presented to the museum by Mr. Wells. Repeated search has failed to further confirm the habitat, and the species cannot therefore be considered an established resident.* It is not included in Pilsbry and Johnson's Catalogue of American Land Shells. The site of its capture is said to be the scene of former "snail banquets" for which great numbers of this species were imported. Judging from our unfortunate experience with other introduced forms, it is not likely to prove a desirable addition to our fauna, however alluring to the palate.

Helix (Tachea) nemoralis Linné.

Reported doubtfully from Baraboo, Sauk Co., Wis., Naut., VI., 131. See also Pils. & Johns. Cat., p. 3. A native of Europe.

* In a letter received from Mr. Brown since the above was penned, is the following: "In clearing away the bushes and rubbish on the old Milwaukee Garden site (Fourteenth and State streets), several additional specimens of the large European edible snail were found. This makes five altogether. These are probably the last, as the site is now almost entirely occupied by dwellings and large flat buildings."

3. **Vallonia pulchella** Müller.

Union Cemetery; Mud Creek valley, common; near the Teller mounds above Lindwurm; near Kraatz's brickyard; Cabeen's farm, south of city. 3074, near Wauwatosa, W. M. Wheeler. Kenosha, Mrs. E. C. Wiswall's list.

The specimens collected appertain to the typical form as distinguished by Dr. Sterki, but those from Lindwurm approach somewhat *V. excentrica*, Sterki.

Polygyra (Triodopsis) inflecta Say.

"Milwaukee, Wis., I. A. Lapham." Smith. Misc. Coll., VIII, 129. Our collecting failed to confirm this citation.

4. **Polygyra (Triodopsis) profunda** Say.

Lake bluffs, north and south of Whitefish Bay resort, abundant; North Point; Lindwurm, and north; near Kraatz's brickyard; Menomonee river dredgings; woods south of Wauwatosa; Reynolds' woods near Layton Park; Hale's Corners, Town Greenfield; Crystal Lake, near Elkhart Lake, Sheboygan Co. Near Smithville, Milw. Co., W. M. Wheeler. Kenosha, Mrs. E. C. Wiswall. "Milwaukee, Wis., I. A. Lapham," Smith. M. C., VIII, 153.

5. **Polygyra (Triodopsis) albolabris** Say.

Whitefish Bay resort; Johnson's woods, and woods south of Wauwatosa; (?) Oak's farm, Cudahy (juv.); 3076, Smithville, Milw. Co., and 3077 (juv.), near Wauwatosa, W. M. Wheeler. "Milwaukee, Wis., I. A. Lapham," and "Rock River, Wis.," Smith. Misc. Coll., VIII, 138.

This species, the dominant Polygyra of the eastern states, is not common around Milwaukee, where P. profunda displaces it in relative abundance. Only occasional dead shells were collected, some approaching *P. exoleta* in form, but lacking the tooth of the latter.

6. **Polygyra (Triodopsis) multilineata** Say.

Milwaukee river at Schlitz' ice-house; Kinnickinnic valley at Eleventh avenue; Hale's Corners, Town Greenfield; Menomonee river dredgings. 3079, Humboldt, Wis., W. M. Wheeler. Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 140.

Like the preceding species, only dead shells were taken.

Polygyra (Triodopsis) elevata Say.

"Wisconsin," Pilsbry and Johnson, Catalogue, p. 13.

This did not appear in the collections, and it is not reported by Baker from the Chicago area.

7. **Polygyra (Triodopsis) thyroides** Say.

Wauwatosa; Johnson's woods; Kinnickinnic valley, near Eleventh avenue. Kenosha, Mrs. Wiswall's list. "Wisconsin, I. A. Lapham," S. M. C., VIII, 148.

This species also is scarce, no living specimens being taken.

Polygyra (Triodopsis) clausa Say.

"Wisconsin," Binney, Smithsonian Misc. Coll., VIII, 149. Said to live on the leaves of the elderberry (Sambucus), Naut., III, 132. "Western Pennsylvania to Minnesota," Pilsbry and Johnson.

This species was not reported.

8. **Polygyra (Stenotrema) hirsuta** Say.

Valleys of the Milwaukee, Menomonee and Kinnickinnic; North Point; Mishicot, Manitowoc Co., under conifers. 2997, Humboldt, Wis., W. M. Wheeler. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 119.

9. **Polygyra (Stenotrema) monodon** Rackett.

Menomonee valley and woods near Wauwatosa. 2996, Humboldt, W. M. Wheeler. Kenosha, Mrs. Wiswall's list.

An edentate specimen was collected near Wauwatosa, and two others from the Menomonee river dredgings.

9a. **Polygyra monodon fraterna** Say.

Lake bluffs, north and south of Whitefish Bay resort; Castalia Park; Johnson's woods; Reynolds' woods at Layton Park; Oak's farm, Cudahy; Oak Creek, near South Milwaukee. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 123.

Polygyra monodon leai Ward.

"Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 123. This form did not occur in the collections.

10. **Strobilops affinis** Pilsbry.

Lake bluffs, south of Whitefish Bay; Menomonee valley above Wells street viaduct; Oak's farm, Cudahy; Mishicot, Manitowoc Co., under conifers.

Our original identification of the species as above is confirmed by Dr. Sterki. The specimens vary toward *S. virgo* in exhibiting but six internal laminæ, hence the reference to the latter species in the preliminary list published in the Nautilus.

Strobilops labyrinthica Say.

"Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 85. As the species of this genus have been but recently discriminated, this may refer to the preceding.

11. **Pupoides marginatus** Say.

(syn. **Leucocheila fallax,** Say.)

Kenosha, Mrs. E. C. Wiswall. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 240.

It is somewhat remarkable that this species should have eluded us at Milwaukee, where it will undoubtedly be found in the more open places, under stones.

12. **Bifidaria (Albinula) armifera** Say.

Whitefish Bay resort and bluffs to south; Menomonee valley at Kraatz's brickyard and Castalia Park. 5787, Humboldt, Wis., W. M. Wheeler. Kenosha, Mrs. E. C. Wiswall's list. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 242.

13. **Bifidaria (Albinula) contracta** Say.

Bluffs south of Whitefish Bay resort; Menomonee valley at Castalia Park; Johnson's woods; Mitchell's woods at Layton Park.

14. **Bifidaria (Albinula) corticaria** Say.

Menomonee valley at Castalia Park, Wauwatosa. "Milwaukee, Wis., I. A. Lapham," Smith. M. C., VIII, 246.

15. **Bifidaria (Vertigopsis) curvidens** Gould.

Johnson's woods, Wauwatosa, rare.

16. **Bifidaria (Vertigopsis) pentodon** Say.

Menomonee valley above Wells street; Mitchell's woods near Layton Park; Teller mounds near Lindwurm.

17. **Vertigo (Angustula) milium** Gould.

Mitchell's woods, west of Layton Park.

18. **Vertigo ovata** Say.

Root river at Loomis road, Town Franklin. 3188, Smithville, Milw. Co., W. M. Wheeler. Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII., 253.

19. **Cochlicopa lubrica** Müller.

Bluffs south of Whitefish Bay; Menomonee valley at Castalia Park. Kenosha, Mrs. Wiswall's list. She-she-pe-comeo Park, Waupaca Co., C. E. Brown, 1903.

20. **Vitrina limpida** Gould.

Mud Creek valley east of North Milwaukee; Castalia Park; rare. For interesting notes on this species see the Nautilus, VII, 47, 95; IX, 94. It is not reported from the Chicago area.

21. **Vitrea cellaria** Müller.

Nehrling greenhouse, Milwaukee, C. E. Brown (museum specimens, unnumbered). Brought on plants from Japan, where it had been introduced from Europe.

22. **Vitrea draparnaldi** Beck.

Currie and Mitchell Park greenhouses. Another importation from Europe which seems to have come by the western route through the Pacific seaboard.

23. **Vitrea hammonis** Ström.

Mud Creek valley at North Milwaukee and eastward; Menomonee valley, Wells street to Castalia Park; Dahlman's woods; Chicago avenue at Cabeen's farm.

24. **Vitrea (Glyphyalina) indentata** Say.

Lake bluffs south of Whitefish Bay; Menomonee valley above Wells street viaduct.

25. **Euconulus fulvus** Müller.

A single specimen only occurred, in a lot of shells whose locality label was unfortunately lost. The general assemblage of species suggests the Menomonee valley above Wells street as the probable source, but this is a pure guess. Kenosha, Mrs. E. C. Wiswall's list.

26. **Zonitoides nitidus** Müller.

Mud Creek valley throughout; Menomonee valley at Twentieth street, common. 5788, Humboldt, Wis., W. M. Wheeler. Lindwurm, C. E. Brown.

27. **Zonitoides arboreus** Say.

Bluffs south of Whitefish Bay; Mud Creek valley near Teutonia avenue; Menomonee valley, from Twentieth street to Castalia Park; Johnson's woods; Oak's farm, Cudahy; Mishicot, Manitowoc Co., under conifers. Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 34.

28. **Zonitoides** (**Pseudohyalina**) **minusculus** Binney.

Mud Creek valley; Menomonee valley above Wells street; Mitchell's woods, Layton Park. Kenosha, Mrs. Wiswall's list.

29. **Limax maximus** Linné

Currie, Mitchell Park, and Pollworth greenhouses, and vicinity of the latter. A troublesome form, likely to spread to houses and gardens, first reported to us by Mr. Kirchner. Imported to the C. C. Pollworth houses in 1901, with palms from Belgium, and now (1902) common on the premises.

30. **Limax flavus** Linné

Currie greenhouse and garden. The name should stand "*Limax (Lehmannia) variegatus* Draparnaud, var. *flavus*, Moquin-Tandon," according to Cockerell, Nautilus, III, 86

31. **Agriolimax agrestis** Linné

Bluffs south of Whitefish Bay; Mud Creek valley throughout, Menomonee valley near Washington avenue; Soldiers' Home; Currie and Mitchell Park greenhouses; abundant in Washington Park and generally throughout the city. A troublesome nocturnal visitant of kitchen gardens. It is interesting to find these three common European slugs already firmly implanted so far inland.

The present species does not appear to have reached Chicago, however.

32. **Agriolimax campestris** Binney.

Lake bluffs south of Whitefish Bay; Mud Creek valley at North Milwaukee; Menomonee valley above Wells street; Currie greenhouses. Unlike the exotic species this is not very common anywhere.

33. **Philomycus (Pallifera) dorsalis** Binney.

Lake bluffs south of Whitefish Bay resort.

No one who has described this species seems to have mentioned the reddish color of the mouth and forward margins of the foot. This was very noticeable in the three specimens obtained above, and in others observed by me in Monroe county, New York, recalling the colors of the animal in the next species. It is probably a constant character of this form, and does no indicate a variety as at first supposed.

34. **Pyramidula (Patula) alternata** Say.

Lake bluffs north and south of Whitefish Bay resort; Milwaukee river valley at Coney Island and mouth of Mud Creek; Menomonee river dredgings and valley above Wells street; woods south of Wauwatosa, Johnson's woods, Reynolds' woods; Hale's Corners, Town Greenfield; Oak's farm, Cudahy; Oak Creek, near South Milwaukee; Mishicot, Manitowoc Co., under conifers. 5720, Humboldt, W. M. Wheeler. Johnson's woods, A. W. Slocom. 11132, Baraboo, Mrs. E. C. Wiswall. Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 76.

One of the most abundant species everywhere.

35. **Pyramidula (Gonyodiscus) perspectiva** Say.

One very typical specimen only, from the bluffs south of Whitefish Bay (the Helicina locality), verifies the citation in Smith. Misc. Coll., VIII, 80, "Milwaukee, Wis., I. A. Lapham." The species is not recorded from the Chicago area; see Baker, Moll. Chic. Area, p. 212.

36. **Pyramidula (Gonyodiscus) striatella** Anthony.

Bluffs south of Whitefish Bay; Mud Creek valley at North Milwaukee and at mouth: Menomonee valley, from Twentieth

street to Castalia Park; Chicago avenue at Cabeen's farm; Oak's farm, Cudahy; Root river, at Loomis road, Town Franklin. 3023, Milwaukee Co., W. N. Wheeler. Kenosha, Mrs. Wiswall's list.

36a. **Pyramidula striatella catskillensis** Pilsbry.

Johnson's woods, in roots of an oak tree; Mishicot, Manitowoc Co., under conifers. See Naut. XII, 86; XIII, 70.

The occurrence of this interesting mutation, so remote from its type locality, is worthy of special notice. There seems no question of the identification, or of the distinctness of characters.

37. **Helicodiscus lineatus** Say.

Whitefish Bay resort and bluffs to south; Menomonee valley from Soldiers' Home to Castalia Park. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VIII, 53.

Punctum pygmæum Draparnald.

(?) Bluffs south of Whitefish Bay resort. Identification of single dead shell doubtful.

38. **Succinea ovalis** Say.

(syn. **Succinea obliqua,** Say.)

Milwaukee River valley below Schlitz ice-house; Mud Creek valley at North Milwaukee, abundant and large; Menomonee river dredgings, and valley at Castalia Park and Wauwatosa; Reynolds' woods, Layton Park. "Milwaukee, Wis. (*obliqua*), I. A. Lapham," Smith. Misc. Coll., VIII, 266.

38a. **Succinea ovalis** Say, **var.**

A form approaching *var. totteniana* was taken in the Mud Creek valley near Teutonia avenue, and at Castalia Park, Wauwatosa.

39. **Succinea retusa** Lea.

(syn. **Succinea ovalis** Gould, not Say.)

Ogden-Copeland arboretum, near Whitefish Bay; Mud Creek valley from North Milwaukee to mouth; Menomonee valley, near Mitchell Park and above Wells street; Honey Creek, near Layton Park; Cabeen's woods, Chicago avenue. Kenosha (as ovalis, Gould), Mrs. Wiswall's list. "Milwaukee, Wis., I. A.

Lapham" (as ovalis), Smith. Misc. Coll., VIII, 258. Less common than the preceding.

40. **Succinea avara** Say.

Bluffs south of Whitefish Bay; Mud Creek valley at North Milwaukee; Castalia Park, Wauwatosa; southwest quarter of section 16, Town Greenfield; Chicago avenue at Cabeen's farm; Mishicot river at Two Rivers, Manitowoc Co.

41. **Carychium exiguum** Say.

Menomonee valley at Soldiers' Home, above Wells street viaduct and at Castalia Park. 3187, damp woods near Smithville, Milwaukee Co., W. M. Wheeler. Kenosha, Mrs. Wiswall's list. "Milwaukee," in pencil in library copy of Smith. Misc. Coll., VII, 6.

41a. **Carychium exiguum exile** H. C. Lea.

With the preceding, and intergrading so closely with it as to make even varietal separation difficult. Dr. Sterki would refer the entire series of Carychium above recorded to "a small, slender form of var. of exiguum, although in shape somewhat like exile." In either case the connection of these two nominal species is indicated by the Wisconsin material.

II. FRESH-WATER UNIVALVES.

A. PULMONATE.

42. **Limnæa stagnalis appressa** Say.

Menomonee river dredgings and at Wauwatosa; Oak Creek, near South Milwaukee; mill pond at Delafield, Waukesha Co., very abundant; Ballad's cottage, Okauchee lake, white variety; East Twin river at Two Rivers, Manitowoc Co.; Lake Winnebago, west of High Cliff, Calumet Co. Kenosha, Mrs. E. C. Wiswall's list. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 29.

Limnæa (Radix) decollata Mighels.

"Madison, Wis., I. A. L.," pencil note in margin of the public library copy of the Smithsonian Miscellaneous Collections, VII, 31. Not verified.

43. **Limnæa (Radix) columella** Say.

Mill pond near Nagawicka Lake, Delafield. "Milw." in pencil, Smith. Misc. Coll., VII, 32.

44. **Limnæa (Bulimnea) megasoma** Say.

Molas Creek, Manitowoc Co. 3248, Lake Koshkonong, Jefferson (?) Co. "Oconto, Wis., Geo. T. Marston," Naut., V, 81.

45. **Limnæa (Limnophysa) reflexa** Say.

Stream near electric light plant, Wauwatosa; pool in Johnson's woods, abundant and variable; Menomonee river dredgings; Kinnickinnic river near Eleventh avenue; pond in Cabeen's woods, old Chicago road; Oak Creek, near South Milwaukee; Sand Ridge Creek, southeast of Kenosha; mill pond at Delafield, abundant. Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham; Farwell's woods, Madison, Wis., Prof. S. F. Baird; Aztalan, Wis., Prof. Baird; Milwaukee, Lewis," Smith. Misc. Coll., VII, 41.

No attempt has been made to discriminate the supposed varieties to which names have been applied. When it is difficult sometimes even to separate this species satisfactorily from the following, further niceties must be left to those who have abundant leisure. The large series from a single pond in Johnson's woods illustrates well the possibilities of variety-making afforded by this species.

Specimens placed alive in an aquarium were cleaned out by dragon-fly larvæ.

46. **Limnæa (Limnophysa) palustris** Müller.

(syn. **Limnæa elodes** Say.)

Small pools near the Milwaukee river opposite the cement works; Menomonee river dredgings; pool in Johnson's woods, feeding on a carcase; hollow by roadside near Cabeen's woods, Chicago avenue; north shore of Lake Winnebago, west of High Cliff. 12657, Johnson's woods, C. E. Brown. "Oshkosh, Lake Winnebago, Wis., A. C. Barry; Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 47.

"Var. michiganensis," Walker, occurs among the specimens from Johnson's and Cabeen's woods.

47. **Limnæa (Limnophysa) catascopium** Say.

On the lake beach at Lake Park and the flushing tunnel pumping station, in the sand. Single dead shells were also obtained from the stream near the electric light plant, Wauwatosa, and Chicago avenue at Cabeen's farm. These stragglers are insufficient to show that this species extends beyond the waters of Lake Michigan at Milwaukee. It would be interesting to know the depth of water which is the normal habitat, the beach specimens being all drifted material.

47a. **Limnæa catascopium** Say, **var.**

With the preceding occur shorter forms approaching *L. emarginata.*

Limnæa (Limnophysa) emarginata Say.

(?) Kenosha, Mrs. E. C. Wiswall's list, under the name *L. ampla,* Say. "Madison, Wis., I. A. Lapham; Wisconsin, Lewis," Smith. Misc. Coll., VII, 53. "First of Four Lakes, Madison, Wis., P. P. Carpenter," Baker, Bull. Chic. Acad. Sci., Vol. II, No. III, p. 195. For the habits of the var. mighelsi, Binney, see Naut. XIV, 8. Not collected around Milwaukee.

48. **Limnæa (Limnophysa) caperata** Say.

Small swamp southwest of Humboldt Park and Honey Creek, near Layton Park; north shore of Lake Winnebago, west of High Cliff. Kenosha, Mrs. Wiswall's list. Overflow pond of Milwaukee river at Lindwurm, C. E. Brown, 1903. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 57. Grades into the following nominal variety.

48a. **Limnæa caperata umbilicata** Adams.

Small pools near the Milwaukee river opposite the cement works; Mud Creek, at North Milwaukee; Honey Creek, near Layton Park, with intermediate forms; hollow beside Chicago avenue, near Cabeen's farm; small creek near Loomis road, Town Greenfield; ponds at Howard's prairie and near St. Martin's, Town Franklin; Sand Ridge Creek, near lake shore, Kenosha.

49. **Limnæa (Limnophysa) humilis** Say.

Milwaukee river at Lindwurm; Mud Creek at North Milwaukee; Menomonee river, near old Falk brewery; Honey Creek,

near Layton Park; doubtfully from Lake Winnebago, west of High Cliff. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 67. Everywhere scarce.

50. **Limnæa (Limnophysa) desidiosa** Say.

Mud Creek and its valley at and east of North Milwaukee; artificial pond near Kraatz's brickyard, Vliet street; Menomonee river, near old Falk brewery and in slough above Castalia Park; Honey Creek, near Layton Park (*L. parva* in part, fide F. C. Baker); Lake Winnebago, west of High Cliff; Mishicot river, at Two Rivers, Manitowoc Co. 12659, Cold Spring avenue, fossil. "Milw." in pencil, Smith. Misc. Coll., VII, 48, public library copy.

A considerable portion of the above were referred to the preceding species by Mr. Baker on a hasty examination, but in this I cannot follow him.

Limnæa (Acella) gracilis Jay.

"Has been quoted from Wisconsin," Smith. Misc. Coll., VII, 69.

51. **Planorbis (Helisoma) trivolvis** Say.

Lake Michigan beach at North Point pumping station; stream near electric light plant, Wauwatosa; Menomonee river dredgings; Kinnickinnic river, near Eleventh avenue; lily-pond in South Park; mill pond at Delafield; Okauchee, and Ballad's cottage, Okauchee Lake, Waukesha Co.; north shore of Lake Winnebago, Calumet Co.; East Twin river, at Two Rivers, Manitowoc Co. Kenosha, Mrs. Wiswall's list. "Madison, Wis., Prof. S. F. Baird; Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 121.

51a. **Planorbis trivolvis** Say, **large form.**

Molas Creek, Manitowoc Co. 3946, Sheboygan, C. M. Wheatley collection, as *P. "corpulentus."* This seems to be the form which has frequently been confounded with *Planorbis corpulentus* Say, a western species. See the Nautilus, XIII, 133; XIV, 33.

52. **Planorbis (Helisoma) bicarinatus** Say.

Menomonee river dredgings; Menomonee valley, near Castalia Park; stream near electric light plant, Wauwatosa; Honey Creek, near Layton Park; Kinnickinnic river, near Eleventh

avenue; Golden Lake, Waukesha Co.; Little Cedar Lake, Washington Co.; north shore of Lake Winnebago, Calumet Co. Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll. VII, 124.

52a. **Planorbis bicarinatus striatus** Baker.

Cold Spring Park (fossil), donated by Mr. Monroe. 12660, Cold Spring avenue (fossil). "Milwaukee (fossil), C. E. Brown," Nautilus, XV, 120, original description.

53. **Planorbis (Planorbella) campanulatus** Say.

Lake Michigan beach at North Point pumping station and near Lake Park; Menomonee river dredgings; stream near electric light plant, Wauwatosa; Kinnickinnic river, near Eleventh avenue; fossil at Cold Spring Park; mill pond at Delafield, Okauchee and Golden Lake, Waukesha Co.; Little Cedar Lake, Washington Co.; Crystal Lake, near Elkhart Lake, Sheboygan Co.; north shore of Lake Winnebago, Calumet Co.; East Twin River, at Two Rivers, Manitowoc Co. Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham; Aztalan, Wis., S. F. Baird," Smith. Misc. Coll., VII, 110.

Some of the specimens from Golden Lake show the curious distortion, due to a second growth after the formation of the first aperture, that is so often observed in senile examples of *P. trivolvis*. This phenomenon is rather unusual in the present species.

Planorbis (Menetus) exacutus Say.

"Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 128. Our search for this species was unsuccessful.

54. **Planorbis (Gyraulus) hirsutus** Gould.

Mishicot river (or East Twin river), at Two Rivers, Manitowoc Co., not uncommon.

55. **Planorbis (Gyraulus) parvus** Say.

Mud Creek valley at North Milwaukee; Menomonee valley, opposite Mitchell Park, and at Castalia Park, abundant; Honey Creek, near Layton Park; ponds at Howard's prairie and near St. Martin's, Town Franklin.

56. **Segmentina (Planorbula) armigera** Say.

Mud Creek valley at North Milwaukee, abundant; slough at mouth of Mud Creek; Castalia Park, Wauwatosa; Johnson's woods; marsh in Menomonee valley, opposite Mitchell Park; dry pond at Cabeen's woods, Chicago avenue; pond near St. Martin's, Town Franklin; Mishicot river, at Two Rivers, Manitowoc Co. Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 138.

Ancylus (Lævapex) diaphanus Haldeman.

"Milwaukee, Wis., I. A. Lapham," Smith, Misc. Coll., VII, 141.

57. **Ancylus (Ferrissia) rivularis** Say.

Root river, at Loomis road, Town Franklin. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII., 143.

58. **Ancylus (Ferrissia) parallelus** Haldeman.

Pond near St. Martin's, Town Franklin. The unique specimen obtained was submitted to Mr. Bryant Walker, who corroborates the identification and writes: "The shell is a good example of the compressed, high form of parallelus that occurs occasionally. (See Naut., XVIII, p. 77, Plate V, fig. 4-6.) It seems to be an individual variation and not a varietal one."

59. **Ancylus** sp.

A single dead shell from an artificial pond near Kraatz's brickyard, west along Vliet street, is considered by Mr. Bryant Walker to represent a new species. See Naut., XVIII, 81.

In all only five specimens of Ancylus were secured, which is disappointing, for a much larger number of species should be found on industrious search in the proper places. The genus has recently been elaborately monographed by Mr. Bryant Walker in volumes XVI to XVIII of the Nautilus.

Physa heterostropha Say.

Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 89. It may be questioned whether these citations appertain properly to this species as now delimited. See Baker, Mollusca of the Chicago Area, p. 308, and Nautilus, VI, 20; XIV, 16; XV, 25. A single immature shell from the mill pond at Delafield, Waukesha Co., is doubtfully referred here.

60. **Physa sayi** Tappan.

Lake Michigan at the pumping stations; Menomonee marshes and dredgings; Kinnickinnic river, near Eleventh avenue; Golden Lake, Waukesha Co.; north shore of Lake Winnebago, near High Cliff, Calumet Co. This species evidently prefers a lake habitat, but is nowhere very abundant.

Physa ampullacea Gould, a west coast species, is marked "Milwaukee" in pencil in the library copy of Smith. Misc. Coll., VII, 79. This must be an error for sayi or gyrina; compare figure 134 of the above work with the Mud Creek specimens of *P. gyrina.*

61. **Physa gyrina** Say.

Milwaukee river, near Coney Island, and at Lindwurm; Mud Creek valley, common; small pond near Kraatz's brickyard; slough above Castalia Park; pool in Johnson's woods; Menomonee marshes and dredgings; Honey Creek, near Layton Park; dry pond at entrance to Cabeen's woods, Chicago avenue, abundant and large, burrowing in the mud; pond near St. Martin's, Town Franklin; small creek near Loomis road, Town Greenfield; small creek at County Line; Sand Ridge Creek, near Kenosha; north shore of Lake Winnebago, Calumet Co.; East Twin river, at Two Rivers, Manitowoc Co. Kenosha, Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham; Farwell's Mills, Madison, Wis., S. F. Baird; Racine, Wis., ditto," Smithsonian Misc. Coll., VII, 79.

61a. **Physa gyrina elliptica** Lea.

(**Physa gyrina oleacea** Tryon.)

Mud Creek, east of North Milwaukee; Honey Creek, near Layton Park; small swamp southwest of Humboldt Park. Not always readily separated from the typical form of the species, and occurring with it.

62. **Physa integra** Haldeman.

Lake Michigan beach at and near North Point; Milwaukee river, near Coney Island (nice series), at Lindwurm and below Schlitz icehouse; Mud Creek, at North Milwaukee; pond near Kraatz's brickyard; Menomonee river, at Castalia Park and Wauwatosa, and stream near Wauwatosa electric light plant; Root river, at Loomis road, Town Franklin; Golden Lake, Waukesha

Co. "Wisconsin," F. C. Baker, Naut., XIV, 16; Moll. Chic. Area, p. 316. In the older citations, this form was commonly confused with *P. heterostropha,* which it largely replaces in the Milwaukee region.

63. **Aplexa hypnorum** Linné.

Menomonee valley, near old cattle chute; pools in Johnson's woods. Kenosha, Mrs. Wiswall's list. Over-flow pond of the Milwaukee river at Lindwurm, large numbers, C. E. Brown, 1903. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 101.

B. OPERCULATE.

64. **Pleurocera subulare** Lea.

var. pallidum? Lea.

North shore of Lake Wninebago west of High Cliff, Calumet Co. Mr. Baker provisionally identified the specimens as pertaining to the above variety. They are of a light horn yellow color, the earlier whorls with several incised revolving lines and a faint median carina.

65. **Pleurocera elevatum** Say.

Milwaukee river at Lindwurm and below the Schlitz icehouse, the latter representing the form *tractum,* Anthony. Also from the Menomonee river dredgings.

66. **Goniobasis livescens** Menke.

Lake Michigan, at the pumping stations and Lake Park; Milwaukee river at Lindwurm and near Coney Island; doubtfully from the Kinnickinnic river, near Eleventh avenue; Menomonee river dredgings. 2816, Milwaukee river. Kenosha, Mrs. Wiswall's list. The specimens from the lake shore are frequently more or less battered, often with a perforation in the body whorl.

Goniobasis livescens depygis Say.

"Wisconsin (*M. occulta* Anthony)," Smith. Misc. Coll., XVI, 248. Walker, Naut., XVI, 35, suggests that this is a good species. It did not occur in our collections.

Bythinia tentaculata Linné.

"Wisconsin," Baker, Mollusca Chic. Area, p. 330. Our collecting failed to find this introduced species, which may be looked for any day at Milwaukee, having established itself through the Great Lakes system and become exceedingly abundant at Rochester, N. Y., Chicago, etc.

67. **Amnicola limosa** Say.

Sandy beach of Lake Michigan, north from flushing tunnel pumping station; Milwaukee river at Lindwurm; Lake Winnebago, west of High Cliff, Calumet Co. Kenosha, Mrs. Wiswall's list. "Madison and Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 84.

67a. **Amnicola limosa parva** Lea.

North bank of Milwaukee river at Lindwurm; Castalia Park, Wauwatosa, in stream "drift."

67b. **Amnicola limosa porata** Say.

Lake Michigan beach at the pumping stations.

68. **Amnicola lustrica** Pilsbry.

Honey Creek, near Layton Park.

69. **Amnicola (Cincinnatia) cincinnatensis** Lea.

Milwaukee river at Lindwurm; Menomonee River dredgings; Lake Winnebago, near High Cliff, Calumet Co. It is doubtful whether this species appertains to the genus Amnicola; see Walker, Naut., XVI, 35. The spelling of the specific name requires emendation as above.

70. **Amnicola (Cincinnatia) emarginata** Küster.

North shore of Lake Winnebago, west of High Cliff, Calumet County.

71. **Somatogyrus subglobosus** Say.

Kinnickinnic river, near Eleventh avenue; Root river, at Loomis road, Town Franklin; Kenosha (Mrs. Wiswall); Lake Winnebago, near High Cliff, Calumet Co. "Wisconsin," Moll. Chicago Area, p. 341.

Somatogyrus integer depressus Tryon.

Kenosha, Mrs. Wiswall's list.

72. **Pomatiopsis lapidaria** Say.

Castalia Park, Wauwatosa. 2788, near cement mills, Milwaukee Co., Wis., W. M. Wheeler. Kenosha, Mrs. Wiswall's list. "Richland City, Wis.," in pencil in library copy of Smith. Misc. Coll., VII, 93.

Pomatiopsis lustrica Say (= **P. lapidaria**).

"Four Lakes, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 95. See Baker, Moll. Chic. Area, pp. 334, 344.

73. **Valvata tricarinata** Say.

Milwaukee river below Schlitz icehouse; Mud Creek, at and east of North Milwaukee; Honey Creek, near Layton Park; Cold Spring Park (fossil); Lake Winnebago, near High Cliff, Calumet Co. "Milwaukee, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 12.

73a. **Valvata tricarinata simplex** Gould.

Shore of Lake Michigan, north from flushing tunnel pumping station.

Valvata bicarinata Say

form normalis Walker.

Specimens from Mud Creek at North Milwaukee having the characters supposed to distinguish this form are probably merely the young of *V. tricarinata.*

74. **Valvata sincera** Say.

Honey Creek, near Layton Park; fossil at Cold Spring Park. 12658, Cold Spring avenue (fossil). "Madison, Wis., I. A. Lapham," Smith. Misc. Coll., VII, 13.

75. **Vivipara contectoides** W. G. Binney.

Kinnickinnic river, near Eleventh avenue, one dead shell only. As this may have been brought on a boat, further evidence is needed before fully admitting the species to the Wisconsin fauna. It is well established at Chicago. For the history of its colonization in northern waters, see Amer. Jour. Conch., IV., 245; Nautilus, V, 133.

Vivipara subpurpurea Say.

"Wisconsin," W. G. Binney, Smith. Misc. Coll., VII, 21.

76. **Campeloma rufum** Haldeman.

Ballad's cottage, Okauchee Lake, Waukesha Co.; Little Cedar Lake, Washington Co.; Lake Winnebago, near High Cliff, Calumet Co. Beasley Brook, Waupaca Co., C. E. Brown, Aug., 1903.

77. **Campeloma decisum** Say.

Milwaukee river at Lindwurm and below Schlitz icehouse; Menomonee river, near old Falk brewery and at Wauwatosa; Kinnickinnic river, near Eleventh avenue; Root river, at Loomis road, Town Franklin; Lake Winnebago, near High Cliff, Calumet Co. (doubtful); East Twin river, at Two Rivers, Manitowoc Co. 2858 (*"integrum"*), Milwaukee river (doubtful). Kenosha (as *"Melantho integra"*), Mrs. Wiswall's list. "Milwaukee, Wis., I. A. Lapham; Aztalan and Racine, Wis., S. F. Baird," Smith. Misc. Coll., VII, 51. The following has generally been confused with this species, and is so difficult to separate from it that the distinction may be properly challenged. I am not at all sure of the correctness of the identifications here given.

78. **Campeloma subsolidum** Anthony.

Milwaukee river at Lindwurm and below Schlitz icehouse; Menomonee river dredgings and at Mitchell Park and Wauwatosa; Kinnickinnic river near Eleventh avenue; Oak Creek, near South Milwaukee; Molas Creek, Manitowoc Co.

79. **Lioplax subcarinata** Say.

Kenosha, Mrs. E. C. Wiswall exchange; Lake Winnebago, near High Cliff, Calumet Co. Not reported by Baker from the Chicago area.

III. BIVALVES.

80. **Lampsilis ventricosa*** Barnes.

Milwaukee river at Lindwurm and below the Schlitz icehouse; Lake Winnebago, near High Cliff, Calumet Co.; Clear Water

* Some emendations are necessary in the orthography of the Unionidæ, as pointed out by Josua Lindahl, "Orthography of the Names of the Naiades," Journal of The Cincinnati Society of Natural History," Vol. XX, No. 2, p. 235, Feb. 1, 1906.

Lake Creek, Oneida Co. 7244, Dodgeville, Iowa Co., R. Marks. 11037, 11039, "Wisconsin River," Wiswall collection as "*U. canadensis.*" Clem Lake, Waupaca Co., C. E. Brown, Aug., 1903. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown. "Lake Ellen, Wis. (*canadensis*), Dr. J. J. Brown," Naut., V, 81.

Lampsilis occidens Lea.

"In the Lea collection from Nashotch, Wis.," as "*Unio cariosus,*" but probably belonging to this species; see Naut., VIII, 123. The locality is evidently a misspelling for Nashotah, Waukesha Co. According to Dr. von Ihering, XV, 50, this species is not a synonym of the preceding, but distinct. *Lampsilis cariosa* Say, is not otherwise reported from Wisconsin. The three forms, ventricosa, occidens, and cariosa, are all very similar and difficult to distinguish.

81. **Lampsilis (Eurynia) luteola** Lamarck.

Milwaukee river, above Lindwurm; Golden Lake and Ballad's cottage, Okauchee Lake, Waukesha Co.; Boom, and ancient shell heaps at Winneconne, Winnebago Co.; Lake Winnebago, near High Cliff, Calumet Co. (doubtful); Two Rivers, Manitowoc Co.; Clear Water Lake and Creek, Oneida Co.. 12652, Fox River, near Big Bend, Waukesha Co., C. E. Brown. 11016, 11017, "Wis.," Wiswall collection. Beasley Brook, She-she-pecomeo Park, Waupaca Co., C. E. Brown, Aug., 1903.

Lampsilis (Eurynia) superiorensis Marsh.

One specimen, from Two Rivers, Manitowoc Co., may represent this northerly race. For description, see the Nautilus, X, 103; Pl. I, p. 121.

Lampsilis (Eurynia) borealis A. F. Gray.

Said to connect with luteolus "in Wisconsin," Naut., V, 88; also 113.

Lampsilis (Eurynia) radiata Gmelin.

"There is a shell in the U. S. National Museum from the northwest boundary of Wisconsin, which is probably this species."—Simpson, Synopsis, p. 536.

82. **Lampsilis (Eurynia) ligamentina** Lamarck.

Milwaukee river at Lindwurm and below Schlitz icehouse;

Fox River, near Big Bend, Waukesha Co.; Winnebago Lake, at Menasha (doubtful); Clear Water Lake Creek, Oneida Co. 10687, Sugar River, Brodhead, Green Co., W. H. Hayssen. 11023, "Wisconsin River," Wiswall collection. Honey Creek, Towns Wauwatosa and Greenfield, several specimens, C. E. Brown, Oct., 1903. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

Lampsilis (Eurynia) higginsi Lea.

Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

Lampsilis (Eurynia) anodontoides Lea.

Same locality as preceding.

83. **Lampsilis (Eurynia) recta** Lamarck.

Fox River, near Big Bend, Waukesha Co., pathologic; La Crosse. 11054, "Wis.," Wiswall collection, C. E. Brown. For Crosse. 11054, "Wis.," Wiswall collection. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown. For the identification of the remarkably deformed specimen from Big Bend, we are indebted to Mr. Chas. T. Simpson, author of the "Synopsis."

84. **Lampsilis (Eurynia) iris** Lea.

Milwaukee river at Lindwurm. "Wisconsin," Simpson, Syn. Naiades, p. 552.

85. **Lampsilis (Eurynia) ellipsiformis** Conrad.

(syn. **Lampsilis spatulatus** Lea.)

Milwaukee river at Lindwurm and below Schlitz icehouse, abundant; Fox river, near Big Bend, Waukesha Co.; mill pond at Hika, Manitowoc Co. 3429, Milwaukee river, A. Kerr. 11003, "Wis.," Wiswall collection.

86. **Lampsilis (Proptera) alata** Say.

Winnebago Lake at Menasha, and west of High Cliff, Calumet Co.; Two Rivers, Manitowoc Co. 5764, Milwaukee River, Wis. Nat. Hist. Soc. 11021, "Wis.," Wiswall collection. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

87. **Lampsilis (Proptera) gracilis** Barnes.

Boom, and north branch of the Fox River at Menasha, Winnebago Co.; Winnebago Lake, near High Cliff, Calumet Co. 3404, Milwaukee River, Wis. Nat. Hist. Soc. 11022, "Wis.," Wiswall collection. Our collecting failed to corroborate the Milwaukee river locality.

Obovaria (Pseudoön) ellipsis Lea.

11030, "Wis.," Wiswall collection.

Plagiola securis Lea.

Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

Plagiola (Amygdalonaias) elegans Lea.

11012, "Wis.," Wiswall collection.

88. **Plagiola (Amygdalonaias) donaciformis** Lea.

Kinnickinnic river, near Eleventh avenue; La Crosse. 11080, "Wis.," Wiswall collection.

A single valve only from the Milwaukee locality, which is therefore questionable.

Tritogonia tuberculata Barnes.

10693, Sugar river, Brodhead, Green Co., H. H. Hayssen. 10998, 10999, "Wis.," Wiswall collection. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

89. **Strophitus edentulus** Say.

Milwaukee river, from Lindwurm to the Schlitz icehouse; Kinnickinnic river, near Eleventh avenue, young; mill pond at Hika, Manitowoc Co. 11042, "Wis.," Wiswall collection. Beasley brook, She-she-pe-comeo Park, Waupaca Co., C. E. Brown, Aug., 1903.

90. **Anodonta cataracta** Say.

Golden Lake, Waukesha Co.,; Maple Lake, Oneida Co.

Inasmuch as Simpson, Synopsis, p. 632, discredits the northwestern records of this species, the identification as above might be challenged. The specimens seem to be this species rather than *A. marginata* Say.

Anodonta implicata Say.

11055, "Baraboo River, Wis.," Wiswall collection. Honey Creek, Towns Greenfield and Wauwatosa, C. E. Brown, Oct., 1903, fairly common.

91. **Anodonta imbecillis** Say.

One young shell from Lake Winnebago, west of High Cliff, Calumet Co.

92. **Anodonta grandis** Say.

Milwaukee river above Lindwurm, and below Schlitz icehouse; mill pond at Wauwatosa; Fox river near Big Bend, Golden Lake and Ballad's cottage, Okauchee Lake, Waukesha Co.; Winnebago Lake at Menasha and west of High Cliff; Jambo Creek and Two Rivers, Manitowoc Co.; Maple Lake, Oneida Co.; Clem Lake, Waupaca Co., C. E. Brown, Aug., 1903, common.

Anodonta grandis footiana Lea.

11038, "Wis.," Wiswall collection.

Anodonta grandis gigantea Lea.

3480, Milwaukee, Wis., Nat. Hist. Soc., as *A. plana.*

93. **Anodontoides ferussacianus** Lea.

Milwaukee river, between Lindwurm and Schlitz icehouse; Mud Creek, east of Teutonia avenue; Root river, at Loomis road, Town Franklin; Jambo Creek, Manitowoc Co. Milwaukee river, Wis., Nat. Hist. Soc. 11032, "Lake Leota, Wis.," Wiswall collection.

94. **Symphynota compressa** Lea.

Jambo Creek, Manitowoc Co. "Wisconsin," Simpson, Syn. Naiades, p. 663.

95. **Symphynota (Lasmigona) costata** Rafinesque,

Milwaukee River at Lindwurm, and below Schlitz icehouse. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

96. **Symphynota (Pterosygna) complanata** Barnes.

Milwaukee river, at Lindwurm and Schlitz icehouse; Two Rivers, Manitowoc Co. 11010, "Wis.," Wiswall collection.

97. **Alasmidonta (Pressodonia) calceolus** Lea.

Lake Michigan shore at Lake Park; Jambo Creek, Manitowoc Co. Beasley Creek, She-she-pe-comeo Park, Waupaca Co., C. E. Brown, Aug., 1903.

98. **Alasmidonta (Rugifera) marginata** Say.

(syn. **Alasmidonta truncata** B H. Wright.)

Milwaukee river, at Lindwurm and below Schlitz icehouse. 3473, Milwaukee river, Wis. Nat. Hist. Soc. 11046, "Wis.," Wiswall collection. Junction Lake, Waupaca Co., C. E. Brown, Aug., 1903. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown. For the evidence that this form rather the eastern variety is the true marginata, see Fox in Naut., XV., 47.

99. **Unio (Elliptio) gibbosus** Barnes.

Milwaukee river, from Lindwurm to Schlitz icehouse, abundant; Fox river, near Big Bend, Waukesha Co.; ancient shell heaps at Winneconne, Winnebago Co.; Lake Winnebago, west of High Cliff, Calumet Co.; Two Rivers and mill pond at Hika, Manitowoc Co. 11034, 11035, "Wis.," Wiswall collection. Beasley brook, She-she-pe-comeo Park, Waupaca Co., common, C. E. Brown, Aug., 1903. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

Unio gibbosus delicatus Simpson.

12649, Fox river, near Big Bend, Waukesha Co., C. E. Brown.

Unio (Elliptio) crassidens Lamarck.

Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown. Fossil at Green Bay, see Wagner, Naut., XVIII, 97.

Pleurobema (Plethobasus) æsopus Green.

11031, 11040, "Wis.," Wiswall collection.

Quadrula (Crenodonta) plicata Say.

"Wis.," Wiswall collection (?). Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

100. **Quadrula (Crenodonta) undulata** Barnes.

Fox river, near Big Bend, Waukesha Co.; ancient shell heaps at Winneconne, Winnebago Co.; Two Rivers, Manitowoc Co.; Clear Water Lake Creek, Oneida Co. 12650, Fox river, near Big Bend, C. E. Brown. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

Quadrula (Crenodonta) heros Say.

Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

Quadrula metanevra Rafinesque.

11013 seq., "Wis.," Wiswall collection.

Quadrula (Theliderma) fragosa Conrad.

11009, "Wisconsin River," Wiswall collection.

101. **Quadrula (Theliderma) pustulosa** Lea.

Ancient shell heaps at Winneconne, Winnebago Co. 11018, "Wis.," Wiswall collection. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

102. **Quadrula (Fusconaia) rubiginosa** Lea.

Milwaukee river, Lindwurm to Schlitz icehouse, abundant; Mud Creek, east of Teutonia avenue, fragment of a young shell; Menomonee river dredgings; Two Rivers, Manitowoc Co.; Clear Water Lake Creek, Oneida Co. 3413, Milwaukee river, Wis. Nat. Hist. Soc. 11001, "Wis.," Wiswall collection.

103. **Quadrula (Fusconaia) trigona** Lea.

Doubtfully from Milwaukee river above Lindwurm. 10698, Sugar river at Brodhead, H. H. Hayssen. 11006, "Wis.," Wiswall collection.

Quadrula (Fusconaia) coccinea Conrad.

11041, "Wis.," Wiswall collection. A fragment from the ancient shell heaps at Winneconne probably belongs to this species.

Quadrula (Fusconaia) solida Lea.

11047, 11049, "Wis.," Wiswall collection. "Wisconsin," Simpson, Syn. Naiades, p. 789.

Quadrula (Fusconaia) pyramidata Lea

"North in the Mississippi to Wisconsin," Simpson, Syn. Naiades, p. 790.

Quadrula (Fusconaia) kirtlandiana Lea.

"North to Wisconsin?," Simpson, Synopsis, p. 791.

Quadrula (Fusconaia) ebena Lea.

11004, "Wis.," Wiswall collection. Between Prairie du Chien and De Soto, Bunde & Upmeyer collection, C. E. Brown.

Quadrula (Rotundaria) tuberculata Rafinesque.

10689, Sugar river at Brodhead, Green Co., H. H. Hayssen. 11027, 11028, "Wis.," Wiswall collection.

104. **Sphærium vermontanum** Prime.

Sandy beach of Lake Michigan at Milwaukee; north shore of Lake Winnebago, one-half mile west of High Cliff, Calumet Co. This is a species of the larger lakes, which has been confused with S. solidulum; see Mollusca of the Chicago Area, p. 394. The identification is still open to some question according to Dr. Sterki.

Sphærium solidulum Prime.

Kenosha, Mrs. E. C. Wiswall's list. "Wisconsin," Prime, Smith. Misc. Coll., VII, 36. These citations may be in error for the preceding species.

105, **Sphærium rhomboideum** Say.

Mud Creek east of Teutonia avenue bridge, and Honey Creek near Layton Park; abundant at both localities. Occurs with *S. simile.*

106. **Sphærium stamineum** Conrad.

North bank of Milwaukee river at Lindwurm; Mud Creek, half a mile east of Teutonia avenue; Kinnickinnic river near Eleventh avenue.

107. **Sphærium striatinum** Lamarck.

Very abundant in Mud Creek, on a gravelly bottom, half a mile east of Teutonia avenue, with the preceding and following; dead shells at the cement mills, Lindwurm. "Wisconsin," Prime, Smith. Misc. Coll., VII, 37.

108. **Sphærium simile** Say.

Sandy beach of Lake Michigan at Milwaukee; Mud Creek, from North Milwaukee to half a mile east of Teutonia avenue, locally abundant; Honey Creek, near Layton Park, common (also in 1903, "very common," C. E. Brown); fossil at Cold Spring Park; Lake Winnebago, near High Cliff; Calumet Co., East Twin River at Two Rivers, and Molas Creek, Manitowoc Co. Kenosha (as *Sphœrium sulcatum* Lamarck), Mrs. Wiswall's list. "Wisconsin" (as *S. sulcatum*), Prime, Smith. Misc. Coll., VII. 34. Widely distributed.

109. **Sphærium fabale** Prime.

Honey Creek, near Layton Park.

Sphærium occidentale Prime.

Kenosha (?) (as "*Pisidium occidentale*"), Mrs. Wiswall's list. Overflow pond of Milwaukee river at Lindwurm, C. E. Brown, July, 1903. "Wisconsin," Prime, Smith. Misc. Coll., VII, 41.

110. **Calyculina transversa** Say.

Mud Creek, half mile east of Teutonia avenue.

111. **Calyculina truncata** Linsley.

Common in Mud Creek east of Teutonia avenue bridge; abundant in a pool in Johnson's woods; Honey Creek, near Layton Park. "Wisconsin," Prime, Smith. Misc. Coll., VII, 51,—to which Dr. Lapham has added in pencil, in the public library copy: "Minnesota—not Wisconsin. I. A. L."

Calyculina jayensis Prime.

Kenosha (?) (as "*Sphœrium jayanum* Prime"), Mrs. Wiswall's list. "Wisconsin," Sterki in Naut. XVI, 92.

Calyculina partumeia Say.

Kenosha, Mrs. Wiswall's list. "Wisconsin," Prime, Smith. Misc. Coll., VII, 45.

Pisidium abyssorum (Stimpson) Sterki.

"Racine, Wis., Geo. T. Marston," and "Green Lake, Wis., Bryant Walker," Nautilus, XI, 125, species described.

112. **Pisidium compressum** Prime.

Mud Creek at North Milwaukee, identified by Dr. Sterki.

Pisidium fallax Sterki.

"Wisconsin," Baker, Moll. Chic. Area, p. 401.

Pisidium medianum Sterki.

"Lakes in Wisconsin," Naut., XIII, 11, species described.

113. **Pisidium noveboracense** Prime.

Mud Creek at North Milwaukee, identified by Dr. Sterki.

Pisidium pauperculum Sterki.

"Fox River, Wisconsin, Geo. T. Marston," Naut., X, 65, species described.

114. **Pisidium sargenti** ? Sterki.

Mud Creek at North Milwaukee; identified with doubt by Dr. Sterki.

Pisidium virginicum Gmelin.

"Wisconsin," Prime, Smith. Misc. Coll., VII, 62.

115. **Pisidium walkeri** Sterki.

Mud Creek at North Milwaukee, identified by Dr. Sterki. Described, Naut., IX, 75.

Dr. V. Sterki has kindly examined all the Sphæria and Pisidia, correcting the hasty identifications of the former made by Mr. Baker and myself, and identifying such of the latter as were in suitable condition. Material not yet identified has been secured from the following additional localities:

Sphærium: Lake Michigan beach, from pumping stations to Lake Park; Mud Creek at North Milwaukee; Menomonee river dredgings; Honey Creek.

Calyculina: Pond in Cabeen's woods, Chicago avenue.

Pisidium: Mud Creek valley at North Milwaukee and eastward; artificial pond near Kraatz's brickyard; Lake Winnebago, west of High Cliff, Calumet Co. Dr. Sterki thinks the latter may be an undescribed form.

These localities should be systematically canvassed in the spring for fuller suites of living specimens.

TWO NEW SPECIES OF PHORIDÆ.

BY CHARLES T. BRUES.

APHIOCHÆTA LONGIFRONS, sp. nov.

Male. Length 2 mm. Brownish-yellow; dorsum just before scutellum, tips of posterior femora, and most of abdominal segments, 2, 3, 4 and 6, black. Wings infuscated on apical third.

Head long and much flattened; front about two and one-half times as high as wide, rather sharply margined on the vertex, the ocelli not situated on a tubercle, but the median frontal line is distinct. Front brownish-yellow, blackened about the ocelli, subshining, but with a sparse and very coarse punctuation. Two proclinate bristles; next two rows above these consisting each of only two bristles, the median pair of each row being absent. The lower pair are placed midway between the median line and the eye, and the upper pair close to the eye margin. Third row and ocellar row complete, the third strongly bowed upward. Antennæ rather small, yellow, with long pubescent arista. Palpi pale testaceous, with normal bristles, short and broad in shape. Cheeks each with a series of long bristles and one especially stout macrochæta at the lower end of the eye. Thoracic dorsum light yellow, with a medium brownish vitta, posterior one-third blackish, with unusually strong and bristly hairs posteriorly. One pair of dorsocentral machrochætæ present. Scutellum whitish yellow, black at base; with four equally strong marginal bristles. Pleuræ pale, with a black stripe extending from the dorsum one-half way to the trochanters. Abdomen testaceous yellow; the second segment black posteriorly and widely so on the sides; third and fourth segments black, with yellow semi-circular markings anteriorly, fifth pale, sixth black. Venter pale. Hypopygium small, with four somewhat bristly hairs near the base of the long slender lamella. Legs very stout, testaceous, the tips of the posterior femora black, and the posterior tibiæ and tarsi lined with black. Four posterior tibiæ biseriately setulose, the setulæ large, almost equalling the width of the tibia on the hind legs, and on the middle legs fully as long as the greatest width of the middle tibia. Anterior tibiæ also with a single series of short and very closely placed setulæ. Tarsi of four posterior legs long and slender, those of the front legs no longer than the tibia, with thick, short joints, the third, fourth and fifth being nearly quadrate. Wings long and narrow, hyaline, distinctly infuscated on apical third, the discal veins but little curved. Costal vein reaching to the middle

of the wing, its cilia short, dense and closely placed. First vein ending a trifle closer to the tip of the third than to the humeral cross-vein. Third vein close to the costa, the cell at its furcation very narrow. Fourth vein faintly curved at base and recurved at tip, fifth and sixth but little curved, seventh very distinct. Halteres pale.

Described from one male specimen collected hovering about the burrows of *Tremex columba* in an old stump where *Thalessa lunator* and *T. atrata* were ovipositing. Milwaukee, Wisconsin, June 8, 1906. Type in the collection of the Milwaukee Public Museum.

Since writing the above, I have received an exactly similar male sent for identification by Mr. E. S. Tucker of the University of Kansas. It is labeled, twilight, Lawrence, Kans., June.

This is a very distinct species, easily recognized by its infuscated wings, long front and very spiny legs. The shape and peculiar chætotaxy of the front are similar to *A. epeiræ* Brues, but it is quite different in other characters, notably the non-thickened costal vein, and the presence of four scutellar bristles.

APHIOCHÆTA CAVERNICOLA sp. nov.

Male and Female. Length 2-2.5 mm. Black or piceous; legs, antennæ and palpi yellow. Head wide and short; the front fully twice as wide as high, sub-shining. Four proclinate bristles present, very long and stout and more nearly porrect than is usual in this genus. Following two rows slightly curved downward; ocellar row normal. Ocelli placed on a tubercle, the median frontal line present. Antennal cavity large and deep; the antennæ brownish-yellow, ovate, of moderate size; arista long, pubescent. Palpi large and rather slender, with the usual bristles; proboscis retracted. Cheeks each with a row of stout macrochætæ along the lower eye-margin; post-ocular cilia very long. Thoracic dorsum piceous, finely hairy and sub-shining, with no conspicuous bristles except a single pair of dorsocentral macrochætæ and a bristle on each side before the wing. Scutellum subtriangular, with only two marginal bristles. Abdomen long and narrow, black, sub-opaque, slightly shining in the female. Bare, except for a few short scattered hairs in the male. Male hypopygium small, the small lamella triangular and scarcely projecting. Legs long and slender; testaceous yellow. Tibiæ bare except for the slightest trace of ciliation on the posterior pair. Wings very large, tinged with brownish. Costal vein reaching a little beyond the middle of the wing, its cilia moderately long and rather thickly placed. First

vein ending midway between the humeral cross-vein and tip of third vein. Furcation of third vein not very acute, the cell formed of moderate size. Fourth vein strongly curved basally and straight apically, ending closer to the wing tip than the fifth. Fifth and sixth sinuate. Seventh distinct. Halteres pale yellow.

Described from four specimens representing both sexes, two collected in Wyandotte Cave, Indiana, received from Prof. J. M. Aldrich, and two others recently sent me by Prof. C. F. Adams, who writes me that they were collected by Mr. A. M. Banta in Mayfields Cave, near Bloomington, Ind. Types in the collection of the Milwaukee Public Museum.

Until recently I have considered this species to be only an extreme type of the variable *A. nigriceps* Loew, but a more careful examination leads me to believe that they are perfectly distinct. The front is much wider than in *nigriceps,* the legs are longer and more slender, and the palpi of the male are not at all enlarged. The hypopygial lamella is also much smaller.

This is the only true cavernicolous form so far to be discovered in North America, and has previously been referred to several times. In the American Entomologist for 1880, Hubbard mentions the occurrence of larva belonging to a species of *Phora* found feeding on offal in Washington Hall, Mammoth Cave, Ky. He describes the larva and pupa, but gives no specific name to the species. Packard in his Cave Fauna (1) quotes Hubbard's observations, but gives nothing further. In 1896 Aldrich (2) recorded as *A. nigriceps* Lw., what were presumably specimens from the lot here described from Wyandotte Cave, with the following note by Blatchley: "Taken from the mouldy remains of bread, chickens, etc., near the 'Augur Hole,' three-fourths of a mile from the mouth."

This is the second cavernicolous Phorid to be described, the European *Phora aptina* being also an inhabitant of caves. This latter species was found in the Adelsberg Grotto in Carniola, (3) and has been recently recorded by Bezzi (4) from the Covolo di Costozza near Venice in Italy. Bezzi considers the European species to be exclusively cavernicolous in occurrence, and the same is probably true of the American one here described.

Public Museum, Milwaukee, June 15, 1906.

(1) Mem. Nat. Acad. Sci., IV., p. 81 (1886).

(2) On a Collection of Diptera from Indiana Caves, Rept. Indiana State Geologist for 1896.

(3) [Schiner, Fauna d. Adelsberg Grotte (1853)].

(4) [Rivista Italiana di Speleologia, I, fasc. II (1903), p. 13].

DESCRIPTIONS OF PARASITIC HYMENOPTERA FROM CAPE COLONY.

BY CHARLES T. BRUES.

The species described in the present paper have recently been acquired by the Milwaukee Public Museum through the kindness of Dr. Hans Brauns of Willomore, Cape Colony. As the smaller parasitic Hymenoptera of this region are still practically unknown, it is not surprising that nearly all the species proved to be undescribed.

The types are deposited in the Milwaukee Public Museum.

FAMILY BETHYLIDÆ.

MYSTROCNEMIS CAPENSIS sp. nov.

Length 7 mm. Black; thorax, antennæ, tibiæ and tarsi rufous. Head seen from above, a little longer than wide, suddenly narrowed just before the eyes, and rounded-truncate on the anterior margin, overhanging the insertion of the antennæ. Antennæ 27-jointed, setaceous; scape stout, two times as long as broad, following joints all of about equal length, gradually narrowing, the last a trifle longer. First few flagellar joints nearly twice as wide as long. Eyes hairy. Pronotum about two and one-half times as long as wide, arcuately incised posteriorly; with a median impressed line. Mesonotum very small, subtriangular, the scutellum about twice as large, rounded and convex; metanotum nearly as long as the prontum, and considerably wider, obtusely pointed behind. Abdomen composed of five segments of nearly equal length, the sides subparallel; tip pointed. Legs stout. Anterior femora a little more than two times as long as wide, ovate in shape; the anterior tibiæ shaped like the femora, but only two-fifths as long. Anterior tarsi stout, the tarsal claws stout and strong, bidentate at tip. Claws of four posterior tarsi very slender, with a rather obtuse tooth beneath near the tip. Entire body sub-shining, covered with a short whitish pubescence.

Described from one female from Sunday River, Capland (O'Neil). This is the third species of this recently discovered genus to be described.

The type species was described by Kieffer in 1905 from

Burma,* and a second one by the same writer previously from Portuguese Guinea.** The present one is very similar to the other two, differing principally by its 27-jointed antennæ.

CONATOPUS PILOSIPES sp. nov. (PL. 1, FIG. 1.)

Female. Length 7 mm. Black, part of face and extreme tip of abdomen reddish or yellowish; everywhere clothed with long, thin, whitish hairs absent only on the antennæ. Head strongly concave about the antennæ and behind; shagreened, with a few indications of longitudinal striations near the ocelli, and with a few large punctures on the sides of the occiput. Face above the base of the antennæ smooth and highly polished, with a raised line extending from the base of the antennæ to the anterior ocellus. Lower half of the face on the sides with a stripe of dense white pubescence under which the ground color is pale. Clypeus yellow, the center blackened, the margin rounded-truncate with a fringe of yellowish hairs. Mandibles 3-dentate, pale basally. Palpi pale. Antennæ 10-jointed; scape and pedicel brown, the former pale beneath. Scape three times as long as thick, twice as long as the pedicel and half as long as the first flagellar joint, the following growing shorter so that the fourth flagellar is as long as the scape. Antennæ slender and of nearly equal width throughout, slightly longer than the thorax. Eyes bare. Thorax elongate, the stalk at the base of the posterior lobe longer than usual; pronotum with the transverse depression distinct but not very deep; shining throughout, except for oblique aciculations laterally behind; the lower front angles and a spot in the middle posteriorly, rufous. Posterior lobe tarnsversely aciculated behind and on the sides; longitudinally so in front above. At the base of the stalk with a small sharp tooth on each side. No meso-metanotal suture evident. Abdomen shining black, the extreme tip rufous. Legs shining black, the anterior knees and chelar claw reddish; anterior trochanters very narrow at the base, their femora stout, obclavate, very shining; tibiæ thickened except at base. Fourth tarsal joint a little shorter than the first, second and third together one-half as long as the first, the third nearly two times as long as the second; chelar claw but little curved, simple, not dentate; the fixed claw reaching to the base of the third joint with a small circular pad of lamellar hairs at tip. Posterior legs rather long

* Ann. Soc. Sci. Bruxelles, Vol. 29, pt. 2, p. 110.

** (Ann. Mus. Civ. Genoa, Ser. 3, Vol. 1, p. 363 (1904)).

and slender, the femora swollen only very close to their base, sparsely clothed with long hairs, those on the tibiæ about twice as long as the thickness of the tibiæ.

One female, Bothaville, Orange Free State, October 12, 1898 (Dr. Hans. Brauns).

This species is noticeable on account of its pilose body, resembling in this respect *G. cilipes* Kieffer from Paraguay.

GONATOPUS CAPENSIS sp. nov.

Female, Length 6 mm. Black, base of antennæ and clypeus pale; legs varied with rufous. Head strongly concave above the eyes and behind; finely shagreened, with indications on the front of microscopic longitudinal striations. Subopaque, with a raised median line extending from the base of the antennæ to the front ocellus. Eyes bare. Clypeus pale, with darker center; white pilose, with a yellow fringe anteriorly; front margin evenly arcuate. Mandibles pale, with three black teeth. Palpi pale. Anterior orbits below and cheeks pale, the former slightly whitish hairy near the lower corner of the eyes. Antennæ black, slender, reaching to the middle of the propodeum. First two joints brown, the scape pale yellow beneath, and clothed with long white pubescence. Scape one and one-half times as long as the pedicel and less than one-half as long as the first flagellar joint, following joints smaller, fifth flagellar as long as the scape. Thorax slender, the posterior lobe with a long stalk at its base, laterally toothed just behind the stalk. Anteriorly lobe microscopically punctate, sub-shining with an æneous cast. Transverse impression well marked, but not very deep, with a few transverse aciculations just behind it. Propleuræ punctured. Posterior lobe with an indication of a meso-metanotal suture, transversely aciculated behind and more finely so below, longitudinally aciculated medially in front. Abdomen shining black, not pilose. Legs moderately long, clothed with a few microscopic white hairs; anterior trochanters remarkably long and very slender, especially at the base. Front femora swollen as usual, their tibiæ very stout, except at base. Fourth tarsal joint as long as the three basal ones together, the second and third equal, together two-thirds as long as the first. Claw long and slender, curved at the tip, reaching to the tip of the first tarsal joint. Posterior legs slender, their femora swollen only at the very base.

Described from one female from Willomore, Cape Colony, Dr. Brauns.

This species resembles the preceding in size and habitus, but differs by its non-pilose body as well as by its differently formed legs and antennæ.

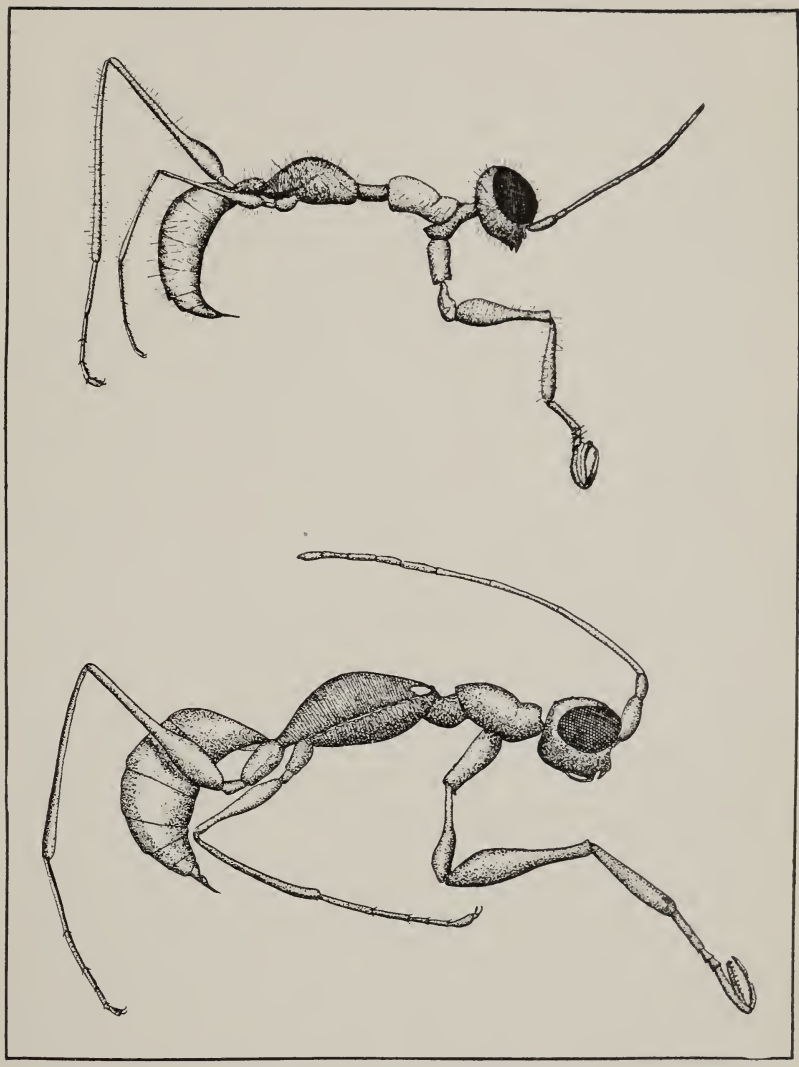
GONATOPUS VARIPES sp. nov.

Female. Length 3 mm. Shining black; the legs, except swollen parts of anterior femora and first two or three joints of antennæ yellowish or brownish. Head flatter than usual, broadly concave above the antennæ and deeply excavated on the vertex. Front highly polished, smooth except for a faint shagreened sculpture on the vertex and occiput. Front with a median line below the front ocellus to the base of the antennæ. Face just above the antennæ whitish pilose and microscopically transversely rugulose. Clypeus pale yellow, rounded in front. Mandibles whitish, with four dark teeth. Palpi pale. Antennæ rather stout and short, barely as long as the thorax; black, the scape and pedicel yellow and the first flagellar joint dark yellow with brown tip. Scape short, but strongly arcuate, pedicel three-fourths the length of the scape and a little more than half the length of the first flagellar joint; second flagellar joint two-thirds the length of the first, others slowly decreasing; last a little longer than the penultimate. Eyes bare. Thorax highly shining, microscopically shagreened, especially on the sides. Metathorax behind more coarsely shagreened or microscopically rugulose, but not aciculated. Pronotum without the transverse impression except a slight one very close to the anterior border. Anterior neck of posterior lobe irregularly longitudinally sculptured, the metathorax with no lateral tooth-like projections at the base. Abdomen very short and broad, clothed with a few long, thin, white hairs; black, the surface shining. Legs beset with a few long pale hairs; pale brownish-yellow, coxæ included; the basal two-thirds of the anterior femora black, and the four posterior tibiæ tipped with darker brown. The femora are all rather short and thickened on almost the entire basal half. First and fourth joints of anterior tarsi about equal, the second two-thirds the length of the third, the two together equal to the fourth. Chelar claw slender, curved toward the tip; chela reaching nearly to the base of second joint. Anterior trochanters with a short basal stalk.

One specimen received from Dr. Brauns, labelled Salisbury, Mashonaland, G. A. K. Marshall.

This is a pretty shining species, with conspicuously bicolored legs.

PLATE I.



EXPLANATION OF PLATE:

Fig. 1. Gonatopus pilosipes sp. nov. Female.

Fig. 2. Gynochelys braunsi gen. et sp. nov. Female.

GONATOPUS SIMILIS sp. nov.

Female. Length 3 mm. Brownish-yellow, the head darkened on the front; the abdomen piceous and the antennæ black, except base and tip. Head deeply excavated behind, and above the antennæ; brownish-yellow, blackened above the ocelli. Front with a median raised line from the anterior ocellus to the base of the antennæ; smooth and shining, shagreened toward the vertex, on the occiput, and on the sides of the face below. Lower orbits not hairy or pubescent. Clypeus strongly and evenly rounded anteriorly. Maudibles 4-dentate. Eyes bare; antennæ short, but not thickened, the scape slender, arcuate, one and one-half times the length of the pedicel; first flagellar joint about the length of the scape; second equal to the pedicel; following joints about two times as long as thick, gradually shortening except the last which is nearly twice the length of the penultimate. Scape and pedicel yellow, flagellar joints one to six black, seven piceous and eight yellow. Thorax bilobed, yellowish-brown. The prothorax with a transverse impression just before the middle and a narrow raised anterior margin. Pronotum finely microscopically punctured in front and shagreened behind the impression. Stalk of posterior lobe short; metathorax shining centrally, microscopically rugulose anteriorly and irregularly transversely aciculated posteriorly; not toothed at the sides anteriorly. Abdomen short, sub-triangular; piceous black, shining, clothed with short sparse pale hairs. Legs rather short, pale yellow, the swollen portions of the anterior femora and tibiæ brownish. Anterior trochanters long, with a rather long stalk-like basal portion. Femora swollen on almost the entire basal half. First joint of anterior tarsus a trifle longer than the fourth. Second and third about equal, together two-thirds the length of the fourth. Chelar claw slender, curved only at the tip; tip of chela reaching to the base of the third joint.

One specimen from Algoa Bay, Capland, May 25, 1898. Dr. Brauns.

This species resembles the preceding rather closely except in color. The flagellum of the antennæ is not so slender basally, however, the apical joint is longer, and the thoracic sculpture somewhat different. The body and legs also lack the whitish hairs which are conspicuous in *G. varipes*.

Both forms are exceedingly ant-like, and strongly recall species of the cosmopolitan myrmicine genus *Pheidole*.

GYNOCHELYS gen. nov.

Similar in general appearance to *Gonatopus,* but with the head subquadrate and front convex as in *Dryinus* and its allies or in *Chelogynus.* Antennæ with the first, second and third flagellar joints extremely elongated. Thorax distinctly bilobed as in *Gonatopus,* but with the mesonotum and scutellum differentiated although small. Wings present as vestiges in the form of small membranous pads. Meso and metapleuræ distinctly separated by a suture. Abdomen and legs as in *Gonatopus.*

The present form seems to differ quite radically from anything that has so far been described, and I think it worthy of generic rank in spite of our present very meagre knowledge of the Dryininæ. It does not seem to be similar to any of the numerous and very closely allied genera recently proposed by Perkins** to include the forms placed by other writers in *Gonatopus, Dryinus, Chelogynus,* etc. In Perkins' table (*l. c.*) it would fall into his genus *Eukœbeleia** on account of its vestigial wings. The latter has, however, the ordinary thoracic structure of the winged forms, while in *Gynochelys,* the thorax is profoundly modified and approaches the anomalous condition seen in *Gonatopus.*

GYNOCHELYS BRAUNSI sp. nov. (PL. 1, FIG. 2.)

Female. Length 5 mm. General color piceous, head black, legs and antennæ varied with paler brown; clypeus and mouth parts rufous; mesonotum and scutellum pale rufous. Head two and one-half times as wide as long, the temples obliquely truncated, vertex between the eyes rounded, gently convex; front also convex, or when seen from above, straight. Antennæ inserted at the base of the clypeus, very slender, as long as the head and thorax together. Scape short and stout, strongly curved; pedicel slender, half the length of the scape; first flagellar joint slender, almost twice as long as the scape and pedicel together, and three-fourths as long as the greatest width of the head; second and third joints decreasing, the third two-thirds the length of the first; the apical four joints shorter and equal. Mandibles slender, the outer tooth very acute. Palpi short. Front microscopically rugulose, with a raised median line. Ocelli small, placed in a small triangle, the vertex slightly margined just behind them.

** (Bull. No. 1, Sugar Planters' Experiment Station, Hawaii (1905)).

* *Eukœbeleia* is preoccupied by Ashmead's *Eukœbelea,* Proc. Wash. Ent. Soc., VI, p. 126 (1904), a genus of Chalcidoidea; but never having seen Perkins' species I would hesitate to propose another name.

Eyes large, bare. Cheeks large, nearly smooth. Thorax binodose, the posterior node the longer. Pronotum with a very deep transverse impression just in front of the middle; shagreened. Mesonotum distinct, but very small, scarcely one-fourth the width of the pronotum, and about as long as wide, narrowed behind. Tegulæ present, rufous. Wings as long as the mesonotum, whitish and without apparent venation. Scutellum convex, about one-half as long and narrower than the mesonotum. Posterior thoracic lobe consisting of the mesopleuræ and the metathorax, distinctly separated by a suture which extends obliquely along the side of the entire node. The metathorax is very coarsely transversely strigose, opaque, the metapleuræ and under side of the lobe more irregularly strigose. Abdomen ovate, pointed, consisting of seven distinct dorsal segments; the first segment rather strongly petioliform; surface shining, not hairy. Legs long, rufous or brownish, the anterior trochanters three-fourths as long as their femora, with a long narrow basal stalk which is longer than the swollen apical portion. First and fourth tarsal joints nearly equal, the second and third together one-half as long, equal. Chelar claw straight, strongly bent at the tip. The chela with the usual squamules rather sparsely placed. Middle femora thick, more strongly so on basal one-half. Posterior pair slender, swollen on basal half. Tibiæ and tarsi slender.

One female from Algoa Bay, Capland, Dr. Brauns.

I take great pleasure in dedicating this remarkable species to my friend and colleague, Dr. Hans Brauns of Willomore, through whose zeal and kindness I have been enabled to study the present interesting collection.

FAMILY SCELIONIDÆ.

SCELIO PULCHRIPENNIS sp. nov.

Female. Length 3.5-4 mm. Black, rugose, whitish, hairy; tarsi brownish; wings fuscous, spotted with white. Head flattened, seen from above a little over two times as wide as thick; the surface reticulate rugose, tending to form irregular oblique striæ about the base of the antennæ. Antennæ 11-jointed, the flagellum one and one-half times the length of the scape; pedicel as long as the first two flagellar joints; second and third submoniliform, equal, each two-thirds as long as the first; club 7-jointed, the joints of nearly equal length, somewhat over twice as wide as

long. Mandibles rufopiceous. Mesonotum and scutellum longitudinally rugose, sub-shining, no trace of parapsidal furrows. Metathorax finely reticulate. Abdomen as long as the head and thorax together, entire dorsum longitudinally aciculate; segments three and four each one-half longer than the second. Venter more or less rufous. Pleuræ rugose, the mesopleural piece more or less striated. Legs black, the four anterior tibiæ and the tarsi, rufous. Wings reaching almost to the tip of the abdomen; the submarginal vein visible only at the middle; stigma subobsolete or not developed, no stigmal vein. Basal half of wing hyaline, with a semi-circular hyaline spot on the anterior margin, half way between the stigma and the wing tip, also sometimes a less evident spot posteriorly nearer the wing tip. Hind wings hyaline.

Five female specimens, Algoa Bay, Capland, January 22, November 29 and December 11, 1896 (Dr. Brauns).

This species is a typical *Scelio,* rather remarkable on account of its pictured wings, in which character it resembles the following species.

SCELIO NITENS sp. nov.

Female. Length 3.75-4.25 mm. Shining, bluish black, everywhere sparsely pale hairy. Anterior legs pale rufous. Wings marked with fuscous. Head scarcely twice as wide as thick; surface polished on the vertex, with a few scattered punctures; central part of face and cheeks rugulose, more or less striate at the base of the antennæ. Mandibles rufous. Antennæ black, the tip of the pedicel yellowish. Flagellum one and one-half times as long as the scape. Pedicel as long as the first and second joints of the flagellum together, the second two-thirds as long as the first. Third and following enlarging to the club which is indistinctly 7-jointed, equal; the club joints two and one-half times as wide as long, the last triangular. Collar, mesonotum, and scutellum polished blue-black, with a few scattered punctures; the scutellum with a submarginal groove and a raised margin. Parapsidal furrows wanting. Metanotum longitudinally rugose, gradually sloping to the petiole. Abdomen shining, the dorsal surface longitudinally aciculate, more weakly so toward tip; third and fourth segments subequal, fifth and second subequal, each two-thirds the length of the third. Anterior legs, including coxæ, yellowish brown, the femora darker above; middle legs, including coxæ fuscous; posterior coxæ and femora piceous, tibiæ and tarsi rufous. Pleuræ finely rugose, the mesopleural piece smooth and polished, except for several striæ below. Wings reaching to the

tip of the fourth abdominal segment. Wings fuscous; the basal half hyaline with a fuscous band; and the apical half with two more or less distinct hyaline spots, one anterior and one posterior. Submarginal vein distinct on the basal half. Stigma well-developed ,piceous, drawn out into a point where the stigmal vein should be, the latter absent. Hind wings hyaline.

This species resembles the preceding on account of its similarly marked wings. The vertex, mesonotum and scutellum are smooth and polished, however. The legs are also lighter in color, and the wings have a well developed stigma.

Described from 6 female specimens, five from Algoa Bay, November 29 and February 6, 1896, and one from Uitenhage, Capland, October 16, 1896. All were collected by Dr. Brauns.

FAMILY ENCYRTIDÆ.

METAPELMA MIRABILIS sp. nov.

Female. Length 9 mm, including ovipositor which is almost as long as the abdomen. Head and thorax greenish æneous, the abdomen black, with greenish and purplish reflections. Legs piceous or black, the base of the posterior tibiæ white. Body covered everywhere with a dense, short, whitish pubescence. Head with coarse scattered punctures, the surface strongly shagreened; blackish on the front and very green below and behind. Mandibles fuscous with black tips; palpi black. Antennæ black, the scape strongly widened toward the tip; pedicel two times as long as the first flagellar joint; second nearly as long as the scape; wollowing distinctly shorter, except the last, nearly quadrate but not moniliform; last pointed, being obliquely and sharply truncated. Eyes strongly hairy. Pronotum and mesonotum shining green, with purplish reflections; very faintly shagreened, almost smooth. Axillæ and scutellums purplish black, the former with their points meeting medially. Metathorax short, depressed, abdomen gradually narrowed from the tip of the first segment to the ovipostor which is almost as long as the adbomen. First segment very long, second, third and fourth equal, each two-thirds the length of the first; all entire on the apical margin. Fifth, sixth and seventh segments narrower and very short. Ovipositor apical, very slender and knife-like, black with greenish reflections. Venter black, with faint reflections. Coxæ and anterior femora greenish, anterior tibiæ and tarsi brownish; middle legs piceous, the tibiæ lighter at tip, their spur three-fourths of the length of

the first tarsal joint. Hind legs black, the extreme base of the tibiæ black. Hind tibiæ very broad, and strongly flattened, cleaver-shaped, fully one-third as wide as long, the leaf-like part two times as wide as the thickened part; at the tip with two small apical spurs. Hind tarsi flattened, but scarcely over one-fourth as wide as the tibiæ. Metatarsus as long as the three following joints which gradually become narrower. Wings hyaline, tinged with brown behind the stigma; marginal and postmarginal veins equal, each two and one-half times as long as the knobbed stigmal vein.

Male. Length 5 mm. Much more slender, the legs very long. Apical joint of antennæ wider than the penultimate, ovate pointed, but scarcely obliquely truncate. Middle tibiæ much longer, their spur one and one-fourth times the length of the first tarsal joint. Hind tibiæ flattened, but not broader than the femora. Tarsi only slightly flattened. Wings without the stigmal spot. Otherwise similar to the female.

Described from two specimens, the female from Algoa Bay, Capland, Dec. 29, 1895, and the male from the same locality Nov. 11, 1905. Both were collected by Dr. Brauns.

This remarkable species is very similar to the North American *Metapeina specabilis* of Westwood,* but differs by its much more strongly compressed hind tibiæ, smoother thoracic dorsum and differently colored legs. I have had opportunity to compare the two through the kindness of Dr. Wm. H. Ashmead, who loaned me a specimen of Westwood's species.

*[Proc. Zool. Soc. London, Vol. 3, p. 69 (1835)].

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This publication is now issued by the Wisconsin Archeological Society.

Vol. 4. (NEW SERIES) OCTOBER, 1906. No. 4

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

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MILWAUKEE, WISCONSIN.

THE EDW. KEOGH PRESS, MILWAUKEE.

Entered as second-class matter, Oct. 24, 1906, at the post-office, Milwaukee, Wis., under Act of Congress of July 16, 1894. (Issued quarterly.)

The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6. 1857.

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These are all held on the last Thursday of each month, except July and August, in the lecture room in the Museum-Library Building, Milwaukee.

PUBLICATION.

The "Bulletin of the Wisconsin Natural History Society."

MEMBERSHIP DUES.

City Members, $3.00 per annum; Non-resident Members, $2.00 per annum; Life Members, one payment of fifty dollars.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 4, New Series. OCTOBER, 1906. No. 4.

NOTES OF THE HERRING GULL AND THE CASPIAN TERN.

(*Larus argentatus* and *Sterna caspia*).

By Henry L. Ward.

The Herring Gull is a permanent resident of Wisconsin, but not of the Milwaukee region. It comes to us from its northern breeding ground about the first of October and stays until the latter part of May.

To the urbanite it is particularly in evidence during the depths of severe winters, when the inhospitable ice fields of the lake force it to seek the rivers and basins that are kept open by passing vessels. From the down town bridges we acquire an intimate acquaintance with so much of its economy as has to do with its search for food under these artificial surroundings and in such unusual proximity to man. Normally this gull is a wary bird, seeming to appreciate the dangers of a close approach to that most destructive creature, man, and to have a fair idea of the range of a gun; but when the frozen lake forces it to seek food and shelter elsewhere its actions indicate that it is well aware that when between the factory lined docks of the river no gun will be raised against it. It is a cause for admiration to notice how quickly not only the gulls but hundreds of wild ducks, principally Old Squaws, Lesser Scaups and King Eiders, accustom themselves under the stress of hunger to this extraordinary proximity to man. When within twenty-five yards of a bridge constantly thronged with foot passengers and carrying a continuous procession of wagons, automobiles and clanging electric cars, these birds are much more at ease than they would be in open water with a man on the shore two hundred yards distant.

The first of July, 1905, a collecting expedition for the Public Museum of Milwaukee, consisting of Messrs. Brues, Shrosbree and myself, going north along the Lake Michigan shore of the Door County peninsula, arrived at Gravel Island, where we found a large breeding colony of Herring Gulls and Caspian Terns. But little could be observed of the habits of either of these birds, as we had not come prepared for such work; so after photographing nests and young and making such notes as were possible, we collected the specimens we required to produce a museum group that would do justice to the colony, and then continued our cruise to Washington Island and down the Green Bay shore of the peninsula. At Washington and Plum Islands we were told of another large colony of gulls at Gull Island, Mich., and, coming down the Green Bay shore, we found small colonies of Herring Gulls breeding on the Strawberry group.

At Sister Islands there were many gulls and terns, but none breeding, nor did we see any sign of terns nesting anywhere except at Gravel Island. The number of gulls was greatly in excess of what might be expected from the Strawberry colonies, and therefore we presumed that both species had come from the Gravel Island colony to feed. That these birds cover even greater distances in feeding was shown by the regular appearance of gulls and terns off Jacksonport, about twenty-two miles to the south, where we had seen them during some days' residence, and between which place and Gravel Island, as we came up the coast, we had noticed them flying. Between Newport and Europe Bay we frequently noticed the predilection of the gulls to fly over the woods rather than over the water, as though seeking terrestrial food; but I never saw them obtain any. Harting writes: "We have repeatedly seen Herring Gulls following the plough and seizing worms and larvæ from the newly turned soil. It is reported also that this bird feeds on grain." The same habits have been noted in this country.

In July of this year, Mr. Shrosbree and myself returned to Newport, from whence as a base we intended to make a detailed study of the Gravel Island colony. A serious accident to my companion compelled his return to Milwaukee after the first day, leaving me without competent or reliable assistance, and the news of a great personal bereavement reaching me a few days later

caused me to abandon the work which had shown promise of very interesting results. Forty-three good photographs were secured, which afforded exact data for mounting the gulls in the Museum's group, and so the main object of the trip was accomplished.

I shall probably be unable to continue the observations another season, as they will then have no direct relation to the museum work in hand, therefore, with a full appreciation of the insufficiency of my observations, I present them for what they are worth.

Our first view this year of the colony caused much disappointment, as it showed that the partnership in the island that existed in 1905 between the terns and gulls had been severed, and that only the gulls were present. It was also apparent that the season was farther advanced than last year, and that there was little opportunity of observing some of the younger stages.

The absence of the terns may, perhaps, be accounted for by our shooting a number of birds the preceding year. Of their habit in this matter Morris says: "* * * yet it has been remarked that when they are once disturbed they do not easily return to their nest, and are said even not to re-visit the same spot the following year if they are fired at."

In all, I remained in the midst of the colony twenty-seven hours, covering the periods from 10:20 A. M. to 5 P. M. of July 3d, and from 3:30 P. M. July 6th to 11 A. M. July 7th. This gave me a little over a solar day of gull life, and, while very interesting, it lacked much of the exhaustiveness required to elucidate some of the conundrums presented. For one whose business would permit, it would be worth while to keep such a colony under fairly close observation from the time that it formed in the spring until it disbanded in the fall.

Gravel Island lies east of the peninsula, about a half mile off shore and about three miles south of its northern end. It forms the western border of the ship canal leading to the passage through Death's Door. The foundation of the island is a limestone reef that here comes to the surface and has received a considerable quantity of gravel and sand, raising the island in its highest parts about three or four feet above the water. In form it is somewhat boot-shaped, its longer diameter approximately north and south. It is about a hundred yards long by thirty to forty yards wide.

On the sandy portions grow a few clumps of sedges, while this year, near the center and surrounded by coarse gravel, was growing about a square yard of turf. In 1905 there were a few drift logs, which were largely increased in number this season, indicating that the waves of the winter storms probably run clear over the island.

In 1905 the nests, eggs and young birds were in quantity, and although there were great numbers of gulls, the terns were considerably more numerous.

The gulls' nests were mostly shallow saucer-shaped affairs of loosely matted sedges, cat tails, small sticks, bits of bark, blocks of wood, bedraggled cast feathers and other beach litter. The nests measured were fourteen inches or more in outside diameter and about seven and a half inches inside. Considerable difference was noticeable in their construction. Some were two or three inches thick, composed mostly of sedges well matted together, making a nest that could readily be picked up and carried in the hands. Others contained much less material, were of a less homogenous nature and so loosely thrown together as to be removable only with great care. See Figs. 3 and 4, Plate 1.

The eggs were two or three, with apparently about as many sets of one number as of the other. This was not because of incomplete laying, as in most instances incubation was well advanced, or one or more of the young were out of the shell. There was much variation in the size and color of the eggs. Three eggs selected from an unselected dozen appear to represent the amount of variation usually seen, though probably not the extremes. They measure in millimeters as follows: 66½x48½, 69x51 and 78x48½. Another egg taken July 1-3, 1905, unmarked, from its coloration I believe to be that of a gull (though its size agrees well with those of the Caspian Tern). It probably represents nearly or quite the minimum in size, measuring 62x41½ mm. The variation in color of eggs is from Ridgeway's Isabella color to a greenish gray most nearly corresponding to his pea green. Eggs of both colors were taken from the same nest. Some are very evenly spotted, with nearly circular marks of bistre. In others the markings are irregular blotches, sometimes with a decided tendency to form vermiculate lines. The spots may be strongly massed about the larger end, or this portion may be less

marked than other parts. The colors are placed both on and beneath the surface of the shell. In the latter placement they appear not only much dulled but of a different shade. That they are of the same pigment may readily be demonstrated by scraping away the shell over these dull spots, when they will be exposed as bright and of the same shade as the others. The outlines given in the

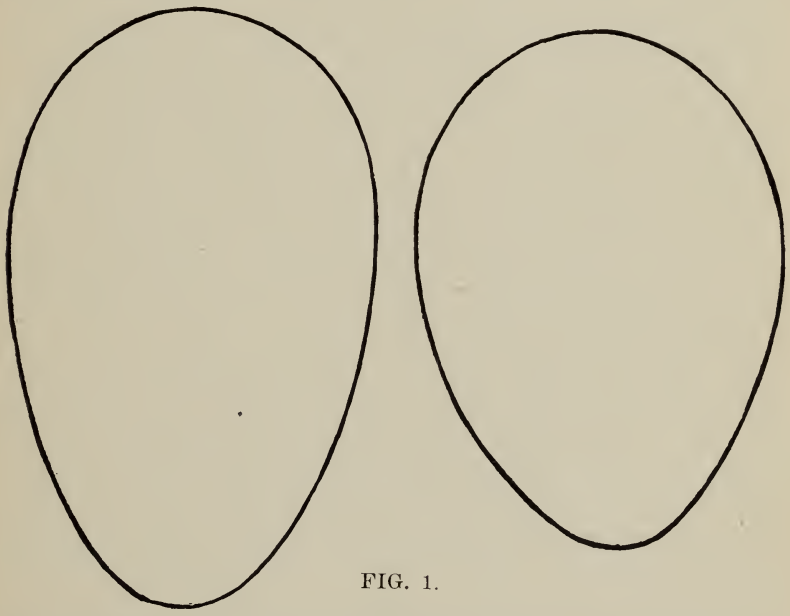

FIG. 1.

figure represent the exact sizes and shapes of two eggs from the above mentioned dozen and show normal variation.

The Caspian Tern makes a slight hollow in fine gravel or sand, which, without any lining, serves for its nest. This varies from five to six and a half inches in diameter, by an inch and a quarter deep. A most remarkable feature of these nests, and one which I believe was present in all, was that each was surrounded by a clearly defined belt of small gravel and shells. *Goniobasis livescens* Menke. was the prevailing species, interspersed with a few *Lymnæa catascopium* Say. Fig. 1 of Plate 1 shows a poorly focused Kodak picture of one of these nests. It has suffered a further loss of clearness in reproduction.

The external diameters of nests measured gave from twelve to fourteen inches across these belts. In collecting for the purpose of making a group to represent the colony, in a few minutes' time we scooped up with our hands from about the nests several quarts of these shells, whereas a fish barrel filled with sand and gravel taken with a shovel from the general surface of the island yielded none at all when examined at the museum. It would therefore appear that these were brought from a distance by the terns and not collected from the surface of the island. Although to our eyes these rings possessed a decorative value, we hardly believe that they were placed there by the terns for that purpose. It is also difficult to believe that they were deposited by fecal ejecta, for there were no indications that these birds soil their own nests, as would be necessarily the case were this the source of the shells. If these were ejected from the mouth as are indigestible portions of the food of some birds, we would not expect them to so evenly encircle the nests, as most birds appear to have fixed habits of orientation when incubating or brooding.

The gulls seemed to be rather unsettled in their nidification, tending to the construction of more flimsy nests; but the materials that were used in these were essentially the same as employed in their more massive ones. If the terns have degenerated in nest building we would hardly expect that a remnant of this instinct would be exercised on such unnatural material as these small conical gastropods. Probably close observation of the nidification and incubation of this tern will yield a simple explanation of this phenomenon.

The eroded character of the shells and the broken walls of one or two whirls of most of them seem much like the ordinary beach worn examples of these species as found upon the lake shore at Milwaukee; but it is possible that a short time in the digestive tract of a bird might produce similar erosions. In this connection the following remarks of Sharpe would indicate that the placement of shells about the nests has been noted in England, though the habit could hardly have been noticed in as well marked examples without eliciting more detailed mention: "The latter (its nest) is only a depression in the sand with a few shells or bents of grass for lining."

Ridgeway says of its nesting: "Unlike most other terns, and

conspicuously unlike the almost equally large Royal Tern (*S. maxima*), the Caspian Tern appears to breed in isolated pairs instead of large colonies, its nest being usually far removed from that of any other bird, and consisting merely of a shallow depression scooped in the sand, with little if any lining, though a few grass, or sedge, blades or other vegetable substances are sometimes added."

Both these authors mention the addition of grass, of which we saw none; and Ridgeway has found it a solitary breeder, while we found it in a colony of probably fifteen hundred birds, and its nests frequently less than a yard from its nearest neighbors.

Baird, Brewer and Ridgeway say: "The nests consisted of slight hollows in the sand, with a few sticks gathered round." The sticks could hardly be useful, and seem to indicate a remnant of a nest building instinct; or they might even be considered decorative. The subject should be investigated farther.

Variation is less marked in the tern eggs than in those of the gulls. Three specimens selected from a small number measure, in millimeters, 59x46, 60½x41½ and 64x42½. The ground color varies from cream to chalky white. The markings from fine dots, through spotted to blotched. One specimen noted is materially different in markings on one side than upon the other.

The laying of the Herring Gull at Gravel Island appears to be later than in many parts of North America, and its average number of eggs appears to be less. Hornaday writes of a pair nesting in the New York Zoölogical Park: "During the whole nesting period, lasting from April 1 to May 15, he either bluffed or fought to a standstill everything that came within ten feet of that nest." Several authors, without specifying locality, mention May as the laying month, while Audubon, writing of these gulls at the Bay of Funday, says: "Some individuals begin to lay about the 19th of May or a few days earlier, while others have not finished the process until the middle of June."

There is an unanimity among authors in assigning three as the proper number of eggs, yet in 1905 I noted that about half the nests had but two, and this year, out of five sets taken, four of them with large embryos, but a single set was of this larger number. Coues, writing of the gulls in Labrador, says: "The eggs, in all instances that came under my observation, were three in

number; in other respects they showed the great variation customary in this family * * * * * *. Early in July eggs were found in every stage of development, though in most instances the embryos were advanced. At the same time many newly hatched birds were caught skulking beneath stones or scrambling over the luxuriant moss."

It would thus seem that our Gravel Island colony is considerably later than those of the Bay of Funday, which is about the same latitude, and corresponds very closely in date of hatching of the young with those observed by Coues on the Labrador coast much farther north. This correspondence would, I fancy, extend fairly well to the temperature of the waters of the respective regions at the time of laying.

Several young of both gulls and terns were seen in the nests freeing themselves from the egg shells, and others came from eggs after we had removed them from the island. On emerging they are wet, weak and keep their eyes closed. After a short exposure to the air their down dries, and though the young yet lie prone, their eyes open and they look much smarter. Fig. 4 of Plate 1 shows a young gull probably about an hour after leaving the egg. The skin of the belly is greatly distended, enclosing a large yolk quite outside of the body lines, and which seems to be used as a sort of cushion on which the young lies. The absorption of this store of food probably requires some days, during which time it is very unlikely that other food is taken. Unfortunately we could make no observations covering either of these points, both from lack of facilities and the pressure of other work.

After the young were large enough to run about, we had no evidence regarding younger stages, they were fed herrings; frequently so large that an inch or more of their tails projected from the mouths of the birds while the heads were being digested.

On Gravel Island and on Strawberry Islands, when we picked up the rather drowsy looking young gulls, they would at the time or a few moments afterwards make a few violent contractions of their abdominal muscles and throw up a fish, after which they would be more lively and frequently fight viciously to recover their freedom.

In December, 1886, on the Triangles, off the Yucatan Coast, I found the Gannets nesting, and whe I approached they would

deposit a fish at my feet, a peace offering, I thought, to secure immunity from molestation, a tribute that they pay to the man-o'-war bird. These gulls were not, I take it, actuated by the same motive, but merely wished to rid themselves of ballast so as to get into fighting trim.

When this gull colony was visited this year most of the young were well advanced, nearly able to fly. (See Fig. 2, Plate 1.) They mostly kept together in a large flock, which I estimated to contain three or four hundred birds. It was too compact and kept too far away from my observation tent to allow of counting. Very likely it was larger, as it contained practically all the young of the colony. At one time I counted 360 adults upon the island, and estimated as many more in the air and upon the water. Seven hundred adults, if evenly divided as to sex, and all breeding, should have, barring accidents, about 875 young, and consequently my estimate of young was very likely too conservative. These young spent much of their time on the water, where, judging from the small number that sought to be fed by the adults, they probably obtained food for themselves.

The half dozen instances of adults feeding them that came under my observation were practically identical, varying only slightly in detail. The following is from my notes made on the spot while viewing the process: The young comes in front of an adult and with a bowing and courtesying movement puts up its bill to that of the old one, continuing the bowing for several minutes, resting between times. Sometimes it took hold of the adult's bill with its own, at other times merely touched bills. When the adult opened its mouth the young put its bill within. Failing to get indications of food, it went to another adult, and repeated the operation, passing in succession to several, until at length it seemed to get some favorable signs, for it remained by this one, alternately begging and resting. After some time it was apparent to me that the adult was striving to regurgitate. It would open its mouth, stretch its neck nearly horizontally, then bring its head down to the ground. After a moment it will close its bill, turn its head to one side and look at the ground over which it had been straining, as though expecting to find something there. Other gulls were from time to time attracted to the scene, but were

promptly chased away by this bird, who ran rapidly at them with open beak and outspread wings. Perhaps half an hour after these efforts began I saw a portion of a fish appear in its mouth, and a moment later it was deposited on the ground, where the young promptly seized it. The fish appeared to be a herring about 7 or 8 inches long and so mascerated that it readily fell apart. The adult assisted in breaking it up, and I saw it pick out the vertebral column, which it dropped with the other pieces.

The young fed mostly from the ground, but occasionally snatched a piece from the bill of the adult. One of my photographs shows a young bird taking food in this manner, see Fig. 1, Plate 2. After some minutes I noticed that regurgitation was apparently to be repeated, and in about a quarter of an hour the remains of another fish were deposited on the ground and disposed of in like manner.

My notes at 7:30 P. M. read: "The young on my part of the island are bobbing up and down before adults begging their suppers. I can not see that there is any family relationship kept up. Most of the young are herded together; the others seem to beg food indiscriminately. The bobbing of the young seems to induce a similar motion in the adult, and if its craw is full a fish must come—at last I have several times seen them disgorge fish when "challenging" and when there were no young near, and then reswallow it."

"4:20 A. M. A perfect mob of young about one adult appearing to be on the point of regurgitating."

From all appearances the identities of the young were so completely lost that no adult knew its own offspring, and it was quite apparent that the young begged food from any adult. It also seemed to me that the adults were rather loath to render tribute in this manner, that it was a case of compulsion by a kind of hypnotism. The bobbing or pumping motion induced a similar motion in the adults. If a fish was in the upper part of the digestive tract the contortions probably gave it an upward motion, and they and the retchings continued until it was expelled. If the fish was farther along in its journey it probably was not interfered with by the contortions, which then soon ceased.

In Fig. 3 of Plate 2 we have an attempt at regurgitation by one adult which had induced larcenous desires on the part of

another which drove back the waiting young and stood ready to snatch the fish should it appear.

The adults seemed to mildly object to feeding the young by trying to turn away and avoid the hynotic (?) influence, and I imagine that there was a certain degree of relief expressed in their actions when the inducement of regurgitation failed. It is hard to conceive that there should be anything pleasurable or voluntary in retching, gagging and vomiting for the benefit of an unknown young. It would be interesting to know whether this act is confined to one sex. The sexes were quite unrecognizable as they occurred on the island, but from the serial manner in which young went from one adult to another it is probable that no distinction in sex is made.

Both last year and this, when we visted the island, there were many dead half-grown young. Last year we were told that some summer visitors had gone to the island and wantonly killed birds; but some that were wounded and were put out of their misery by our party were injured about their heads in an inexplicable manner that caused me to doubt that they had been victims of tourists.

This season I had opportunity to see the manner of death of these birds, but could deduct no satisfactory explanation of the exciting cause. When first visiting the island, and still some hundreds of yards away from it, the young began to take to the water and swim away, so that when we stepped ashore nearly all had left. After the tent was set up and my companions rowed away, the return began, and in a few minutes the flock was swimming about close to the shore of the island. Several adults approached its flank and one began to deliver savage blows with its beak on the head of a young one, then seized it by the occiput and held its head under water, after which it pulled the half insensible victim about by its bill and legs. The young one ultimately reached the beach in a half insensible state and was lost to sight among the others. Several times I saw adults attack young in the water, but in all other instances the young escaped with little punishment. One that was hard pressed managed to reach a partially submerged rock, from which vantage point it put up such a savage fight as to quite disconcert and put to flight its persecutor. Again I saw young driven in shore onto the beach, and every adult near which it came would rush savagely at it,

driving it again into the water, until at length it reached temporary safety in the flock of young.

Those few stragglers near the center of the island that I saw attacked fared worse than those upon the water. The following account is from notes written in my observation tent while the action was taking place: "Time about 3:30 P. M., just after a rain squall. When this came up two of the smaller sized young huddled together beside a log. One showed by the livid color of its head that it had been maltreated. Soon an adult came up, grasped it by its upper mandible and dragged it out into the open, where it grasped it about the sides of the head and tugged it about. Then it let go and struck it several sharp blows on the head with the point of its bill, again grasped it about the head and pulled it about. When another adult came near, this one promptly let go its victim, sounded its challenge and again returned to its brutal task. After a time the young was exhausted and fell on its back, where it lay, occasionally kicking spasmodically with its legs. The adult plucked at its breast, tearing out beakfuls of feathers, pecked sharply at its wings, and also dragged it about by its wing feathers. Ultimately it left the young one lying motionless upon its back and apparently dead. However, after a few moments it began to move its members, struggled to its feet and attempted to make off. Several old ones intercepted it and one of them gave it another and similar beating, after which still another took a turn at the victim, whose head now looked much like that of a turkey buzzard. Finally it reached a log on which were two gulls that for some reason did not attack it, and here it stayed for some time, ultimately wandering to the beach, where it crouched miserably. Later on it again wandered inland and was set upon by an adult and so severely mauled that it was left apparently dead, though a half hour later it revived enough to crawl to the shelter of a log. This young is shown crouching beside the log in Fig. 1 of Plate 2.

While this last drubbing was being inflicted an adult bird flew to where the chastisement was being inflicted as though to interfere. It was immediately set upon by several onlookers and driven back eight or ten yards. Here it stood for some moments, facing those that had driven it, when it again attempted a sortie, but was restrained by the menaces of the others. Several of these

then picked up small pieces of wood in their beaks, put them down and again picked them up. Another sortie was again blocked, followed by more picking up and putting down of beach debris. Herrick mentions that often the gulls' sparring bouts come to naught "when one or both birds seem suddenly to lose all interest in the quarrel, and begin to pick up chips, pull grass, or stab a rotten log with their strong, chisel-pointed bills." In this case these actions were performed in an apparently ostentatious manner, and I could not help thinking that by them it was intended to convey some information to the restrained bird.

I was quite unable to determine why the young were attacked. In the last described occurrence the young was wounded, the victim of a previous attack, but in various other instances there was nothing in the appearance or actions of the young to distinguish it to my eyes from any of the others. The habit of killing the young appears to be fairly common. I saw several instances in my short stay, and the dead bodies of young with the skin and flesh cut away from their occiputs were mute evidences of the prevalence of the revolting habit. One of the wounded young I removed from the island to the house where I boarded to see if it would recover. It would not voluntarily eat either raw or cooked fish or other food, so we were in the habit of opening its bill and pushing food down its throat. From the first it was evidently a doomed bird, sitting all the time huddled up, with scarcely life enough to offer any resistance when handled. After a couple of days it was evident that it was becoming thinner and weaker, and so it was killed. I found that below the occipital wound the neck was badly infested with maggots. This is probably the cause of death of any that may escape actual killing by their persecutors. There was much evidence that they not infrequently are directly killed by the adults, though I did not happen to observe any completely despatched.

I was quite unable to see that the victims of these attacks were in any way abnormal, or that they had given any offense. Some times the victim of an attack had for some hours been unmolested in the midst of the adults, when, as in the instance described, it was set upon while in the most passive state. Rapid movement seemed always to excite the adults and a running young one was sure to be attacked by every adult near which it passed, but these

attacks that came under my observation consisted only of a few jabs of the beak on any part of the body, and none ended seriously.

In a recent article in a popular magazine descriptive of a gull colony at Lower Klamath Lake, Oregon, Finley writes: "By watching the actions of the parents, I soon discovered that their greatest anxiety seemed to be to keep their children crouching low in the nest, so that they would not run away and get lost in the crowd. I saw one young gull start to run off through the reeds, but he hadn't gone a yard before the mother dived at him with a blow that sent him rolling. He got up dazed and started off in a new direction, but she rapped him again on the head till he was glad to crouch down in the dry reeds.

"The parents seemed to recognize their own chicks largely by location. Several times I saw old birds pounce upon youngsters that were running about and beat them unmercifully. It seemed to be as much the duty of a gull mother to beat her neighbor's children, if they didn't stay home, as to whip her own if they moved out of the nest, but often this would lead to a rough-and-tumble fight among the old birds.

"Some times a young gull would start to swim off in the water, but it never went far before it was pounced upon and driven back shoreward."

Writing of the disagreeable conditions accompanying his observations he says: "We had to breathe the foulest kind of air on account of the dead birds and decaying fish scattered about * * * *."

Although the conditions at Finley's colony were somewhat different from those at Gravel Island, I am inclined to believe that the attacks on the young that he mentions, particularly when we consider the number of dead that polluted the air, were not greatly dissimilar to what I have described. The cause that he assigns for these beatings would not, however, be at all applicable to the Gravel Island occurrences.

In a description of the Laysan Albatross, Fisher, following an account of the regurgitation of food for the young, writes: "The young bird is not at all modest in its demands, but keeps asking for more. The old bird now pecks back in an annoyed manner, and if the other still urges, she arises and walks off, usually to some

neighboring young one, which she viciously mauls about the neck. This exhibition usually takes place just before she feeds her young and likewise between courses, as it were. Why she does this I am at a loss to suggest, unless it be mere ill-will. The old bird does not always confine this ill treatment to one strange young bird, but takes in a circle of those whose parents are absent. The young thus rudely treated sometimes bite back, but usually do not offer resistance, uttering instead a plaintive little squeak. A small mortality is the result of this practice."

Here again we seem to have a similar habit in a different group of birds, and perhaps Fisher's suggestion that it is the result of "mere ill-will" is as good as we can offer. At the time of observation I suggested in my notes that perhaps the cause was impatience at having the young to care for. I have recently asked in "Science" for the observations or explanations of others. It would be interesting to determine whether both sexes took part in this slaughter.

Several writers speak of the sexes of these gulls as if they were readily distinguishable. There is, I believe, no distinction at all in plumage, and the smaller size of the female, if it exists at all, is so slight that neither Mr. Shrosbree, a taxidermist of many years' experience, nor myself were able to predicate the sexes of any of the twenty or more adults that we skinned until we made the necessary dissection. Only in cases were I saw the act of copulation could I be certain of the sex of one of the live birds.

When this year I first set up my tent among the gulls there were three people in the boat that went to the island. A position near the center of the colony was selected, the tent quickly erected and my camera and other paraphernalia placed within. While my companions were close by I stepped inside and closed the flap; then they went to the beach, pushed off the boat and rowed away. Within ten minutes swarms of gulls were hovering low over the island and tent and screaming loudly. Within five or ten minutes gulls had gathered on the ground within one or two yards of the tent. In one hour and ten minutes after the boat left a gull alit upon the tent and spent some minutes there screaming, and from then until I left the island there was an almost constant succession of gulls upon the roof of the tent, and sometimes two at once. The

next time that I visited the colony, three days later, I was alone. I beached my boat, set up my tent and entered. Six minutes later the first of the young reached the island, followed two minutes later by the settling of the first adults, some on the island at its most distant point, but most in the water. It was an hour and thirty-five minutes before any came close to the tent, and not until half past four the next morning, or thirteen hours after setting up my tent, did the first one alight on it. The gulls on this occasion were quite uneasy and were frequently thrown into a panic by their own actions. The sudden alighting of a bird, or a fight between two, would frighten one, who, not waiting to see what was the trouble, would take wing, followed by one after another as the panic-formed wave swept over the island, leaving it almost bare of gulls. Fortunately they quickly recovered and returned, but their alertness and the frequent *"wak-wak, wak-wak"* of their note of suspicion showed that something bothered them. Apparently the departure of two people and the boat the first visit had deceived them into thinking that all had left the island, while on the second trip, although I had disappeared, yet no one had left the island, and for thirteen hours they remembered this and were suspicious. After the first gull alit on the tent they abandoned their suspicions and were as familiar with it as on the previous day.

Regarding the general intelligence of this bird the following from Audubon is pertinent: "They also take up shells in the air, and drop them on the rocks to break them. We saw one that had met with a very hard mussel, take it up and drop it three times in succession, before it succeeded in breaking it, and I was much pleased to see the bird let it fall each succeeding time from a greater height than before." Mackay states: "I have seen them carry up the same clam four times when it failed to break on account of insufficient height; but they will carry them up higher after several ineffectual attempts and thus obtain the desired result; they also carry up scallops (*Pecten concentricus*) and mussels (*Modiola modiolus*)."

When I first established myself in the colony I fancied that I must keep very quiet in order not to acquaint the gulls with my presence, and consequently took much pains not to rattle the stones under foot as I moved about within the tent.

The great feet of the gulls silhouetted on the roof of my tent as they stood upon it led me to experiment, and I was surprised to find that I could tickle them with the point of a lead pencil or even push it hard against them without apparently attracting the attention of the gull. Then I found that even when one was perched upon the pole I could strike sharp blows with a stone upon it without causing alarm. Not only must the jar from these blows have been violent, but it was also accompanied by a sharp noise. Carrying my experiments farther, I found that I could tramp about heavily on the loose gravel, could cough, whistle or sing without apparently causing the slightest uneasiness to gulls on top of the tent or upon the ground within a yard or two of its wall. I also found that I could smoke and that when a cloud of smoke issued from one of my loop holes and drifted full in the face of a gull a few feet away it appeared to produce no effect. A quick movement of the face or of a hand at one of these openings was sufficient to cause a stampede, which, however, seemed to be forgotten almost immediately. The black front of my reflecting camera with its sunken lense did not seem to disturb them and the considerable noise of its swinging mirror accompanied by the the swish of the shutter when an exposure was made produced no panic, although it sometimes attracted attention. It therefore seemed as if sight, and particularly that of a rapid motion, was about all that disturbed the gulls, and that they were remarkably obtuse to evidences of my presence that would have required little intelligence to appreciate.

The noises of the colony were continuous and varied. I fancy that I am safe in saying that there was not one second of the twenty-seven hours' observation but that one or more gulls was calling, and frequently there were several hundred screaming at once. Some times one hears sounds like the lowing of cattle, except that the pitch is higher, like the bleating of sheep, the mewing or snarling of cats, the clucking of hens, the crowing of cocks, hoarse human chuckles, and sounds for which I could find no comparisons. The first day that I was in the tent, at 3 P. M. a rain squall came up. Dark clouds obscured the sun, occasional flashings of lightning were seen and peals of thunder sounded from time to time. The wind came in cold sharp gusts. The shrill cries of the gulls were quickly subdued and a plaintive mewing was the

all-prevailing sound. English writers not infrequently mention the mewing of the gulls, but I had never before heard any number of gulls whose prevailing sound was so well described by that term.

Frequently the general clamor would be dominated by a peculiar cry which I put into words as *"yeh, yeh, yeh,"* rapidly repeated and increasing in vehemence to the utmost capabilities of the gull, when it quickly ceased. Usually a few seconds after one began another joined, until often there were a half dozen birds screeching at once, and occasionally this number would be increased to a score or more. This is a definite vocal effort, always produced in its peculiar attitude. Probably a dozen or fifteen of my photographs show one or more birds executing it, and some show six or eight engaged. Fig. 4 of Plate 2 shows a close front view of a couple of "challenging" gulls. Any thing that startles the gull without producing a panic, or the proximity of fighting birds, or even at times the approach of others seems to be sufficient cause for its production. The bird stretches its neck downward, opens its bill widely and begins the call, then with a jerky sort of start it stiffly raises its outstretched neck, usually to an angle of about forty-five degrees. Generally, almost invariably, the head, neck, body and tail are all held in practically the same line and in a remarkably stiff manner. The whole operation is so machine like in its rigidity and precision of motion that the gulls appear like a lot of automatons. If the challenge, or "scream of defiance" as Herrick terms it, is not answered it may cease in perhaps a quarter of a minute, but if answered it is continued to about double that time.

Another peculiar and definite combination of attitude and voice at once reminded me so of descriptions of the "dance" of the Albatross at Laysan that I at once entered it in my notes as a dance. It lacks much of the complexity of the Albatross dance, in fact, as I saw it many times repeated, it is but a single stage in that remarkable performance. A comparison of the birds in the foreground of Fig. 2, Plate 2, with Fisher's "First steps in favorite dance," Fig. 25, Plate 6, will show the similarity. Two adults may be standing near together when one will stoop, hold its neck nearly horizontal, its bill pointed down, move its head in and out from its body, and slightly up and down,

in a rapid jerky way, reminding one somewhat of the motions of a duck feeding in shallow water, at the same time emitting a peculiar chicken-like chatter. The other one immediatly joins in, apparently directing its attention to the same place on the ground, and the performance is kept up for a minute or two, when the birds straighten up; perhaps to repeat the operation two or three times with short intermissions. There was no assignable cause for the performance and no observable result. Without any satisfactory clew, it was suggestive of having some relation to the selection of a site or the building of a nest. Two birds usually took part, one of my photographs apparently shows three, but whether or not these were pairs I could not tell. There was a lack of point to the affair that leads me to suspect that it may be a remnant of a more elaborate ceremony indulged in earlier in the season.

Incipient nest building was going on continuously. There were, perhaps, half a dozen nests with fresh eggs, but most that I collected contained large embryos. I saw no new nest making that seemed likely to be carried to completion, but observed a score or more of gulls picking up sedges and other materials, carrying them to some spot, frequently beside a log, and depositing them. Not infrequently one billful would be all that would be brought to that spot, and no farther attention would be paid to it after it was laid down; but some gulls had a stronger trace of unsatisfied nesting instinct (as Herrick had called it) and brought several loads to the same place and went through the motions of moulding the nest. This was accomplished by dropping the breast onto the gathered material and with the posterior part of the body tilted upwards and the feet straining, pushing it into shape with the breast. There seemed to be no attempt to arrange the material with the bill. Late in the evening one bird near my tent who had gathered three or four handfuls of rubbish spent some time moulding it, and then complacently sat upon the shapeless mass for several hours.

Copulation occasionally, though rarely, took place on the island during my stay. I observed it three or four times. The preliminaries were short and were quickly followed by the female squatting slightly. The male then jumped upon her back, trod for some moments, then turned his tail sharply down and swung

it back and forth like a pendulum, brushing against the female's tail. She invariably raised hers to the left and he brought his down to the right. When coition was complete the female raised her neck and head straight upwards and the male caressingly rubbed his bill against hers and then jumped to the ground.

A few gulls were still incubating. The weather was pleasantly warm, though not hot, yet the sitting gulls, near enough for careful observation, kept their bills open most of the time, as does a bird suffering from the heat. Gulls standing about were not doing this. In these sitting birds the end of the tongue was curved upward, so that about an inch of it appeared rising from near the end of the lower mandible. In no other instances, whether screaming or doing anything else that required the mouth to be open, could the tongue be seen from a side view; apparently lying passively between the lower mandibles.

The gulls, adult and young, usually stood squarely upon both feet. It was very rarely that one was seen standing on one foot.

Sleep seemed to occur perhaps a little more frequently during the warmer hours of the afternoon than at other times, though pretty evenly distributed through the twenty-four hours. The birds sometimes stood, but more frequently squatted on the ground and turned their heads over their backs and tucked them under their wing feathers. Sleep was of very short duration, as fights, panics and alarms of various sorts followed one another too closely to allow of unbroken repose for more than a few minutes at a time. The night that I spent among them there was less sleep than during the day. The sun set about half past seven; but at eight o'clock the colony was as busy as ever fighting, making abortive nests and screaming. At ten minutes past eight the moon arose, and ten minutes later nearly all the gulls suddenly took wing in what I conceived to be a panic, until shortly afterwards I spied a large flock of them on the water in the direction of the moon. Later they worked around the island, so that I was between them and the moon, and I could then see that they were busily fishing. My notes continue up to a quarter of three, when I fell asleep with the gulls still on the water and noisy. When I awoke at twenty minutes after four the sun was up, most of the gulls were on the island and many young were teasing a few adults for breakfast.

At this season of the year there was no rivalry for mates and the fights that were frequently occurring were from petty causes only. None were severe or long continued and consisted mostly in one taking another unaware and pulling its tail or wing feathers. Occasionally a face to face encounter occurred, and in these the attempt seemed to be to grasp the opponent by one of the mandibles and drag him about. In these clinches one bird had the other by its upper mandible and was itself seized by the lower one. Which hold was considered the preferable I could not determine. The larger young were frequently fighting among themselves and were addicted rather to quick thrusts with their beaks than to pulling. Several times I saw clashes between fully grown and half grown birds, in which the latter were victorious. I imagined that a sort of chivalry kept the adults from fighting as hard as they might have done were their opponents larger, but the young were noticeably quicker and more savage in their thrusts.

It was with much regret at the fragmentary nature of my work and at the many unsolved problems of larine sociology which I must abandon, perhaps forever, that I discarded my mantle of invisibility by stepping out of the tent, and amid the frantic shrieks of nearly a thousand panic stricken gulls took my departure.

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EXPLANATION OF PLATES.

Plate 1.

Fig. 1. Nest of Caspian Tern containing three eggs. Taken with a kodak July 1, 1905. Out of focus and further obscured by reproduction.

Fig. 2. Young Herring Gulls standing near my tent.

Fig. 3. Nest of Herring Gull with three eggs taken July 6, 1906.

Fig. 4. Another gull nest with recently born young, taken on same day.

Plate 2.

Fig. 1. Young Herring Gull taking food from bill of adult; severely wounded young crouching by log.

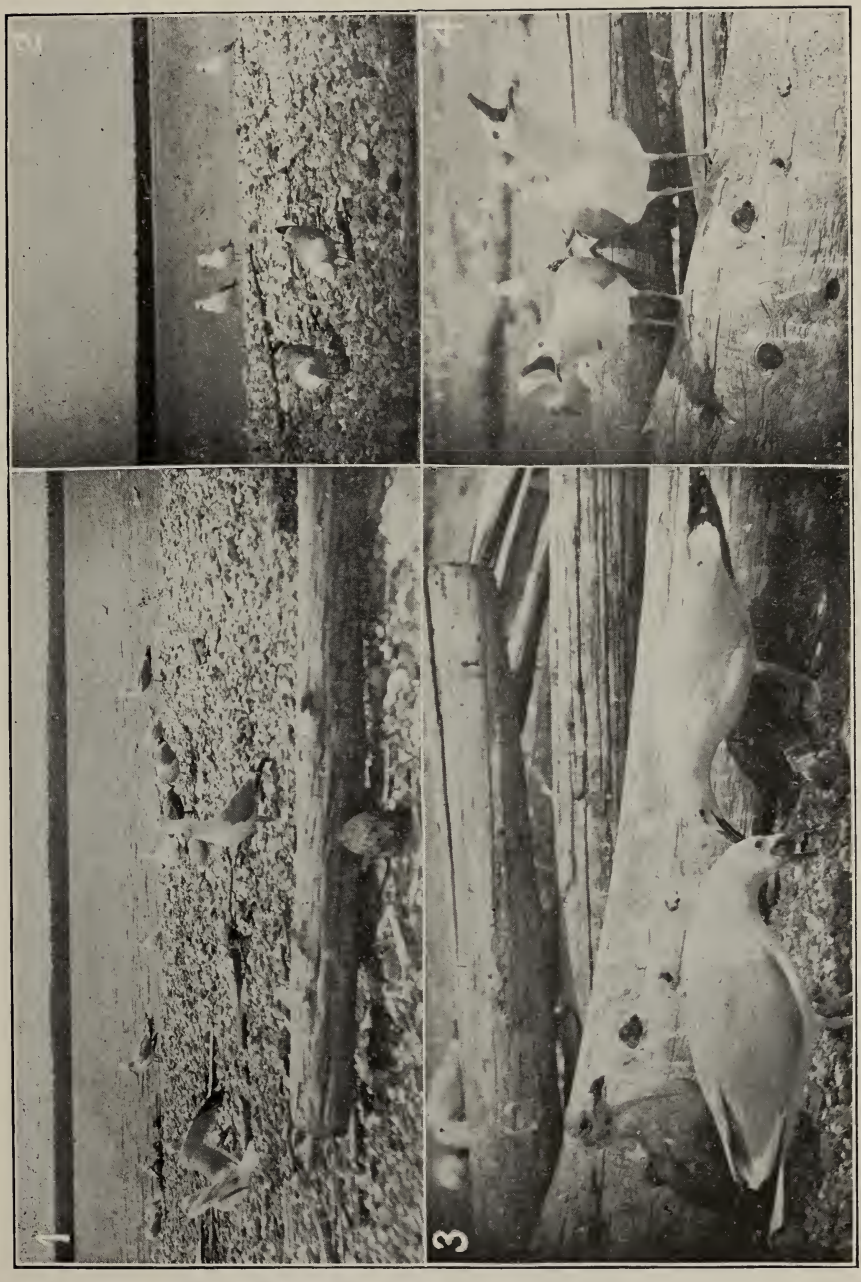
Fig. 2. Two gulls performing "dance."

Fig. 3. Adult attempting to regurgitate a fish for young. Another adult has come near while this one was unable to resent its approach, has driven the young back and stands ready to seize the expected fish.

Fig. 4. Adult gulls "challenging."

THE HERRING GULL AND CASPIAN TERN.

FOR EXPLANATION OF PLATE SEE PAGE 134.



THE HERRING GULL AND CASPIAN TERN.

FOR EXPLANATION OF PLATE SEE PAGE 134.

A CONTRIBUTION TO OUR KNOWLEDGE OF THE VISUAL MEMORY OF BEES.

By S. Graenicher.

Various writers have undertaken an explanation of the ease and certainty with which bees and wasps are able to find their nests, even when returning from a considerable distance. Within the last few years a rather spirited discussion of the questions involved has been brought about by A. Bethe, who has maintained that these insects are directed to their nests by an "unknown power," i. e., some mysterious power unknown to us. His views were derived mainly from studies of the honey-bee. On the other side, the observations of Lubbock, Friese, von Buttel, Forel, etc., on bees, and of Mr. and Mrs. G. W. Peckham, Bouvier, etc., on wasps, have established the fact that such an insect by making a careful inspection of the immediate and extended neighborhood of the nest in all its details, and storing up the manifold visual impressions thus gathered in its memory, is enabled to find its way back to the nest, as also to find its way from the nest to certain objects of interest, flowers and other sources of food-supply, for example. So far as bees are concerned, the highly specialized among them, viz., the social bees, have been studied in this connection, in the majority of the cases the honey-bee, but occasionally also the bumble-bees. I herewith offer the results of a few observations relating to this subject made on a solitary bee, *Alcidamea producta* Cr., and a parasitic bee, *Argyroselenis* (*Tricepeolus*) *minima* Rob.

A. **Alcidamea producta** Cr.

The nests of this species are situated in the dry stems of various plants, rather frequently in those of the blackberry, and the bee has to excavate the pith to a depth ranging from about 7 to 15 cm. or even more. This work of excavation requires a day or two, and while thus engaged the bee often interrupts its work, and flies around in the neighborhood, sometimes in search of food, but usually on a tour of inspection. On several occasions I have witnessed the actions of such a nest-building bee from the beginning on. After digging away for several minutes the bee

leaves the nest, and flies around the stem, and up and down along the latter, paying much attention to details such as thorns protruding from the stem, leaves, branches, etc. Thereupon the insect takes a look at some other stems or other objects in the vicinity, and returns to the nest for further work. After a while the bee reappears, goes over the field studied in the previous trip, extends its observations over a new stretch of territory, and reenters the nest. In this manner, dividing its time as it does between digging and inspecting, the bee gradually increases the depth of the gallery, and it also increases its knowledge of the topography of the surroundings. By the time the gallery has been completed and the bee is able to begin with the storing away of pollen and honey in the first cell it has become entirely familiar with the locality. When returning to the nest it passes objects of different size, shape and color, and its memory of these, as well as of the relative position of these objects to one another, makes it possible for the bee to find the nest with little difficulty. As the days pass by it gains through frequent practice, finally its actions become more or less automatic, and it flies swiftly and directly to the nest without seemingly taking any notice whatever of the objects en route.

A specimen of *Alcidamea producta* with its nest in a blackberry stem was observed at Cedar Lake, Washington Co., Wis., on July 20th, while at work carrying in the food-supply for a cell. The upper portion of the stem containing the nest was protruding slightly from a group of blackberry plants, and it was bending over so as to be nearly horizontal. The nest-opening was about 8 dm. above the ground. The bee was bringing in its load of pollen and honey about every 9 minutes on the average.

Two days later, on July 22nd in the forenoon, this same bee had provisioned all of its cells, and was engaged in closing the entrance to the nest with the customary plug, the so-called "outer defense," consisting of a paste of chewed pieces of leaves. On its way to the nest it came flying in along the group of blackberry plants following a direct course to the nest, and always appearing from the same direction for the simple reason that the strawberry plant, from the leaves of which it was obtaining its building material, was situated in that direction. This bee was certainly quite familiar with the locality, and I decided to change to some

extent first the site, and then the appearance of the nest-entrance, for the purpose of noting the effect on the bee's behavior.

The bee was visiting and leaving the nest as follows:

entering at 10:48:13 A. M.
leaving at 10:48:50 A. M.
entering at 10:49:10 A. M.
leaving at 10:51:20 A. M.

Experiment 1.— As soon as the bee had departed the stem was pushed upward, and in this manner the nest-entrance was placed 3 inches above the former site and brought into somewhat different surroundings.

At 10:52:10 the bee returned along the usual course leading to the former site of the nest-entrance. Not finding the latter immediately it started to fly around, and soon discovered the opening, but it made a careful survey of the stems and grasses around it before entering at 10:52:52, 42 seconds after its return.

At 10:53:35 it left the nest, and returned again at 10:54:10 to the former site of the entrance. It did not go in until 10:54:20 (10 seconds later), after having examined the surroundings as before.

In its subsequent visits it

returned at 10:56:58, entered at 10:57: 5 (7 seconds);
returned at 10:57:58, entered at 10:58: 0 (2 seconds);
returned at 10:59:40, entered at 10:59:42 (2 seconds);

always flying in too low before finding the entrance.

At the next visit, at 11:00:45, it flew directly to the entrance without an error, and the same was the case with all of the following visits at

11:1:30,
11:2:20,
11:3:40,
11:5:18,
11:7: 5.

Experiment 2.— The bee had evidently become acquainted with the new order of things, and a blackberry leaf with a round hole in the middle was pushed over the end of the stem. The entrance to the nest was now situated in the middle of the vertical green leaf, and this arrangement had given to the immediate surroundings of the nest opening quite a different aspect.

At 11:8:50 the bee returned to the opening, but seemed greatly disturbed, and did not enter until 11:9:10 (20 seconds later), after a thorough examination of the leaf by flying around it and behind it a number of times. It left as usual.

At 11:11:28 it was back again, but entered only at 11:11:35, 7 seconds later, and in the meantime made an inspection of the leaf. This it also did at the next visit at 11:13:50, but it went into the nest 3 seconds later at 11:13:53. At 11:16:10 it entered directly, without any hesitation, and from this time on it did not seem to pay any attention to the leaf whatever.

These experiments show that the solitary bee under discussion is capable of adding new visual impressions to its memory within a short time. It learns easily, and soon becomes acquainted with changes in the surroundings of its nest. In the first experiment the insect was guided by the new impressions from the sixth visit on, although the previous impressions had been the dominating ones throughout a comparatively long period. It is also interesting to note how from visit to visit the time spent in studying the new surroundings became shorter. The insect had evidently less to learn on each subsequent visit until it had become entirely familiar with the situation. In the second experiment the insect had overcome the difficulty at the fourth visit, and the time spent in studying the altered conditions was much less than in the first experiment. It would therefore seem that by changing the site of the nest we confront the bee with a more difficult task than by changing the appearance of the nest-entrance.

The actions of this bee when dealing with changes in the topography of the surroundings of its nest are identical with those exhibited when it has undertaken the building of a new nest. In each instance it submits the region around the nest to a thorough and repeated inspection, and keeps the visual impressions resulting therefrom in its memory. This is quite in accordance with the facts obtained for social bees and wasps as referred to at the beginning of this paper.

B. **Argyroselenis minima** Bob., a parasitic bee.

While watching a nest of the leaf-cutter bee, *Megachile latimanus,* at Cedar Lake, Washington Co., Wis., on the afternoon of July 13, 1903, I noticed a parasitic bee, *Coelioxys rufitarsis,* mak-

ing three visits to the nest within 27 minutes. This bee seemed to possess a certain knowledge of the locality, since it always found the entrance to the nest, hidden among the grass on a hillside, nearly as easily as the owner itself. At that time I was under the impression that it was always the same individual returning to the nest.

Last year at the end of September I dug a nest of the same species of leaf-cutter bee out of a clay-bank at Milwaukee, and after having replaced the earth, and in this way removed all traces of the nest, I was surprised to see a parasitic bee, also *Coelioxys rufitarsis,* appear near the former site of the nest, and hunt around as eagerly as if it was looking for a nest of its own. This observation strengthened me in the belief that parasitic bees, or some of them at least, after having come across a suitable nest of a host-bee, become acquainted with the locality, and return to the nest from time to time.

In order to settle this question it seemed to me essential to follow up the actions of a parasitic bee from the time that it made its first acquaintance with a nest of a host-bee. Such an opportunity presented itself in the summer of the present year, and I offer an account of the observations in detail, as contained in my notes.

August 12, 1906.

A nest of *Colletes eulophi* Rob. is situated in a clay-bank in Lake Woods (between Milwaukee and Whitefish Bay), the opening to the nest being about 3 dm. below the top of the bank. A specimen of a parasitic bee, *Argyroselenis minima* Rob. comes flying leisurely along the bank, examining every hole or crevice on the look-out for a nest of its host-bee. It discovers the nest of *Colletes*, and shows much excitement, crawling over the ground with quivering wings, approaching the nest from different sides, and looking in, but not entering. It soon takes up a position on a small plant about 2 dm. above the nest, and waits patiently and motionless until the owner arrives with its load of pollen and honey, and disappears in the nest. Thereupon *Argyroselenis* becomes restless, undertakes a general preening of its body, the antennæ first and again becomes quiet. After the departure of the owner, the parasite first goes through the preening process

again, and enters the nest at 12:10:15 P. M., staying in until 12:11:20. It then spends nearly 6 minutes studying the territory around the nest, at first only the immediate vicinity, but gradually extending its excursions to a distance of 3 m. to the east and west, also above, flying over the top of the bank, and below. It frequently returns to take a look at the nest, and it rarely ever passes through the neighborhood of the latter without taking notice of it. At 12:17 it departs but is back again at 12:31, and this time, judging from its behavior, it is less excited than at first, it displays a certain familiarity with the surroundings, and leaves again after looking at the nest.

August 13.

I arrived at the nest at 11:14:30 A. M. The parasitic bee (probably the same specimen) was already there, sitting on a rootlet above the nest. At 11:15:10 the host-bee arrived, entered, and left again at 11:26:25. During these 11 minutes the parasite became impatient, and changed its position quite frequently, sometimes sitting to one side of the nest, sometimes to another on some small plant, but always facing the nest. It usually took a glance at the latter when flying from one plant to the other. It acted as if more at home and much more unconcerned than yesterday. It remained quiet for about 20 seconds after the departure of the owner, and then it visited the nest, remaining inside only about 15 seconds. After this several excursions along the bank on both sides of the nest were made, the parasite always turning its head towards the nest when passing by. It then left. Its behavior on this day pointed to an intimate acquaintance with the locality. At 12:8 P. M. I went away, and up to this time the parasite had not returned.

August 14.

At 9:36:20 A. M. I visited the nest and found *Colletes* engaged in clearing out the nest. *Argyroselenis* was already there, flying around the nest, but before long it alighted on a leaf nearby. I felt certain that I had been dealing throughout these days with the same individual of *Argyroselenis minima*, but in order to leave no doubt about this I caught the specimen at 9:40, marked the back of the mesothorax distinctly with a bright red crayon and set it free. It flew away and had not returned again at noon, when I left.

August 15.

At 9 A. M. the nest is still closed, although the weather is bright and warm. At 9:20 our old acquaintance *Argyroselenis*, easily recognized by the bright red mark, arrives, inspects the nest, and, as usual, takes up a position on a small plant. It waits until 10:18, but the nest has not yet been opened, and it flies away. Every once in a while it returns, examines the nest-entrance, and alights on a neighboring twig or leaf, remaining motionless for many minutes at a time.

August 16.

An examination of the nest showed it to be completed and closed definitely. This had undoubtedly been the case the previous forenoon. Nothing more was seen of *Argyroslenis*, nor of *Colletes* the owner of the nest.

It is quite evident that after having discovered the nest this parasitic bee pursued a course similar to that of a host-bee when constructing a nest. It started out to make a careful and repeated inspection of the environment of the nest, gradually covering more territory in different directions, but often returning to the nest as the main object of its attention. Being possessed of a good memory for visual impressions it became acquainted with the locality within 6 minutes, and experienced no difficulty in refinding the nest at its next visit after an absence of 14 minutes. It gradually acquired a thorough familiarity with the topography of the region, and on its return to the nest it was seen to fly towards the opening as directly as the owner itself.

Such a parasitic bee when hunting for a nest of a host-bee is not always flying around in a haphazard way, trusting to its good luck in finding a nest here to-day, and one somewhere else to-morrow. When it has come across a suitable one it is very careful to keep this under observation, and in making its trips to and away from the nest it is directed by its visual memory in exactly the same manner as the host-bee itself. It would not be in the interest of such a bee to pursue a different course. The work of the host-bee in constructing a cell, and providing it with the food-supply must have progressed to a certain point before the parasitic bee may find it suitable for the reception of the latter's

egg. For this reason such a bee usually has to make repeated visits to the nest, in order to be on hand when the right time comes. If it were in the habit of wandering around until it happened to come across a host-bee's cell in the proper stage of construction, then it might not get much chance to deposit an egg within its lifetime of a few weeks duration, especially in rainy seasons. It is even possible that a parasitic bee has more than one nest under observation during the same period.

Of course I do not wish to be understood as applying the statements set forth above to parasitic bees in general, but I have good reasons for believing that in this respect the behavior of the species of *Tricpeolus, Coelioxys* and *Stelis* known to me agrees with that of *Argyroselenis minima.*

NOTES AND DESCRIPTIONS OF NORTH AMERICAN PARASITIC HYMENOPTERA. II.

By Charles T. Brues.

BETHYLIDÆ.

Pristocera hyalina sp. nov.

Male. Length 7.5 mm. Black, the wings hyaline, body less coarsely sculptured than in *P. armifera* Say. Head strongly punctured, the punctures distinctly separated toward the vertex and widely so on the cheeks. Mandibles and palpi entirely black; antennæ 13-jointed setaceous, first flagellar joint one-third longer than the second, others sub-equal and gradually lengthening to tip. Collar closely and evenly punctured, pleura of prothorax punctured above, smooth medially and obliquely striate below. Mesonotum with four furrows, shining, strongly and sparsely punctured, the scutellum smoother. Coxæ and pleuræ with well separated and only moderately strong punctures. Metathorax distinctly areolated basally, irregularly rugulose elsewhere. Abdomen oval, shining. Wings hyaline, stigmal and submarginal vein black, other veins brown. Marginal cell open, not narrowed. Discal nervures not indicated; sub-median cell indistinctly longer than the median. Legs black, the tarsi piceous. Body everywhere sparsely clothed with grayish white pile.

Described from a male specimen from Austin, Texas; collected by the writer.

This species comes near to the common *P. armifera* Say, but differs by its hyaline wings and less strongly punctured body. The difference in punctation is most marked on the cheeks, pleuræ and coxæ.

Epyris secundus n. nov.

Epyris analis Kieffer, Ann. Soc. Sci. Bruxelles, Vol. 29, pt. 2, p. 17 (1905), (nec Cresson, Trans. Am. Ent. Soc. IV, p. 193 (1872).

Aphelopus varicornis sp. nov.

Female. Length 1.75 mm. Black, legs and first two antennal joints light yellow; face below the ocelli white. Head finely shagreened, shining black, the face white below the frontal ocellus. Clypeus trun-

cate, mandibles white with three black teeth; palpi white. Antennæ 10-jointed, the scape and pedicel yellow, flagellum black; scape and pedicel about equal, stout; second and third flagellar joints the longest, about equal; first and fourth equal but shorter, fifth, sixth and seventh shorter, the apical one one-half longer than the penultimate. Mesonotum black, shagreened, with distinct furrows on the anterior two-thirds. Metathorax rounded behind, areolated and rugulose. Abdomen small, compressed, shining back, a little shorter than the thorax. Legs, including coxæ, pale yellow, the posterior femora and tibiæ infuscated. Wings hyaline; stigma rhomboidal, radial vein a little longer than the stigma, faintly curved at the tip.

Described from a female specimen collected at Woods Hole, Mass., July, 1903.

The present species resembles *A. melaleucus* Dalm., but differs in the color and configuration of the antennæ. It could hardly be the female of *A. americana* Ashm., of which only the male has been described, on account of the truncate clypeus.

CERAPHRONIDÆ.

Ceraphron Jurine.

Since the publications of Ashmead's Monograph of the North American Proctotrypidæ in 1893, four additional North American species have been described, and the two added here bring the total up to twenty-four species. As pointed out by Dalla Torre (Cat. Hym. V, p. 524) *basalis* Ashm. (nec Thomson) must be known as *tertius* D. T. I cannot adopt his change of *fusciceps* Ashm. to *secundus* D. T. as the name *fusciceps* is not identical with Ratzeburg's *fuscipes*.

Our species, exclusive of West Indian forms, may be distinguished by the following table, which is based almost entirely on females:

NORTH AMERICAN SPECIES OF CERAPHRON.

1. Winged 2
   Wingless, or with abbreviated wings..... 21
2. Head, thorax, and abdomen black..... 3
   Body, or at least the abdomen in part pale or brownish..... 17

3. Antennæ unicolorous, entirely black or fuscous (at least in the female) 4
Antennæ bicolored, at least the scape pale or yellow..... 9
4. Legs entirely black..... 5
Legs in part yellow or pale..... 6
5. First flagellar joint 2½ times as long as thick, penultimate 1½ times as long as thick (male).....**glabricornis** Kieffer
First flagellar joint 4 times as long as thick, penultimate 2½ times as long as thick (female) .....**unicolor** Ashmead
6. Pedicel not longer than the first flagellar joint..... 7
Pedicel as long as the first and second flagellar joints together **salicicola** Ashmead
7. Second abdominal segment a little longer than the rest united, second flagellar joint hfalf the length of the first. **melanocerus** Ashmead
Second abdominal segment twice as long as the rest united.... 8
8. Female. Second flagellar joint ⅔ the length of the first. **carinatus** Ashmead
Male. Flagellum longer than the body, scape brownish yellow. **carinatus** Ashmead
Male. Flagellum considerably shorter than the body, scape black .....**brevicornis** sp. nov.
9. Head and thorax closely, distinctly punctate..... 10
Head and thorax smooth, or at least finely shagreened..... 11
10. Pluræ aciculated, flagellar joints 2-5 transverse. **punctatus** Ashmead
Pluræ smooth, flagellar joints 2-5 longer than thick. **quissetensis** sp. nov.
11. Legs uniformly yellow or pale brown..... 12
Legs with the femora and tibiæ infuscated, wings subfuscous, first flagellar joint as long as the pedicel, flagellum subclavate. **amplus** Ashmead
12. Thorax black, collar sometimes pale..... 13
Collar black, maculate with yellow on each side, post-scutellum not spined, first flagellar joint ⅔ as long as the pedicel **croceipes** Brues
13. Wings clear hyaline..... 14
Wings subfuscous or tinged with yellowish..... 16

14. Second flagellar joint quadrate..... 15
Second flagellar joint transverse.....**flaviscapus** Ashmead
15. First flagellar joint twice as long as thick....**nevadensis** Kieffer
First flagellar joint one and one-half times as long as thick...
mellipes Ashmead
16. Tegulæ black .....**pedalis** Ashmead
Tegulæ pale .....**glaber** Ashmead
17. Thorax black or piceous..... 19
Thorax brownish-yellow..... 18
18. Head black, abdomen brownish-yellow..**melanocephalus** Ashmead
Head brownish-yellow, abdomen black .... **californicus** Ashmead
19. Flagellum of antennæ brown (male)..... **longicornis** Ashmead
Flagellum in part black..... 20
20. Flagellum of antennæ entirely black, only the scape rufous, wings hyaline ..... **pallidiventris** Ashmead
21. Four or five apical joints only, black; wings tinged with yellow-
tertius Dalla Torre
Entirely black, with slight traces of wings, legs golden yellow
auripes Ashmead
Not entirely black..... 22
22. Entirely yellow or brownish-yellow..... 23
Black, only the base of the abdomen yellowish, antennæ except scape black, wings entirely absent..... **minutus** Ashmead
23. Wings entirely absent, vertex of head fuscous **fusciceps** Ashmead
Wings present, but short and narrow, reaching only to the middle of the first abdominal segment, antennæ black except base of scape .....**crassicornis** Harrington

Ceraphron brevicornis sp. nov.

Male. Length 1.3 mm. Black, legs piceous, the tibiæ and tarsi honey-yellow. Head shining, smooth, shagreened below on the face; vertex impressed laterally behind the ocelli, and with a slight impressed groove extending back from the anterior ocellus and a similar one on the front below the ocellus. Antennæ entirely black; scape a little shorter than the head height, flagellum a little shorter than the body; pedicel small, moniliform; first flagellar joint 2½ times as long as thick and fully three times as long as the pedicel; second flagellar ⅔ the length of the first, the two together about as long as the scape; following each as long as the second, the last ½ longer. Thorax smooth, shining,

scarcely shagreened, the median line strongly impressed; axillæ meeting distinctly before the scutellum, the latter 1½ times as long as wide, with a marginal frenum. Pleuræ smooth, the metapleuræ above slightly striate or rugose; hind coxæ rugose. Postscutellum with a short pyramidal spine; lateral angles of metanotum acute, its surface rugose. Abdomen about as long as the head and thorax, the second segment about 1½ times as long as the remaining segments together, striate on the basal fourth. Legs brown, the femora strongly darkened medially, the coxæ black, rufous at their tips. Trochanters, tips of tibiæ and tarsi honey-yellow. Wings distinctly tinged with fuscous, more strongly so anteriorly. Stigmal vein long and curved, 2½ times as long as the stigma.

One female from Milwaukee, Wisconsin, June 1, 1906.

This species resembles *C. carinatus* Ashmead, but differs from the male of that species by its shorter flagellum and black scape.

Ceraphron quissetensis sp. nov.

Female. Length 1.4 mm. Black; the legs, including coxæ and base of antennal scape yellow. Head rather strongly punctate, about twice as wide as thick antero-posteriorly; vertex not or scarcely impressed behind the ocelli, the median impressed line evident from behind the ocellus to the edge of the facial basin which is deeply impressed. Antennæ 10-jointed, slender, not incrassate toward the tips. Pedicel scarcely longer than the first flagellar joint; second, third, and fourth flagellar joints equal, each two-thirds the length of the first, the second not quite twice as long as wide; fifth, sixth, and seventh growing longer, the last joint one-half longer and sharply pointed. Scape and flagellum black, the basal half of the scape yellow; the scape half the length of the flagellum. Mesonotum distinctly punctulate, the median line distinct; axillæ united in front of the scutellum, the latter about one-half longer than wide. Postscutellum spined; pleuræ smooth, except the upper part of the metapleuræ which is more or less irregularly roughened and not distinctly ridged above. Posterior angles of metathorax strongly produced into sharp, pointed teeth, the lateral angles also projecting angularly. Wings strongly tinged with fuscous; the marginal vein curved, almost closing the cell. Abdomen black, very highly polished, 1½ times as long as the head and thorax together; second segment about two times as long as the remaining ones taken together,

coarsely striate on its basal two-fifths. Legs, including coxæ pallid yellow, the posterior coxæ rugose.

Aside from its punctate body, this species may be distinguished from *C. melanocerus* Ashm. by its acute metathoracic angles; from *C. pedalis* Ashm. by its dark wings, and from *C. glaber* by the length of the antennal joints.

SCELIONIDÆ.

Telenomus heracleicola sp. nov.

Female. Length 1.25 mm. Black; legs yellowish red, with black coxæ; antennal scape yellowish at base; mandibles except tip and palpi, yellow. Head two and one-half times as wide as long, the front highly polished medially, on the sides shagreened; hollowed out just above the antennæ, the depression divided by a short median carina; vertex shagreened. Eyes very faintly pubescent. Antennæ rather slender, the flagellum almost two times the length of the scape. Pedicel narrowed at base, at the tip wider than the first flagellar joint; first flagellar one and one-third times the length of the pedicel and one and one-half times as long as the second; third and fourth moniliform. Club five-jointed, the three middle joints largest, quadrate, last joint scarcely longer than the penultimate. Thorax oval, the mesonotum finely punctate, dull, sparsely pruinose. Abdomen as long as the thorax, first segment coarsely fluted; second striate at the base, about one and one-half times as long as wide, following segments very small. Legs yellowish red, the coxæ black. Wings hyaline, marginal vein about two-thirds the length of the stigmal. Post-marginal somewhat less than two times the length of the stigmal.

Male. Similar, but the antennæ are filiform, the flagellum two and one-half times the length of the scape, the pedicel two-thirds the length of the first flagellar joint, the second flagellar about one-third longer than the first; fourth and following decreasing, the last equal to the pedicel.

Described from four females and one male sent me by my friend Professor A. L. Melander. He tells me that they were reared from butterfly eggs collected on a species of *Heracleum,* at Pullman, Washington.

Macroteleia kiefferi n. nov.

Macroteleia rufipes Kieffer, Berliner Entom. Zeit. Vol. 50, p. 264 (1905), nec Cameron, Invertebrata Pacifica, Vol. 1, p. 52 (1904).

By a queer coincidence Kieffer described this species from Nicaragua as *rufipes*, overlooking Cameron's description of *rufipes*, which is also from Nicaragua, both species having been collected by Professor Baker.

The two are apparently distinct, *kiefferi* differing by the quadrate joints of the antennal club, which are plainly transverse in *rufipes*. The latter species also has a longer abdomen.

Sparaison graenicheri sp. nov.

Female. Length 4.5 mm. Black, coarsely rugose, but still rather shining; tibiæ and tarsi reddish. Head seen from above as wide as long, the frontal ledge on the same plane as the vertex with a broad sulcus along its anterior margin. Surface of head very coarsely rugose-punctate, the under side of the ledge transversely arcuately striated. Mandibles and palpi black. Antennæ black, scape much swollen at the tip below, slender at the base, about four times as long as the pedicel, the latter two-thirds the length of the first flagellar joint; second to seventh flagellar joints about equal, quadrate, or slightly transverse, the second narrower at the base; eighth, ninth and apical joints of equal length but growing narrower. Collar and mesonotum sparsely and deeply punctate, shining, parapsidal furrows indicated only by a series of more or less separated punctures, the scapulæ with a slight, weakly defined groove. Scutellum about two times as wide as long, coarsely confluently punctate, except for a median smooth space. Post-scutellum longitudinally spined. Metathorax emarginate behind, the posterior angles distinct but not much produced; its upper face with a series of six longitudinal carinæ. Abdomen elongate oval, almost as long as the head and thorax together; strongly longitudinally striate, the tip punctate. Venter shining, coarsely and sparsely punctate, the sutures crenulate. First segment wider than long; second to sixth decreasing in length; seventh rounded at the tip. Legs black, whitish hairy; anterior tarsi and tibiæ reddish, the latter strongly spinous; posterior tibiæ and tarsi fuscous or piceous. Wings strongly infuscated, the submarginal vein not united with the stigma; postmarginal ill-defined, as long as the thin, curved and knobbed stigmal; radial nervure indicated except at the tip.

This species is characterized by its short, broad frontal ledge, punctate scapulæ, short flagellar joints, metathoracic sculpture and rugose head.

I have a single specimen from Milwaukee, Wis., July 27, 1906. It was collected by my friend Dr. S. Graenicher, after whom I take great pleasure in dedicating the species.

Pantoclis nicaraguana n. nov.

Pantoclis rufipes, Kieffer, Berliner Entom. Zeit., Vol. 50, p. 278, (1905), nec Szepligeti, Zichn. Ergebn., II, p. 157.

DIAPRIIDÆ.

Galesus Curtis.

Ten species of this genus have been recognized as occurring in North America, including the one described here as new. They may be recognized by the following table.

NORTH AMERICAN SPECIES OF GALESUS.

1. Sides of the vertex cornuted, or furnished with angled prominences 2
   Head not cornuted above the antennæ, head only a little longer than wide ..... **floridanus** Ashmead
2. Antennal prominence emarginated medially between the antennæ 3
   Antennal prominence rounded, not emarginate..... 8
3. Coxæ black 4
   Coxæ pale or reddish; antennal scape black, flagellum more or less reddish, middle lobe of thorax with a fovea posteriorly. **politus** Say
4. Abdominal petiole longitudinally grooved or fluted above..... 5
   Abdominal petiole rugose above with a median carina, antennæ of female rufous, legs ferruginous, wings not emarginate at apex ..... **autumnalis** sp. nov.
5. Antennæ in part reddish or rufous, wings not or scarcely emarginate at the tip..... 6
   Antennæ entirely black, wings deeply emarginate at apex **atricornis** Ashmead

6. Head but little longer than wide, legs rufous, middle flagellar joints not longer than wide ..... **pilosus** Ashmead
   Head much longer than wide, legs honey-yellow or reddish 7
7. First flagellar joint longer than the second, median sulcus on second abdominal segment much longer than the lateral ones ..... **texanus** Ashmead
   First flagellar joint much shorter than the second, second abdominal segment with three short sulci at the base **viereckii** Brues
8. Antennæ black 9
   Antennæ brown, frontal prominence with a broad diamond-shaped fovea above scapulæ sulcate near the tegulæ ..... **quebecensis** Provancher
9. First flagellar joint of male only ½ as long as the pedicel or the second flagellar joint ..... **microtomus** Kieffer
   First flagellar joint at least as long as the pedicel or the second flagellar joint ..... **clarimontis** Kieffer

Galesus autumnalis sp. nov.

Female. Length 2.5 mm. Shining black, impunctate. Antennæ rufous, darker at the tips; legs ferruginous, the coxæ black. Head polished, about two times as long as wide. Vertex anteriorly deeply sulcate, with two tuberculous teeth on each side. Antennal prominence deeply emarginated so that it appears bilobed; its margin translucent brown. Face on each side of a median raised portion concave; mandibles ferruginous, black at the tips; posterior margin of cheeks arcuately concave. Antennæ reaching to the base of the metathorax; 12-jointed, moderately clavate, rufous except the club, which is piceous. Scape very strongly angulated below just beyond the middle. Pedicel thick, not quite twice as wide as long; first flagellar joint nearly as long as the pedicel, but more slender; second, third, and fourth moniliform; fifth to ninth widening, the fifth quadrate moniliform; sixth transverse moniliform; seventh one-half wider than long; eighth transverse moniliform; ninth quadrate moniliform; tenth ovate, as long as the two preceding taken together; these last three of equal thickness. Mesonotum with the furrows wide apart behind and divergent, not reaching the anterior margin; scapulæ not grooved. Scutellum as wide as long, with two large, oblique, almost confluent foveæ at the base; with a punctate margin. Metathorax short, rugose, with a Λ-shaped

carina above. Abdomen not quite as long as the head and thorax together, the petiole twice as long as the hind coxæ; irregularly striate on the sides; above with an enclosed rugose space traversed by a delicate median longitudinal carina. Second segment at the base with a median sulcus as long as the petiole and a short lateral one on each side; following segments smooth, impunctate, scarcely projecting beyond the second. Wings yellowish-hyaline, not emarginated at the tip. Legs ferruginous, stout, the coxæ black.

Described from a female collected by the writer at Fox Point, Milwaukee Co., Wis., October 27, 1906.

The sculpture of the petiole will serve to distinguish the species. It seems to be more closely related to the European *G. rufipes* Thoms, than to any North American species.

Public Museum, Milwaukee, October 16, 1906.

ON THE HABITS AND LIFE-HISTORY OF LEUCOSPIS AFFINIS (SAY). A PARASITE OF BEES.

By S. Graenicher.

J. H. Fabre (1) has presented us with a very detailed account of the habits of the European *Leucospis gigas,* a parasite of two species of mason-bees of the genus *Chalicodoma,* and further on I shall compare his results with those obtained from a study of our species, *L. affinis.*

My first acquaintance with the larva of *Leucospis affinis,* a Chalcidid parasite of bees of the genus *Osmia* was made from a nest of *Osmia pumila* Cr., collected at Cedar Lake, Washington Co., Wis., September 27, 1903. The nest was situated in a dead branch of an elder, and contained two cells placed longitudinally. One of the cells contained a male specimen of the bee ready to leave the nest, but still enclosed within its cocoon. It may be stated in this respect that in this, as well as in the two additional species of *Osmia* to be considered in this paper (*O. atriventris* Rob. and *O. simillima* Sm.) the bees reach the imago-stage in the fall, but pass the winter inside of their cocoons, and leave the nest in the spring. The same has been reported for several species of *Osmia* of Europe, the habits of which are known.

The second cell of the nest of *Osmia pumila* under consideration harbored a full-grown larva of the parasite *Leucospis affinis* inside of a cocoon (spun by the Osmia-larva), and this pupated on May 28th of the following year, and made its appearance as an imago on June 27th.

In an additional nest of the same species from the same locality found in the dead stem of a sumac, altogether four cells were present, and three of these were infested by *Leucospis affinis.* At the time the nest was opened (July 31, 1905,) the parasitic larvæ were already fully developed, but they too passed the winter in the larval stage.

From a nest of *Osmia atriventris* in a piece of dry bark (Cedar Lake, July 31, 1905,) two larvæ of this same parasite were obtained.

1. J. H. Fabre, Souvenirs entomologiques, Vol. III, pp. 154-177, pp. 212-218.

On September 18th of the same year I came across a very young larva and an empty egg-shell of *Leucospis affinis* in a nest belonging to a third species of *Osmia, O. simillima.* The larva of the parasite was crawling around on a dead larva of *Osmia,* it did not seem to thrive on this kind of a diet, and died two days later. A cell of another nest of *O. simillima* collected on the same date contained also a dead larva of the bee inside of its cocoon and an egg of the parasite adherent to the inner wall of the cocoon. These two nests of *O. simillima* were found at Milwaukee in small pieces of driftwood lying on the beach of Lake Michigan.

The most valuable information was obtained from a nest of *Osmia atriventris* situated in a broken off dry branch. A specimen of *Leucospis affinis* was observed ovipositing in three different places close together near the end of the branch between 11 A. M. and 12:15 P. M. on July 11th of the present year. On opening the nest two days later it was found to contain three cells of *Osmia* situated about 7 mm. below the upper surface of the branch in the old gallery of a coleopterous larva running longitudinally. These 7 mm. represent the distance the ovipositor of the parasite had to travel through solid wood before reaching the cavity of the cell. In this, and in the other two species of *Osmia* referred to above, a paste consisting of chewed pieces of leaves is made use of in the construction of the partitions between the cells and the plug closing up the outer end of the gallery. In the nest under consideration the plug had a length of 9 mm. and each of the three cells one of 7 mm., giving the entire structure a length of 3 cm.

In each of the cells an egg of the parasite had been deposited, and it is an interesting fact to be recalled further on that while the lowest cell contained a full-grown bee-larva just beginning to spin its cocoon, and the middle cell also a full-grown one, the larva of the uppermost cell had only reached half of its size, and still had a fair amount of food to dispose of.

Mode of oviposition. While in search of a suitable spot for inserting its ovipositor the parasite was observed walking slowly over the branch in the region outside of the *Osmia* nest, palpating the surface with its antennæ, and at the same time moving the abdomen upward and downward. The antennæ alternate in their palpating movements, the one going upwards while the other goes downwards. As soon as a spot has been selected the insect turns

its body around in such a manner as to bring the tip of the abdomen just over the point palpated by the tips of the antennæ. Thereupon the ovipositor is brought into action. This has its origin on the lower surface of the abdomen, but is bent up over the back of the latter. Standing high up on its legs the insect bends the tip of its abdomen forward under its body, and by boring movements forces the ovipositor down through the wood. This was done by the insect under observation in three different places corresponding to the three cells of the bee's nest, and in each instance it took about ten minutes to complete the work. After it had got through with all of the cells it spent a considerable time resting on the branch.

The European *Leucospis gigas* has to drive its ovipositor through the hard cement comprising the walls of the nest of the mason-bees *Chalicodoma muraria* and *C. sicula*, and according to Fabre it spends at times three hours before reaching the cavity of the cell.

Egg. The slightly curved egg of *Leucospis affinis* (Fig. 1) shows a small knob-shaped tip on the rounded cephalic pole, while the other end is drawn out into a long, slender process. It reaches a length of about 1½ mm., and shows under the microscope an elegant sculpture, due to numerous small papillae covering the egg-membrane. It differs in appearance from the egg of *Leucospis gigas* (Fig. 2) with its hook-shaped slender process as illustrated by Fabre.

Larva. In the larva of *Leucospis* we are dealing with a marked degree of hypermetamorphosis and the conditions met with in the European species *L. gigas* have been considered very thoroughly by Fabre. If the size of the head of the larva before the first moulting, the so-called "primary larva" is correctly represented in Fabre's illustration of the primary larva of *L. gigas* (Fig. 4) then we have in our species *L. affinis* (Fig. 3) a more advanced degree of hypermetamorphosis since the head of the latter is comparatively much larger. In other respects the larvæ of the two species seem to agree pretty closely.

Of the three eggs of *Leucospis affinis* found in the cells of *Osmia atriventris* not one was in contact with the Osmia-larva, every one of them was attached to the wall of the cell.

At 6 A. M. on July 14th a newly hatched primary larva was

discovered in one of the cells, at the same time a larva was noticed coming out of a second egg, and at noon a larva appeared from the third egg. These eggs had undoubtedly been deposited on July 11th around noon, and we may therefore estimate the duration of the egg-stage at about 66 to 72 hours. Such an egg is fastened by the tip of its slender process to the wall of the cell or the inner surface of the cocoon, and it protrudes free into the cell-cavity or the cocoon-chamber if the cocoon has already been constructed at the time of oviposition. During the process of hatching the cephalic end of the egg is forced open and lifted up like a lid, and the head of the larva appears. After crawling out the larva still remains clinging to the egg-membrane by means of the enlarged anal segment. In this position it sways its body in different directions, as if trying to gain a hold, and it probably succeeds in sooner or later coming in contact with the body of the bee-larva, since the latter occasionally changes its position. One of these parasitic larvæ was placed on a bee-larva, and it at once secured a hold with its mandibles.

The most conspicuous part of the primary larva of *Leucospis affinis* is the large head with its rather firm covering of chitinous substance. In addition to the head the body consists of thirteen segments adorned with four rows of long, stiff hairs, viz: a lateral row on each side along the lower surface, and one along each side above. Fabre also describes such hairs in the larva of *L. gigas,* and he refers to those along the ventral surface as locomotory organs ("organs ambulatoires"), although he witnessed the curved larva walking around on the bee-larva in a similar manner as a so-called measuring worm (larva of a Geometrid-moth) walks around on its plant. In our species of *Leucospis* we notice the same peculiar movements. At first the head obtains a hold with the mouth parts, and then the curved body is drawn forward, and brings the anal segment near to the head. In turn the anal segment holds fast to the surface, the head is pushed forward for a new hold and in this manner the larva moves over the surface. I can not see any reason for regarding the lower hairs as organs of locomotion as Fabre has done in the case of *L. gigas.* They are probably tactile organs, and furthermore, they may serve the purpose of protecting the small and delicate larva from being crushed between the bee-larva and the surrounding walls.

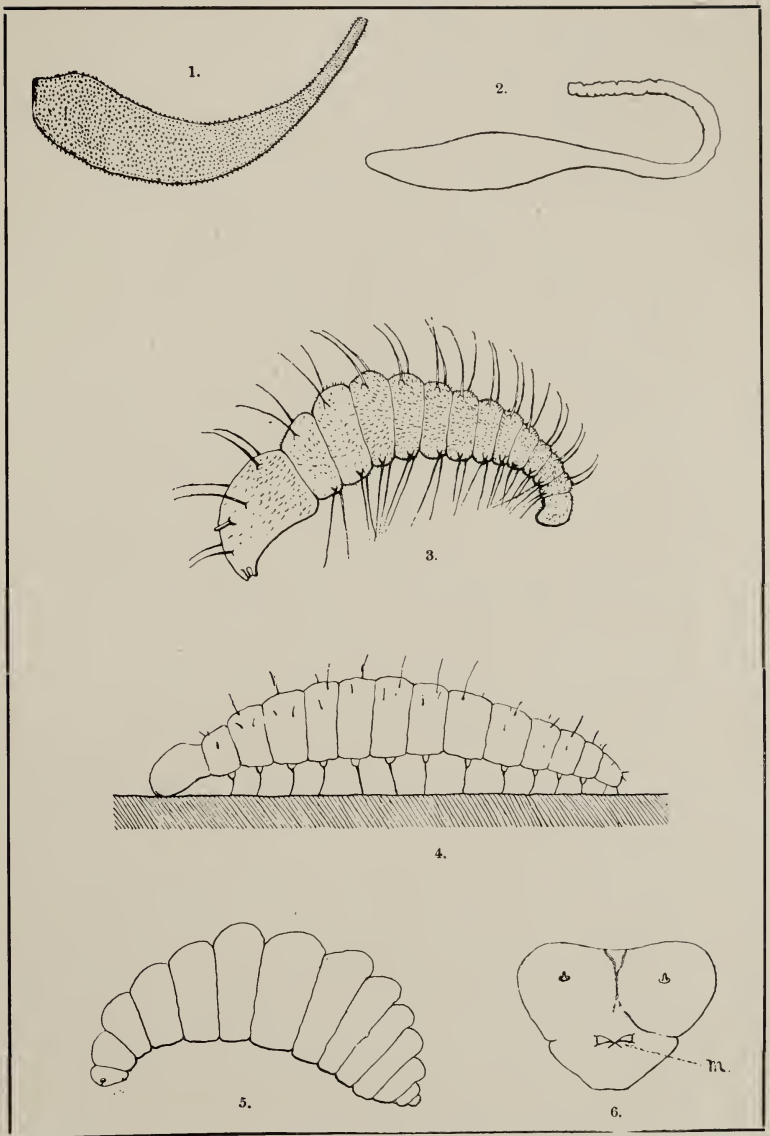


Fig. 1. Egg of *Leucospis affinis* Say.
Fig. 2. Egg of *Leucospis gigas* Fabr. (after Fabre).
Fig. 3. Primary larva of *Leucospis affinis* Say.
Fig. 4. Primary larva of *Leucospis gigas* Fabr. (after Fabre).
Fig. 5. Full grown secondary larva of *Leucospis affinis* Say.
Fig. 6. Front view of head of secondary larva of *Leucospis affinis* Say.
m Mandibles.

Fabre often found two or three and in one instance even as many as five eggs of *Leucospis gigas* in the same cell of a mason-bee, but never more than one primary larva. He always observed this larva making repeated excursions over the body of the bee-larva, and even around the inner wall of the cocoon, and he was led to believe that these were undertaken for the purpose of destroying any rival egg or eggs that might be present in the same cell. Later on he witnessed the destruction of the remaining eggs by the first-born larva. I have not yet come across more than one egg of *L. affinis* in an Osmia cell, but the number of such cells under observation has been altogether too small. Judging from our acquaintance with several other hymenopterous parasites of bees, as also from the behavior of the primary larva of *L. affinis*, we may feel assured that in this species also more than one egg may be deposited in a single Osmia-cell. The primary larva of this species shows a marked degree of restlessness, and spends most of the time crawling over the Osmia-larva or even leaving the latter and moving around on the wall of the cell or cocoon. We are informed by Fabre that the corresponding trips of *L. gigas* around the wall of the cocoon of the mason-bee are made for the purpose of destroying the rival eggs. The size and strong build of the head in the primary larva of our *L. affinis* seem to me to indicate that such a larva is destined to undertake not only the crushing of harmless eggs, but also the destruction of an equally powerful rival larva. I desired to study the attitude of two such larvæ toward each other, and placed them together with an Osmia-larva in a small glass-tube of the same size as an Osmia-cell. During the day one of the larvæ attacked and killed the other one and sucked its contents, and in the evening nothing was visible of the conquered one but the shrivelled remains. The bee-larva serves as food for one parasite only, and when more than one egg has been laid in a single cell, only one larva issuing therefrom can survive.

The first moult causes some considerable changes in the appearance and behavior of the larva, and in its new form it is called by Fabre a "secondary larva" (Fig. 5). The bulky head is replaced by one smaller in size and with less chitinous covering, the long hairs disappear more or less, and the larva leads a quiet life on top

of the bee-larva, never leaving the latter, and rarely shifting its position.

Of the three larvæ of *Leucospis affinis* only one was alive on July 16th, and this went through the first moulting process early in the morning of July 17th, being about three days old. This number of days is the time within which the larva has to rid itself of its rivals in the cell, and considering its great activity on the first and second days of its existence it undoubtedly gets through with its destructive work long before the time is up. Already on the third day it shows a tendency to become more sedentary, and it passes the last few hours before moulting in a rather quiet state. The secondary larva of my specimen showed a length of about 2 mm. immediately after the moult had taken place, it had therefore within three days doubled its length by taking up the contents of the destroyed rival larva, as also by feeding to a very slight extent on the bee-larva. From now on it partook of the juices of the bee-larva without causing any visible injury to the latter, and in this manner kept it in a fresh condition throughout the procedure. For this purpose it is equipped with very sharp, small mandibles. (Fig. 6.) The bee-larva gradually assumed a shrivelled appearance, and on July 26th nothing was left of it except the entirely empty skin.

On July 31st the Leucospis-larva pupated, and on August 14th a male imago appeared. The larva does not construct a cocoon, the pupa lies inside of the cell or of the Osmia-cocoon, if the bee-larva has had time to construct one.

We have therefore for this specimen of *Leucospis affinis* a duration of the different stages as follows:

egg stage about 3 days,
larval stage 17 days,
pupal stage 14 days.

Female specimens making their appearance at the same time of the year as this male specimen certainly produce another brood, the members of which pass the winter in the larval state and transform into the perfect insects around the beginning of July or somewhat later. As stated at the beginning of this paper, a young larva and an egg of this parasite were found in two different nests of *Osmia simillima* as late as September 18th. From the evidence on hand it can be stated that there are two generations a year. The

females of the first generation are derived from hibernating larvæ that pupate in the spring, and these females lay their eggs at some time during the month of July. These eggs give rise to the second generation, the females of which appear in the month of August or perhaps a little later. They in turn produce the eggs for the following year. It is a noteworthy fact that not all of the descendants of the first generation reach the imago-stage during the same year as shown by finding on July 31st three full-grown larvæ in a nest of *Osmia pumila* that passed the winter as larvæ.

The female of Leucospis is able to locate the cell of the bee with a considerable degree of certainty, but she is also liable to commit grave errors as has been pointed out by Fabre. This author observed *Leucospis gigas* ovipositing in old and empty cells, and he also calls attention to the fact that the insect is incapable of ascertaining whether a cell has already received an egg of its kind or not, and as a result several eggs may be dropped into the same cell. I have twice found in the nest of *Osmia simillima* an egg of *Leucospis affinis* on a bee-larva that had been dead at the time the egg was deposited. This failure of the parasite to distinguish between a dead and a living larva in a cell is certain to bring disaster to its offspring, since the latter can subsist on the contents of a living larva only. In the nest of *Osmia atriventris* opened on July 13th of the present year the parasite had laid an egg in a cell with a half-grown bee-larva. In such a case the larva of the parasite has a scanty food-supply, and it either perishes from lack of food, or else it developes into an undersized imago. *Leucospis affinis* is extremely variable in size, the smallest specimen in my collection being only 6 mm. long, while the largest one shows a length of over 11 mm. The smallest one has probably come from such a poorly fed larva as referred to above, since a specimen bred from the nest of *Osmia pumila*, our smallest species of Osmia is decidedly larger, being 8 mm. in length. According to Guérin (cited by Dalle Torre in his Catalogus Hymenopterorum) this parasite preys also upon a Cuban species of leaf-cutter bee *Megachile poeyi* Guér.

A REMARKABLE CEREMONIAL OBJECT FROM MICHIGAN.

By Henry L. Ward.

The Public Museum has recently purchased a remarkable ceremonial object, found some months ago by Charles Buesch in the bed of a creek about eight miles northwest of Freesoil, Mason Co., Mich.

It is of a type that would be classed in the vernacular as a two-hole gorget, although its real use is, like that of so many ceremonials, merely a matter of conjecture.

The specimen is remarkable both for its shape and size, and when obtained we knew of no other as large, but have since seen figured in a circular advertising Moorhead's forthcoming work on archaeology one that almost duplicates this, both in form and dimensions. Nothing is stated about it except that it is made of cannel coal and was found in Ohio.

The Museum's specimen may be cannel coal, but it is so much weathered that it is difficult to make certain. A minute fragment held in an alcohol flame ignited, giving off a bituminous odor. Before seeing Moorhead's figure I had called the material from which this is made bituminous shale. The distinction is unimportant in this connection.

The surface is so altered as to very closely resemble old wood in color and weight, and the specimen was, I am given to understand, considered to be of that material by some local collectors to whom it was shown. An end had been broken off and cemented before it came to our hands, and from the edges that did not join, the color of the interior is seen to be dull black. The weathering has produced cracks and emphasized the laminated structure which is shown in the drawing. Its original specific gravity has evidently been lowered.

The specimen is 262 mm. (10¼ inches) long, 17mm. (11-16 inch) thick at the center between the perforations. The two surfaces of the ends are nearly parallel, the upper very gradually swelling to meet the connecting shaft; 8 mm. (5-16 inch) fairly represents the average thickness of these wings. The side opposite to that figured is flat, but not in the same plane. The shaft is

A REMARKABLE CEREMONIAL OBJECT FROM MICHIGAN.

slightly concave from end to end and the wings turn slightly upwards. A transverse section of the shaft at its center would approximate a semi-circle. The weight of the object is eight ounces.

The inner edges of the holes and a shallow groove connecting them appear to have been worn as by a thong passing from one to the other; but there are no indications of similar wear about the holes upon the opposite side of the object, as might be expected; therefore it is possible that the slope of the inner edges of the holes and the connecting groove were cut by the maker, or else that the thong that presumably passed through the holes was knotted on the opposite side and did not have any movement there.

On the flat side of the object, beginning at what is the upper right hand corner of the figure and running down the outer edge for about an inch and a quarter, are three series of talley lines, one consisting of nine marks, with probably a tenth so worn away as to be uncertain, one of ten, and one of twelve lines, running at an angle of about 45 degrees to the curved border and each subtended by a single line. The members of each series are practically parallel to each other, but the three series stand at angles to one another. There is a hint of another talley following the last of these, or perhaps a continuation of it, but so obliterated as to be quite uncertain.

We are aware that Mr. Gerard Fowke in "Stone Art," 13th Ann. Rept. Bureau of Ethnology, in writing of gorgets and their uses says on page 117: "Some of the specimens have various notches and incised lines, the latter being sometimes in tolerably regular order; but there is not the slightest indication that these marks had any meaning or were intended for any other purpose than to add to the ornamental appearance of the stone."

The general appearance, style of arrangement, fineness and consequent inconspicuousness of these lines and their placement upon a surface which undoubtedly was the back of the gorgit and very likely was hidden from view leads me to incline to the opinion that they represent tallies and not ornamentation.

We can imagine that this object was a symbol that was used in the native ceremonies of long ago, and was either carried fastened to a staff or, more probably, hung about the breast of a participant in an unknown aboriginal procession.

NOTES OF THE FOSSIL FISH-SPINE. PHLYCTAENACANTHUS TELLERI (EASTMAN).

By Edgar E. Teller.

To the specialist and student of palæichthyology the fossil fish remains as found in the Hamilton limestones at Milwaukee, Wisconsin, possess more than ordinary interest. While never found in any great quantity, and then found only in a fragmentary condition, the state of preservation is nevertheless in what we might term a very good condition, and consists entirely of the original external bony plates, spines, scales and teeth, almost all of which are really remarkable. Local collectors for nearly a quarter of a century have from time to time fortunately secured a single specimen or two, until in the aggregate quite a quantity of material of several species has been brought together which, in the hands of one or two specialists, has resulted in bringing to the notice of those interested valuable additions to the known fauna of the period.

In 1898 Dr. C. R. Eastman of the Cambridge Museum of Comparative Anatomy published in the American Naturalist a series of papers describing and figuring several species new to science from this locality. In volume XXXII, No. 380, pp. 550-552 (August, 1898) of that journal, in a continued article on the dentition of devonian Ptyctodontidæ he describes the figures as a new genus and species the spine *Phlyctænacanthus telleri.* We copy a portion of this article as follows:

ASSOCIATED ICHTHYODORULITES.

"Rohon* in his paper on *Ptyctodus* mention the occurrence in the Russian Devonian of dorsal fin-spines belonging to the so-called "Chimœroid type of ichthyodorulites," as defined by Jaekel**.

As no other form with which the remains can be theoretically

*Rohon, J. V. Beitrag zur Kenntniss der Gattung Ptyctodus, Verhandl. Mineral Gesellsch. St. Petersburg, Vol. XXXIII, pp. 1-16 (1895).

**Jaekel, O. Ueber fossile Ichthyodoruliten, Sitzungsber. Gesellsch, naturforsch. Freunde, Berlin. No. 7, p. 123 (1890).

associated is present in the same horizon, Rohon suggests that both dentition and defenses may have belonged to *Ptyctodus*. The Russian spines are bilaterally symmetrical, triangular in section, slightly curved backwards, and are ornamented with numerous small tubercles, more or less regularly arranged. The posterior face is concave and bears a double series of small denticles.

The style of ornamentation of these spines is remarkable, and we are at once struck with the coincidence that in the Hamilton limestone of Milwaukee ichthyodorulites should be found which have a similar tuburculated ornament. Several very choice examples have been obtained by Messrs. Teller and Monroe, one of the most perfect being that reproduced in Fig. 49 (Plate 1, this paper), the property of Mr. Teller.

This spine has a very graceful curvature, and is of comparatively large size, the length of the arc joining the extremities on the anterior margin being 20 cm. The width where it is broken off below, which is not far distant from the beginning of the exerted portion, is 5.5 cm., and the maximum thickness at this point is 5.5 mm. The spine is extremely compressed laterally, both sides being almost flat. There is no strongly marked anterior keel. The posterior face is slightly sulcated, and each side of the sulcus is set with closely approximated tubercles of somewhat larger size than those occurring elsewhere. The bottom of the sulcus is traversed by a faint longitudinal ridge, triangular in section.

The individual stamp imparted to this spine by its flattened, arcuate shape is heightened by its peculiar ornamentation. The lateral faces are beset with numerous small tubercles not having a very definite arrangement, but in some specimens showing a tendency to become parallel to the anterior and posterior margins. One of Mr. Monroe's spines has the tubercles disposed more numerously along a series of parallel grooves, situated some distance apart, the whole presenting a more or less concentric appearance, and indicating successive growth stages in the development of the organ. The appearances indicate that the inserted portion tapered gradually towards the base, but this region itself has not been recognized in any of the specimens thus far examined. Most of the tubercles have been worn down smooth to their bases, or are evenly rounded on top, but a few retain traces

of a fine original stellation. One or two spines, instead of having the anterior margin uniformly curved, show a slight angulation at the region of maximum width, in that the spine tapers gradually from this point in both directions, distally and proximally.

Obviously these spines, differing as markedly as they do from the majority of Palæozoic ichthyodorulites, cannot be included under any known genus or species. We therefore propose the new genus *Phlyctœnacanthus* for their reception, and have pleasure in naming the species *P. telleri,* * * *.

Regarding their affinities, we can only suggest that they may have pertained to *Palœomylus.* Their large size precludes an association with either *Rhynchodus* or *Ptyctodus;* and *Cladodus,* the only other Elasmobranch known to occur in the Wisconsin Hamilton, was in all probability a spineless shark. On the supposition that they were the spines of *Ptyctodus ferox,* then we ought by good rights to have found similar fossils in the Slate Quarry fish beds, where there is such a wonderful concentration of *Ptyctodus* remains. But such spines as have been recovered from the Iowa locality are very different from *Phlyctœnacanthus.* The latter are thus definitely excluded from all known genera occurring at Milwaukee, except *Palœomylus.* But as we know nothing, for instance, of the denition with which *Heteracanthus politus* was associated, so, too, there is as much likelihood of *P. telleri* belonging to some unknown Elasmobranch genus as to *Palœomylus.* But as to the relative probability of one of these "genera" of Milwaukee ichthyodorulites belonging to the *Ptyctodontidœ,* the evidence of the tuberculated Russian fin-spines would go to show that *Phlyctœnacanthus* is the likelier of the two to have its position established here. * * *."

At the time of the writing of that article, but few specimens of the species had been collected, the best one of them being used as the type of the genus and species as described. Since then a few more specimens having been secured that throw more light on its structure, it has been thought proper to reprint that portion of the original description with such other information as we now have from the new material at hand. The difficulty of obtaining anything like perfect specimens at the locality can only be appreciated by those who have collected these, and while the nature of the formation is such as to give the impression that they should

be found, as those portions secured are generally in a very good state of preservation, the large quantity of high explosives used in getting out the limestones, which, while fine grained and rather uniformly stratified, break up very irregularly and almost invariably furnish the collector with a quantity of fragments almost impossible to assemble, and in most cases furnish even a poor conception as to what portion of the specimen they should be assigned.

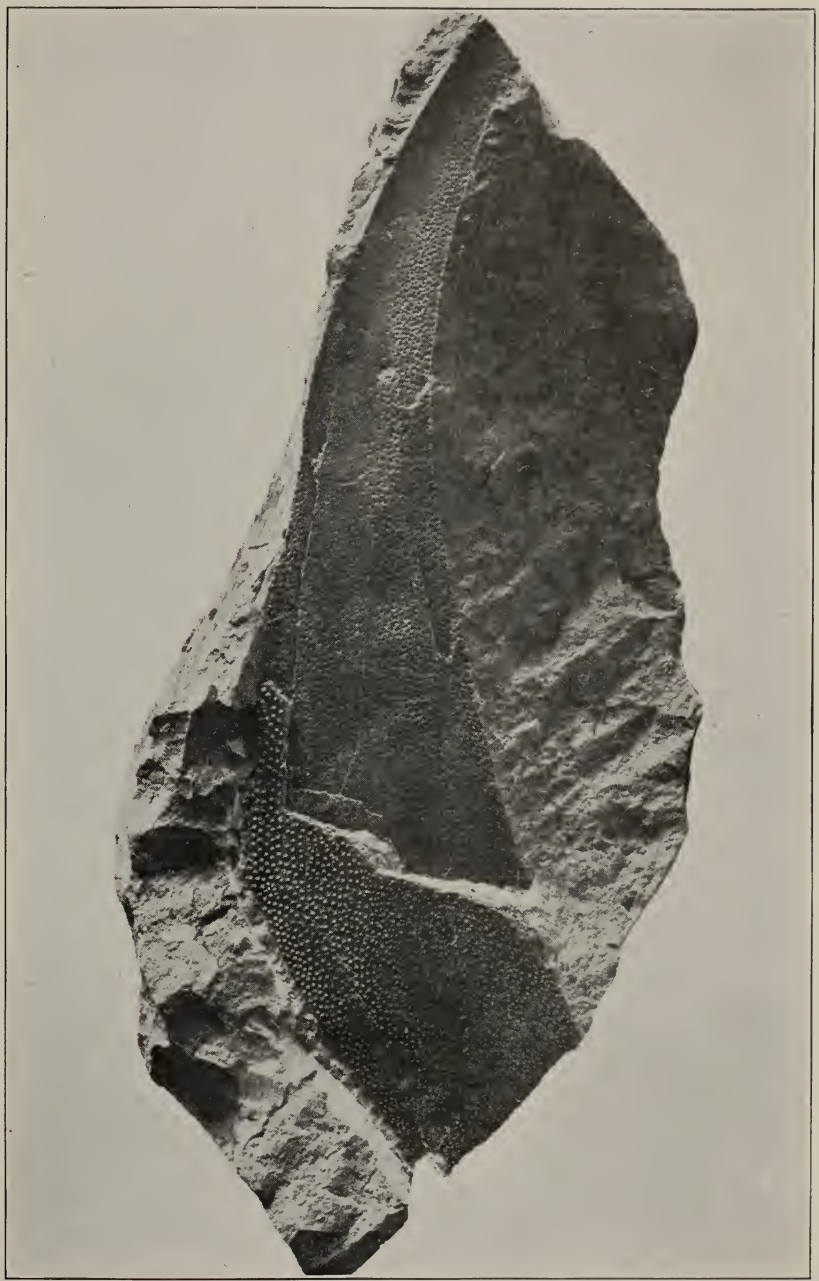
The figure shown on plate I is that of the type specimen. As found the spines are uniformly almost flat on both their right and left faces and of a nearly uniform thickness from the anterior to the posterior margins. The writer, who has been familiar with all of the specimens collected in the past twenty-five years, has never observed but one specimen in any other form, and that one, while showing a strong tendency to be triangular in its section, preserved no indications whatever of a posterior margin. The anterior margin is slightly rounded, and has an irregular arrangement of tubercles down its face to the angle of the spine (Plate 2), below which none have been observed. As noted by Dr. Eastman, the tubercles on the lateral faces are without any regular arrangement, unless in a few cases where the lines of growth are prominent there seems to be a tendency to parallel those lines; the double row of tubercles noted by him on the posterior angle we find to occur only on a small portion of the upper part of the spine, below which we find the angular sulcus as described, but without tubercles, the greatest width of the spine being at the angle on the anterior face which is at or about the bottom line of the type specimen. Plate 2 is that of another specimen in which the angle of the anterior face, the curvature of the upper portion of the spine and that portion below the angle is most beautifully shown. Plate 3 is that of left face of another specimen of the spine from slightly above the angle of the anterior face downwards toward the inserted portion, showing a length very nearly equal to the length of spine above the angle. At the base of this specimen, at about the middle of the left face, we find a line running diagonally towards the posterior face. This we at first supposed to be a fracture of the spine, or, if possible, the line of a vascular canal, and which later proves to be the portion of another spine.

Plates 4 and 5 are those showing the right and left faces of still another specimen, in which is seen not only the base of the inserted portion of the spine, but which shows that it is supported by a second ray of the spine laying directly back of and fitting accurately into the sulcus on the posterior part of the first ray, a fact that was unknown at the time the type was described. The faces of this second ray are covered with tubercles, as is the first ray, and agrees with it in every particular. This second ray of the spine has about the same general thickness of the first ray. The inserted portion terminates in a bulbous end, and penetrated the body of the fish some distance lower than the termination of the first ray, while its distal end was probably approximately acute and terminated at a point about midway between the distal termination of the first ray and a line about even with the angle on the anterior face of that ray. The anterior margin of the second ray should have an angular face to fit into the sulcus noted on the posterior face of the first ray. The markings on the posterior face of the second ray are unknown at this time. This specimen shows the gradual contraction at the base of the right and left faces of the first ray, bringing the base to almost an acute termination. (Dr. Eastman's supposition, that the inserted portion of the spine tapered gradually towards the base is thus proved correct.) The bulbous termination of the second ray and the manner in which it fits against the acute termination of the first ray shows the very strong support given thereby. Both the right and left faces of the two rays show the tubercles peculiar to the species to extend to the extreme ends of the inserted portion, where, however, they are much smaller and rather more numerously disposed than on the exerted portion. Assuming that the specimens that we have secured in the aggregate are of the average size, a reconstruction of a spine from them would show a length of about sixteen and one-half inches from the base of the inserted portion to the apex, a very formidable weapon of either offense or defense, and one that could have belonged only to a fish of very large size.

Associated with the specimen on Plates 4 and 5 is to be seen a fairly well preserved specimen of the fossil tooth *Palœomylus greenei,* the only case we know of in which any portion of a tooth has been found with any of the spines so far collected, and, while there is probably nothing in this association to positively identify

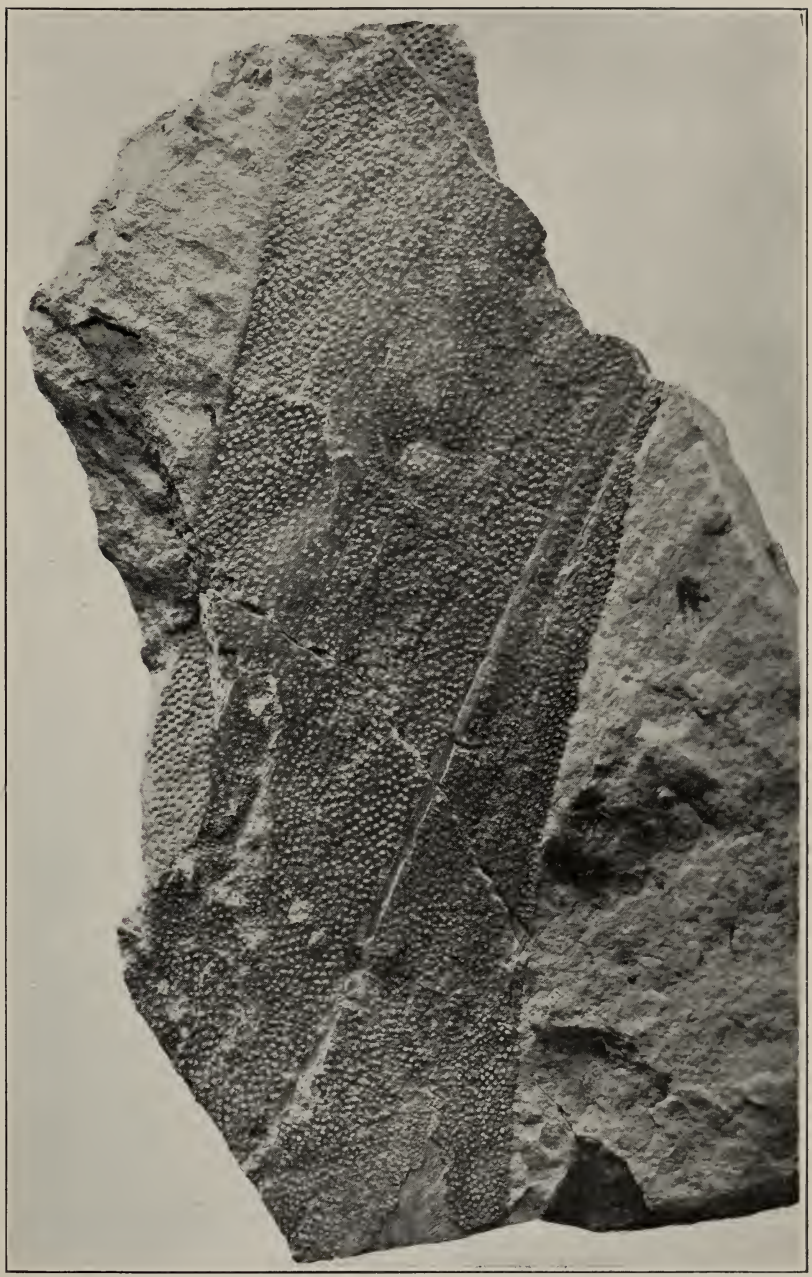
PHLYCTÆNACANTHUS TELLERI EASTMAN.

FOR EXPLANATION OF PLATE SEE PAGE 167.



PHLYCTÆNACANTHUS TELLERI EASTMAN.

FOR EXPLANATION OF PLATE SEE PAGE 167.



PHLYCTÆNACANTHUS TELLERI EASTMAN.

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PHLYCTÆNACANTHUS TELLERI EASTMAN.

FOR EXPLANATION OF PLATE SEE PAGE 167.

PHLYCTÆNACANTHUS TELLERI EASTMAN.

FOR EXPLANATION OF PLATE SEE PAGE 167

the tooth and the spine as belonging to the same species, there is the strong supposition that they may. Of the dentition found at the locality but two of them,*Palœomylus* and *Dinichthys,* are of a size that might refer them to a fish that might carry a spine the size of *Phlyctœnacanthus.* We have always believed that the spine would prove to be that of *Dinichthys,* from the fact that in one case also it has been found associated with plates of that genus, also that the tubercular markings are characteristic of the latter, and it must therefore remain for still further discovery of the tooth and spine to be found with other fish remains already described, or to be hereafter described, before it can be fully and finally determined to just what genus and species they must be eventually assigned.

All of the specimens figured in this paper were collected from the Hamilton formation at Milwaukee, Wis., by the writer, and are now in his private collection.

Oct. 17th, 1906.

DESCRIPTION OF PLATES.

Phlyctænacantus telleri Eastman.

Plate 1. Type specimen, showing the upper part of the spine.

Plate 2. Another specimen showing the angle of the anterior surface and that portion of the spine above the angle.

Plate 3. Showing the angle and that portion of the spine below the angle and above the inserted portion, also a part of the second ray of the spine.

Plate 4. The right side of a specimen that shows the inserted portion of the two rays, and a portion of the spine below the angle, also the tooth Palæomylus greenei.

Plate 5. The left face of the specimen shown on Plate 4.

All figures two-thirds natural size.

BULLETIN

OF THE

Wisconsin Natural History Society

VOLUME IV

(NEW SERIES)

WITH TEN PLATES

MILWAUKEE

1906

CONTENTS OF VOLUME IV.

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(New species and new names are marked with an asterisk *.)

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