BULLETIN

OF THE

Wisconsin Natural History Society

Published with the cooperation of the

Public Museum of the City of Milwaukee

VOLUME VII

(NEW SERIES)

EDITED BY CHARLES T. BRUES

MILWAUKEE, WISCONSIN
1909

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Vol. 7 APRIL, 1909 Nos. 1—2

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EDITED BY CHARLES T. BRUES

MILWAUKEE, WISCONSIN.
THE EDW. KEOGH PRESS.

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The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6, 1857.

OFFICERS AND DIRECTORS.

George P. Barth, President..................302 21st Street, Milwaukee
Henry L. Ward, Vice-President.......... Public Museum, Milwaukee
Richard A. Muttkowski, General Secy. .....Public Museum, Milwaukee
Paul H. Dernehl, Acting Treasurer... ...Majestic Building, Milwaukee
Edgar E. Teller, Director............. ..3321 Sycamore St., Milwaukee

PUBLISHING COMMITTEE.

George W. Peckham, Henry L. Ward,
Charles T. Brues.

MEETINGS.

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room in the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

PUBLICATION.

The "Bulletin of the Wisconsin Natural History Society."

MEMBERSHIP DUES.

Active Members, $3.00 per annum; Junior Members, $1.00 per annum; Corresponding Members, $2.00 per annum; Life Members, one payment of fifty dollars.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 7. **APRIL, 1909.** **Nos. 1—2.**

PROCEEDINGS.

Milwaukee, October 8, 1908.

Meeting of the combined sections.

President Teller in the chair and eighteen persons present.

Mr. Herbert Clowes exhibited a greatly enlarged model of the Great Golden Digger Wasp, *Proterosphex ichneumonea* Linn., prepared by him for exhibition in the public museum. He described the methods employed in making such models of minute and complicated objects, and showed the detailed drawings used in modeling the separate parts.

Mr. Brues then exhibited some Hymenoptera representing genera new to North America. Two of these, *Asaphes* and *Aphanomerus* had been bred by Dr. Barth in connection with his studies on the habits of the Crabronidæ, a third was a member of the genus *Alaptus* just described by Girault, from Illinois. An insect from South Africa, representing a new subfamily of the Scelionidæ, a family of Parasitic Hymenoptera was also shown.

Mr. R. A. Muttkowski then showed several dragon-flies not hitherto collected in Wisconsin, together with some others of special interest.

The meeting then adjourned.

Milwaukee, October 28, 1908.

Regular monthly meeting of the society.

President Teller in the chair and about forty persons present.

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

The names of Dr. Filip A. Forsbeck, 754 Marshall Street, and Mr. Paul Hammersmith, 116 Michigan Street, were nominated for membership and subsequently elected active members. There being no further business, Mr. Henry L. Ward spoke on new methods of mounting museum specimens, and their effect on the educational value of the exhibits. He described the way in which large mammals are mounted on manikins prepared from clay models of the specimens, showing how a mold is taken which later serves to cast the manikin in reinforced papier maché. This, covered by the skin, forms the mounted mammal. The speaker also showed some of the steps in preparing the birds and assembling them with other accessories in the making of large groups for museums. The making of the accessories was also described. The talk was illustrated by lantern slides made of work done in the Public Museum.

Mr. C. T. Brues then gave a brief talk on injurious insects in their relation to some of the broader problems of agricultural development in the United States. He dealt with several of the insects which have affected large areas of the country so as to necessitate changes in agricultural procedure, and elimination of certain crops. The Mexican cotton boll-weevil was cited as an instance of the awakening of a new agricultural era for the South, especially as recent discoveries concerning the cattle-tick have removed another stumbling block to the development of stock raising in this same region. The Codling Moth, Corn-ear Worm, Hessian Fly and several others were also dealt with in a brief way.

The meeting then adjourned.

Milwaukee, November 12, 1908.

Meeting of the combined sections.

President Teller in the chair and eighteen members present.

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

Mr. Herbert Clowes exhibited an enlarged model of a yucca flower and a yucca moth, showing the peculiar method of pollination of the plant. He described the remarkable interdependence between the yucca plant and the insect which pollinates it, also giving an account of the plant and the insect in detail by means of charts and lantern slides. Mr. George W. Colles then gave an account of a foot trip taken last summer from Orizaba to Esperanza through the mountains of Mexico, speaking more particularly of the character and vegetation of the country between these places, the latter being at a much higher altitude than the former. Mr. Howland Russel exhibited some specimens of *Selaginella*, a plant new to our region, and also some specimens of *Oenothera cruciata*, one of DeVries mutants.

The meeting then adjourned.

Milwaukee, December 10, 1908.

Regular monthly meeting of the society.

President Teller in the chair and about ninety persons present.

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

The names of Mrs. Charles Catlin, Miss Helen Sherman, and Messrs. A. C. Katze-Miller, Louis F. Frank, William Hinrichs, Walter N. Goldschmidt, B. Frank Adler, Robert G. Washburn, Richard W. Houghton, James G. Jenkins, Walter Stern, Frederick L. Pierce, George P. Miller, George Burroughs, Alexander R. Houston, Albert C. Elser, Robert Nunnemacher, Charles S. Forsyth, William MacLaren, Charlie B. Whitnall, Gustav Pabst, George P. Mayer, Edward M. Hyzer, Clarence R. Falk, William J. Grant, Alvin P. Kletzsch, Richard Dewey, Louis Mayer, A. S. Lindemann, Joseph E. Uihlein, Rudolph G. Richter, Nelson P. Hulst, Thomas E. Barr and Ralph M. Friend were proposed for membership in the society and later elected by the board of directors. There being no further business, Mr. Henry C. Pearson, editor of *The India Rubber World* and an expert of world-wide reputation, addressed the meeting on India Rubber. The speaker told of the sources of crude India rubber, wild and cultivated in Southern and Central Americas, Africa and Ceylon, and the Malay States. He then gave a general résumé of the rubber manufacturing business, telling of the great factories of the world and explaining various processes used in making modern products. The lecture was illustrated by a remarkable series of lantern slides, in great part made from photographs taken by Mr. Pearson in many far-off and little-known parts of the world. At the conclusion of the lecture, President Teller thanked the speaker for his extremely interesting talk, after which the meeting adjourned.

Milwaukee, January 28, 1909.

Regular monthly meeting of the society.

President Teller in the chair and about 100 persons present.

The minutes of the last regular monthly meeting were read and approved. The secretary read an invitation extended by Milwaukee-Downer College to the society, asking its members to attend the commemoration of the 100th anniversary of the birth of Charles Darwin, on Friday evening, February 5, at which Dean Edward A. Birge of the University of Wisconsin, was to deliver an address.

The names of Miss Flora Elmer, Miss Della S. Guile, Miss Anna M. Berger, Mrs. Sarah M. Boyd, and Messrs. William George Thwaits, Herman F. Haessler, N. A. Christensen, Rudolph M. Koss, Adolph Finkler, Samuel D. Adler, Dr. Joseph Schneider, Richard E. W. Sommer. Eltinge Elmore, William W. Plankinton, William W. Allis, Louis W. Bunde, Dr. A. J. M. Lasché, Dr. J. S. Bachelor, George B. Terry and F. A. W. Kieckhefer were proposed for membership and subsequently elected by the board of dirctors.

Professor E. C. Case then lectured on "Earthquakes, Their Causes and Results." Dr. Case described the various sorts of earth tremors, or seisms, showing graphicaliy the different types of motion by means of photographs of objects in regions that had been visited by earthquakes. Many cases were described in detail, after which he passed to a consideration of the causes of earthquakes, stopping to call attention to the popular fallacy that earthquakes and volcanic eruptions are due to the same causes. He told of the old centrum theory of earthquakes which had held that they were due to explosions or disturbances at special points beneath the solid crust. This view was at one time widely accepted, but has now been cast aside as it does not accord with observed facts. The more recent idea that earth tremors are due to a slipping or faulting of the rock underlying the earth's surface has been shown to be more rational. The strain caused by contraction due to the cooling and other causes is relieved by such faults which cause the tremors known as earthquakes. We can thus by a study of topography ascertain the probable liability of a certain region to earthquake disturbances. In closing he described the wonderful instrument known as the seismograph by means of which tremors can be detected and their location ascertained at far distant points.

The meeting then adjourned.

Milwaukee, January 14, 1909.

Meeting of the combined sections.

President Teller in the chair and twelve persons present.

The minutes of the November section meeting were read and approved.

Mr. Herbert Clowes exhibited an enlarged model of a dragon-fly, recently prepared for the Public Museum, mentioninig briefly the methods used in making such models, which show accurately the anatomy of the insects.

C. T. Brues then exhibited a new fossil grass, *Melica primæva* from the Miocene of Florissant, Colorado, together with a specimen of *Stipa laminarum* Cockerell, the only other grass known from the Florissant shales.

Dr. S. Graenicher then showed several Diptera new to this region and remarked on the frequent sudden occurrence of new or little known species of insects almost simultaneously in distant localities. After some more general discussion the meeting adjourned.

Milwaukee, February 18, 1909.

Regular monthly meeting of the society.

President Teller in the chair and about 120 persons present.

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

The names of Dr. G. V. I. Brown, Dr. John M. McGovern, Dr. John Jefferson Davis, Dr. Gustav J. Kaumheimer, Mr. Edgar W. Coleman and Mr. J. M. W. Pratt were proposed for membership and subsequently acted favorably upon by the board of directors.

The secretary then read a recommendation adopted by the board of trustees of the Public Museum, offering to coöperate with the society in the publishing of its quarterly bulletin. They proposed to share the cost of publication in such proportion as the number of copies used by the museum for exchanges compared with the total edition of each bulletin. On motion of Dr. Barth the matter was referred to a committee of three for consideration. President Teller appointed Dr. Barth, Dr. Graenicher and Mr. Finger to serve as such committee to report at the next regular meeting. There being no further business before the meeting, Dr. William Alanson Bryan, of Honolulu, Director of the Pacific Scientific Institution, lectured on "Fire Fountains," a visit to Hawaii's active volcano, Kilauea. Dr. Bryan first gave a general account of the Hawaiian Islands, with regard to both their geological and biological characteristics. He showed by means of charts the form and character of the crater of Kilauea and the relation which it bears to the geological form of the island upon which it is situated. He then described with the aid of colored lantern slides a trip from Honolulu by water and across country to the vicinity of Kilauea. From there to the crater the journey was depicted by means of motion pictures showing the region directly surrounding the crater, tourists toasting post-cards over the heat-cracks in the earth, etc., and finally a series of motion pictures of the seething mass of boiling lava within the crater. One of the latter, taken at night by the light of the molten lava, was truly wonderful and, according to Dr. Bryan, gave a most realistic impression of the crater which is over two miles in width.

After thanking the speaker for his most unusual and interesting lecture, President Teller declared the meeting adjourned.

Milwaukee, February 25, 1909.

Meeting of the combined sections.

Seven persons present.

On motion of Dr. Graenicher Dr. Barth was nominated for chairman pro tem. Carried. Motion by Dr. Graenicher, seconded by Miss Elmer, that Mr. Clowes act as secretary pro tem. Carried. A general discussion (on means for making the combined section meetings more popular and better attended) then followed by all present. Mr. Colles moved the recommendation of the following resolution to be presented at the next general meeting.

RESOLUTIONS.

WHEREAS, It is the sense of the section meetings of the society that the meetings known as the combined section meetings do not attract or receive the attendance or attention of the members they should attract; be it

Resolved, That we recommend to the society that the program committee be instructed hereafter until further notice to prepare in advance certain topics of a more or less specific nature for each such meeting and announce one or more such topics for each meeting, notices to be sent in advance to the members; and be it

Resolved, That we recommend to the society that in the next and future seasons the program committee be instructed to prepare, print and distribute to the members, in October of each year, a list of dates and subjects set for the section meetings for the twelve months following, together with such other information regarding speakers and titles of papers to be presented as may then be obtainable; and be it further

Resolved, That we recommend to the society that the program committee obtain (in the interval between the publication of such list and the dates of the several meetings) such speakers and papers for said meetings as they may find practicable; and that an advance notice of each section meeting containing such additional information be mailed to the members.

Those present were Dr. S. Graenicher, Dr. Barth, Mr. Carpenter, Miss Elmer, Mrs. Ruemmelin, Mr. Colles and Mr. Clowes.

There being no further business, the meeting then adjourned.

Milwaukee, March 25, 1909.

Regular monthly meeting of the society.

President Teller in the chair and about 100 persons present.

The order of business was reversed and the lecture of the evening preceded the business meeting.

Dr. R. M. Strong, of the University of Chicago, lectured on bird behavior, the behavior of birds from the standpoint of structure, bird senses and instinctive activities contrasted with behavior of a higher order. The speaker referred to the general occurrence of reflexes and instinct in the animal kingdom and showed the difference between these and true intelligence as manifested in the higher vertebrates. The relation of various bird senses, particularly that of smell to the development of the central nervous system in different groups was shown, after which he described various experiments both by himself and others to test the development of the sense of smell in birds. The experiments also served to show the amount of intelligence of birds. The remainder of the lecture dealt with certain instinctive activities of birds which were made clear by means of colored lantern slides of the birds.

After a five-minute intermission, for the withdrawal of non-members, the business meeting was called to order.

The secretary read the minutes of the last regular monthly meeting, which were approved after an emendation by Dr. Barth.

The names of Miss Emma J. Gardner, 676 Wilson Street; Dr. P. H. Dernehl, 942 Second Street, and H. C. Oberholser, Biological Survey, Washington, D. C., were proposed for membership and elected by the board of directors.

Dr. Barth reported that the committee appointed to consider the offer of the Public Museum to coöperate in publishing the bulletin had decided after investigation of the matter that it would be to the advantage of the society to enter into the proposed agreement and moved that the society accept it as recommended by the board of trustees of the Public Museum. Seconded by Mr. Burrill. President Teller then read the recommendation as follows: The committee would recommend that the Museum pay to the Wisconsin Natural History Society on such bulletin as may be issued hereafter the pro rata cost of printing of the number of copies which the Museum uses for exchange. That this bulletin shall have printed on the cover and title page in approximately equal type "Bulletin of the Wisconsin Natural History Society, published with the coöperation of the Public Museum of the City of Milwaukee"; that the Natural History Society shall pay the postage on such copies of the bulletin as are distributed to its members or are sent to other than museum exchanges. After some discussion the motion was passed.

The secretary then read the resolution passed by the February section meeting in regard to a regular annual program for the section meetings. After lengthy discussion by Messrs. Colles, Clowes, Graenicher and Brues, it was moved to appoint a program committee to prepare such programs. Seconded and passed. The president then appointed Mr. Colles, Dr. Barth and Mr. Russel to serve on this committee. On request of Dr. Barth the secretary was substituted for him on the committee. Dr. Barth moved that a vote of thanks be extended to the secretary for his efforts to prepare programs for the section meetings. The matter of a junior membership was then brought before the meeting by Dr. Barth in the form of a motion to amend the by-laws to permit the admission of junior members. As the wording of the amendment did not receive the unanimous approbation of all members present it was laid over for action at the next regular meeting.

ADDITIONAL RECORDS OF THE ALLEGHENIAN LEAST WEASEL IN WISCONSIN.

By Henry L. Ward.

In this Bulletin for January 1907 (Vol. V, No. 1) pp. 64-65, I recorded the first know instance of this small weasel's occurrence within the state, the specimen mentioned having been taken at Burlington, Racine Co. Since then until recently I have unavailingly striven to obtain other specimens or to learn anything further regarding its presence in Wisconsin.

Last fall my friend E. D. Ochsner of Prairie du Sac was at the museum and I was greatly interested to hear him state, when shown the skin of the previously reported specimen, that he had two of the same kind in his possession. He has recently sent me these, which he had mounted, and one has been dismounted in order to permit of an examination of its skull. They agree so well in external features that I have no hesitancy in pronouncing them subspecifically identical: *Putorius rixosus allegheniensis* (Rhoads.).

Both sexes are represented. The female was captured alive in November 1902, in the Town of Sumpter, Sauk Co., and kept in captivity until its death, December 26, 1902. Mr Ochsner states that it "was brown over back when taken." This color was largely lost during its period of captivity and the specimen now is mostly in its white winter coat. From between the shoulders forward to the eyes the dorsal surface is chestnut in a pattern resembling a certain type of broad, straight-stemmed Indian arrowhead, its apex lying between the shoulders and the constriction of the stem beginning three or four millimeters back of the ears. It is suggestive to note that the breaking up of the chestnut on the facial region has left a rather definite bridle pattern. Above the nose pad is a transverse bar of chestnut somewhat wider than the rhinarium, from the center of this is a narrow mesial line to the arrow-shaped chestnut patch above mentioned, while from both its extremities extend lateral lines passing above and half circling the eyes. The ears are chestnut but are separated from the occipital patch of the same color by a narrow posterior extension of the white of the temporal region. The basal two-thirds of the tail and its terminal pencil are chestnut; otherwise the animal is white except for a little clouding due to a small number of chestnut colored hair persisting in some places.

The male was taken January 10, 1906, in the Town of Merrimac, Sauk Co., Wis. It is entirely white except for a faint clouding of chestnut on the occiput and forehead and the presence of a terminal pencil of chestnut hair on the tail.

The measurements of these mounted specimen are:
Female, length, 162 mm. tail 32 mm.
Male, length 169 mm., tail 35 mm.

The vertebral lengths of the tails appear to be too great, but I place little significance on these measurements which are probably due to the taxidermic treatment the animals had received.

Mr. Ochsner writes: "I know that they are rare here as I know only of these two in all my twelve years of mounting and they were taken in deep woods by wood cutters."

The small size, less than seven inches in total length, of this weasel, coupled, it seems likely, with a preference for the solitude of deep woods has perhaps much to do with its apparent rarity. It is to be hoped that other records of its occurrence in Wisconsin may be forthcoming.

A SUMMER'S INSECT COLLECTING.*

By Richard A. Muttkowski.

Note.—(F), (J), and (B) after the names of species refer to Mr. V. Fernekes, Mr. H. Bower, and Mr. John Jacobs, respectively; and species so marked should be credited to these collectors.

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* Concluded from Vol. VI, Nos. 3-4, p. 169 (October, 1908).

LEPIDOPTERA.*

Scepsis fulvicollis Hbn.
Anisota virginiensis Drury.
    rubicunda Fabr.
Hypoprepia fucosa Hbn. (F)
Clemensia albata Pack.
Eubaphe aurantiaca Hbn. and varieties. (F)
Haploa lecontei Bdv. and varieties.
Estigmene acræa Drury.
Hyphantria textor Harris.
Isia isabella S. & A.
Phragmatobia fuliginosa Linn. (F)
Diacrisia virginica Fabr.
    latipennis Stretch.
Apantesis virguncula Kirby. (F)
    vittata phalerata Harris.
Ammalo tenera Hbn. (F)
Euchætias egle Drury. (F)
Halisidota tessellaris S. & A.
    caryæ Harris.
Alypia octomaculata Fabr.
Apatela americana Harris.
    dactylina Grote.
    populi Riley.
    morula Grote. (F)
    interrupta Gn.
    lobeliæ Gn.
    furcifera Gn.
    hasta Gn. (J)
  clarescens Gn.
    superans Gn.
    connecta Grote.
    vinnula Grote. (B)
    brumosa Gn.
    retardata Walker.
    impleta Walker.
    oblinita S. & A.
Arsilonche albovenosa Goeze. (F)
Micrococlia diphteroides Gn.
    obliterata Grote.
Jaspidia lepidula Grote.
Chytonix palliatricula Gn.
Baileya ophthalmica Gn.
    dormitans Gn. (F)
    levitans Smith.
Catabena lineolata Walker (F)
Platysenta videns Gn.
Balsa malana Fitch.
    tristrigella Walker.
    labecula Grote.
Perigea vecors Gn.
    sutor Gn. (F)
    epopea Cram.
Hadena bridghami G. & R.
    leucoscelis Grote.
    modica Gn.
    mactata Gn.
    miseloides Gn. (F)
    misera Grote.
    semicana Gn.
    fractilinea Grote.
    passer Gn. (F)
    suffusca Morr.
    vultuosa Grote. (F)
    apamiformis Gn.
    dubitans Walker.
    ferens Smith.
    devastatrix Brace.
    arctica Bdv.
    verbascoides Gn.
    nigrior Smith.
    cariosa Gn.
    lignicolor Gn.
    remissa Hbn.
Hyppa xylinoides Gn.
Euplexia lucipara Linn.
Dipterygia scabriuscula Linn. (B)
Pyrophila pyramodoides Gn.
Heliotropha reniformis Grote.
    atra Grote.
Prodenia commelinæ S. & A. (F)
    ornithogalli Gn.
    eudiopta Gn. (F)
Laphygma frugiperda S. & A.
    obscura Riley.
Magusa divaricata Felder. (Det. Beutenmüller.)
Homohadena badistriga Grote. (F) Bred from Honesuckle.
Rhynchagrotis placida Grote.
    anchocelioides Gn. (F)
    alternata Grote.
Adelphagrotis prasina Fabr.
Eueretagrotis sigmoides Gn.
Agrotis ypsilon Rott.
Peridroma occulta Linn.
    saucia Hbn.

* Rhophalocera, Sphingidae, and Tineoidea not included.

Noctua smithii Snell.
normanniana Grote.
bicarnea Gn.
c-nigrum Linn.
fennica Tauscher.
plecta Linn.
haruspica Grote.
clandestina Harris.
Feltia subgothica Haw.
jaculifera Gn.
herilis Grote.
venerabilis Walker. (F)
Paragrotis messoria Harris. (F)
redimicula Morr. (F)
Anytus privatus Walker
Mamestra imbrifera Gn.
lustralis Grote (?)
detracta Walker.
picta Harr.
latex Gn.
adjuncta Bdv.
ligitima Grote (F)
renigera Steph.
olivacea Morr. (F)
ectypa Morr. (F)
lorea Gn.
Nephelodes minians Gn.
violans Gn. (F)
Heliophila unipuncta Haw.
pseudargyria Gn.
luteopallens Smith.
minorata Smith.
albilinea Hbn.
commoides Gn.
phragmatidicola Gn.
Orthodes crenulata Butl.
cynica Gn.
vecors Gn.
Graphiphora oviducta Gn.
alia Harv. (F)
subterminata Smith. (F)
Tricholita signata Walker. (F)
Xylina disposita Morr.
Xylina petulca Grote.
antennata Walker.
grotei Riley.
innominata Smith.
bethunei G. & R.
unimoda Lint.
pexata Grote.
Calocampa nupera Lint.
curvimacula Morr. (F)
Cucullia asteroides Gn. (F)
Sphida obliqua Walk. (F)
Nonagria subflava Grote. (F)
Gortyna velata Walk.
nictitans Bork.
Papaipema cataphracta Grote.
purpurifascia G. & R. (F)
Pyrrhia umbria Hufn.
exprimens Walker. (F)
Brotolomia iris Gn. (F)
Trigonophora periculosa Gn. (F)
Eucirrœdia pampina Gn.
Scoliopteryx libatrix Linn.
Orthosia decipiens Grote. (F)
bicolorago Gn.
ferruginoides Gn.
helva Grote.
lutosa And.
Scopelosoma sidus Gn.
moffatiana Gn. (F)
morrisoni Grote.
walkeri Grote. (F)
Glæa inulta Grote.
Epiglæa decliva Grote.
Calymnia orina Gn.
Heliothis armiger Hbn.
umbrosus Grote. (F)
Rhodophora florida Gn. (F) Bred from Evening Primrose.
Schinia trifascia Hbn.
Euthisanotia unio Hbn. (F)
brevipennis Strech.
Plusiodonta compressipalpis Gn.
Calpe canadensis Berth- Also bred from Tall Meadow Rue.
Panchrysia purpurigera Walk. (F)
Plusia ærea Hbn. (F)
æroides Grote. (F)
Euchalcia contexta Grote. (F)
putnami Grote. (F)
Eosphoropteryx thyatiroides Gn. (F)
Autographa biloba Steph. (F)
precationis Gn.
brassicæ Riley.
falcifera Kirby.
simplex Gn.
Ogdoconta cinereola Gn.
Alabama argillacea Hbn.
Anomis erosa Hbn.
Amolita fessa Grote (F)
Rivula propinqualis Gn.

Eustrotia albidula Gn.
synochitis G. & R.
muscosula Gn.
apicosa Haw.
carneola Gn.
Galgula partita Gn.
Chamyris cerintha Treitschke.
Tarache candefacta Hbn.
Homopyralis contracta Walker.
Isogona natatrix Gn.
Drasteria erechtea Cram.
crassiuscula Haw.
Euclidia cuspidea Hbn.
Catocala vidua S. & A.
retecta Grote.
judith Str.
relicta Walker.
cara Gn.
amatrix Hbn.
nurus Walker.
concumbens Walker.
unijuga Walker.
briseis Edw.
parta Gn.
coccinata Grote. (B)
adriana Edw.
lucinda. (Det. Beutenmüller.
ilia Cram.
uxor Gn.
piatrix Grote.
cerogoma Gn.
phalanga Grote. (F)
palæogama Gn.
antinympha Hbn.
polygama Gn. (C. blandula Hulst.)
pretiosa Lint.
grynea Cram.
Parallelia bistriaris Hbn.
Remigia repanda Fabr. (F)
Poaphila deleta Gn.
Celiptera frustulum Gn.
Anticarsia gemmatilis Hbn.
Zale horrida Hbn.
Pheocyma lunifera Hbn.
Ypsia æruginosa Gn. (F)
undularis Drury.
Homoptera lunata Drury.
edusa Drury.
calycanthata S. & A. (F)
Erebus odora Linn.
Epizeuxis americalis Gn.
æmula Hbn.
lubricalis Geyer.
Zanclognatha lævigata Grote, and varieties.
cruralis Gn. (F)
protumnusalis Walker.
marcidilinea Grote. (F)
ochreipennis Grote.
Hormisa absorptalis Walker. (F)
Chytolita morbidalis Gn.
petrealis Grote.
Renia flavipunctalis Geyer.
tilosalis Smith.
Bleptina caradrinalis Gn.
Heterogramma pyrumusalis Walker.
Palthis angulalis Hbn.
Bomolocha baltimoralis Gn. (F)
scutellaris Grote.
abalinearis Walker.
madefactalis Gn.
sordidula Grote. (F)
toreuta Grote.
deceptalis Walker.
Plathypena scabra Fabr.
Hypena humuli Harr.
Melalopha albosigma Fitch. (F)
Datana ministra Drury.
perspicua G. & R. (F)
integerrima G. & R. (F)
Hyperæschra georgica H.-S.
Hyperæschra sp.
Nadata gibbosa S. & A.
Heterocampa guttivitta Walker.
bilineata Pack. (F)
Schizura perangulata Edw. (F)
Harpyia cinera Walker. (F)
Ellida caniplaga Walker. (F)
Pseudothyatria cymatophoroides Gn.
expultrix Grote.
Hemerocampa leucostigma S. & A.
definita Pack.
Tolype velleda Stoll. (F)
Malacasoma americana Fabr. (F) Eagle, Wis.
Epicnaptera ferruginea Pack. (F)
roseata Stretch. (F)
Oreta rosea Walker.
Dyspteris abortivaria H.-S. (F)
Eudule mendica Walker.
Talledega montanata Pack. (F)
Nannia refusata Walker.
Heterophleps triguttaria H.-S.
Eucymatoge intestinata Gn. (F)
Euchœca lucata Gn.

Epirrita dilutata D. & S.
Hydria undulata Linn.
Eustroma diversilineata Hbn.
Rheumaptera hastata Linn.
Percnoptilota fluviata Hbn.
Mesoleuca ruficillata Gn.
    lacustrata Gn.
    intermediata Gn.
Hydriomena autumnalis Strom.
    multiferata Walker. (F)
    latirupta Walker.
Cœnocalpe magnoliata Gn. (F)
Gypsochroa designata Hufn.
Petrophora ferrugata Clerck. (F)
Hæmatopsis grataria Fabr.
Deptalia insularia Gn. (F)
Synelys alabasteria Hbn.
    ennucleata Gn.
Aplodes mimosaria Gn. (F)
Orthofidonia vestaliata Gn.
Psysostegania pustularia Gn.
Deilinea variolaria Gn.
Cymatophora inceptaria Walk. (F)
    subcessaria Walker.
Homochlodes fritillaria Gn. (F)
Nepytia semiclusaria Walker, (F)
Paraphia subatomaria Wood.
    unipuncta Haw. (F)
Melanolopha canadaria Gn.
Cleora larvaria Gn. (F)
Melanolopha canadaria Gn.
Ectropis crepuscularia D. & S.
Lycia ursaria Walker. (F)
Phigalia titea Cram. (F)
Erannis tiliaria Harr. (F)
Cingilia catenaria Dru. (F)
Therina athasiaria Walker.
    fervidaria Hbn.
Ennomos subsignarius Hbn. (F)
    magnarius Gn. (F)
Xanthotype crocataria Fabr.
    cælaria Hulst.
Plagodis serinaria H.-S. (F)
    alcoolaria Gn.
Hyperitis amicaria H.-S.
    alienaria H.-S.
Ania limbata Haw.
    expunctaria Grote. (F)
Gonodontis hypochraria H.-S.
Prioeycla armataria H.-S.
Azelina ancetaria Hbn. (F)
Caberodes confusaria Hbn. (F)
Tetracis crocallata Gn. (F)
Sabulodes lorata Grote.
    transversata Dru.
Abbotana clemataria S. & A. (F)
Lithacodes fasciola H.-S. (F)
Packardia geminata Pack. (F)
Tortricidia testacea Pack.
Sesia tipuliformis Clerck. (F)
    pictipes G. & R.
    acerni Clemens. (F)

TINEOIDEA COLLECTED IN 1908.

By Richard A. Muttkowski.

The remarks as to general collection in 1908 (see Vol. 6., p. 164) apply also to the Microlepidoptera captured in that season. During the months of June and early July they were very abundant, and had the traplantern, which was not completed till the end of August, been then available, the list would undoubtedly be considerably larger. Even in its present form the list shows a number of species never before listed from the state.

Mr. Kearfott has recently examined and named about forty of the species listed, chiefly Tortricidæ and Elachistidæ, of which a number are not given in Dyar's Catalogue. These are cited after Mr. Kearfott's letter. The determination of the species marked with asterisk should be credited to Mr. Kearfott, through whose kindness this list was made possible.

Desmia funeralis Hbn.
Pilocrocis ramentalis Led.
Pantographa limata G. & R.
Evergestis straminalis Hbn.
Crocidophora serratissimalis Zell.
Nomophila noctuella D. & S.
Loxostege obliteralis Walk.
Phlyctænia ferrugalis Hbn.
  washingtonalis Grote.
  ferrealis Treit.
  tertialis Gn.
Cindaphia bicoloralis Gn.
Pyrausta pertextalis Led.
  thestealis Walk.
  fodinalis Led.
  funebris Stroem.
Hpysopygia costalis Fabr.
Pyralis farinalis Walk.
Schœnobius clemensellus Rob.
Crambus hastiferellus Walk.
  girardellus Clem.
  laqueatellus Clem.
  alboclavellus Zell.
  albellus Clem.
  hortuellus Hbn.
  perlellus Scop.
  vulvivagellus Clem.
  ruricolellus Zell.
  trisectus Walk.
Argyria nivalis Dru.
Chilo densellus Zell.
*Scoparia basalis Walk.
Oxyptilus tenuidactylus Fitch.
  elliotti Fern.
*Exartema permundanum Clem.
  fasciatum Clem.
  *merrickana Kearf.
  *versicoloranum Clem.
Olethreutes nimbatana Clem.
  chalybeana Walk.
  bipartitana Clem.
  *removana Kearf.
  *chionosema Zell.
  *coruscana Clem.
  *fuscalbana Clem.
*Proteoteras æsculanum Riley.
*Proteopteryx haracana Kearf.
*Eudemis bolliana Sling.

Ancylis goodelliana Fern.?
nubeculana Clem.
*dubiana Clem.

*Acleris viburnana Clem. var.

*Eucosma dorsisignatana Clem.
*otiosana Clem.
*transmissana Walk.

Epagoge belfrageana Zell.
reticulatana Clem.
*pettitana Rob.
*groteana Fern.

Sparganothis puritana Rob.

Archips rosaceana Harris.
purpurana Clem.
rileyana Gr.
argyrospila Walk.
*clemensiana Fern.
melaleucana Walk.

*Tortrix quercifoliana Fitch.
*albicomana Clem.
*pallorana Rob.
*Aristotelia roseosuffusella Clem.
*Platynota sentana Clem.
*Ypsolophus ligulellus Fern.
*Eumeyrickia trimaculella Fitch.
*Bucculatrix ainsliella Murt.
*Scardia approximatella Dietz.
*Holcocera modestella Clem.
*Depressaria alienella Bsk.
*Agnopteryx curvilineella Beut.
*pulvipennella Clem.
*atrodorsella Clem.
*sp. near or = sanguinella Bsk.
Ethmia zelleriella Chamb.
*Carpocapsa pomonella Linn (Cydia)
*Eulia mariana Fern.
*Cœlostathma discopunctana Clem.
*Monopis dorsistrigella Clem.

WISCONSIN FLOWERS AND THEIR POLLINATION.

By S. Graenicher.

COMPOSITÆ.

PART I.

Within the last 10 or 12 years a rather spirited exchange of views has taken place concerning the influence of the color of flowers on the visits of insects. From the time of Sprengel[1] on there has been a tendency to consider color the principal means by which the flowers are enabled to attract insect visitors. Hermann Mueller[2] in discussing the effect of conspicuousness and odor in flowers states that "under otherwise equal conditions a species of flower is the more visited by insects the more conspicuous it is." Mueller came to the conclusion that insects with a high degree of adaptation to flowers, such as bees, butterflies and some specialized flies show a preference for red, purple, and blue, while those poorly adapted favor yellow and white. In Knuth's Handbook of flower pollination[3] we find the following passus: "It is the petals or perianth leaves which, owing to their bright color, play the leading part in bringing about *conspicuousness* in flowers, and in enticing cross-pollinating insects to visit them." In several papers, the first of which appeared in 1895 Plateau[4] published the details of his observations, and very carefully conducted experiments with differently colored flowers of his garden, as also with artificial flowers. Summing up the results of his investigations Plateau[5] arrives at the conclusion that insects are directed to the flowers mainly through their sense of smell, and that the more or less vivid color-

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1) Christian Konrad Sprengel. Das entdeckte Geheimniss der Natur, etc., 1793.

2) Hermann Mueller. Die Befruchtung der Blumen durch Insekten, 1873, p. 426.
English translation "The fertilization of flowers," by D'Arcy W. Thompson, p. 570.

3) Paul Knuth. Handbuch der Bluetenbiologie, Vol. I., p. 100
English translation by J. R. Ainsworth Davis "Handbook of flower pollination," Vol. I., p. 83.

4) Félix Plateau. Comment les fleurs attirent les insectes. 1st part. (Bull. Acad. royale de Belgique, 3me série, tome XXX., No. 11, Novembre 1895.)

5) Félix Plateau. Les insectes et la couleur des fleurs. L'Année psychologique, tome XIII., pp. 67-79, (1907). In this paper reference is made to Plateau's previous publications on this subject.

ation of floral organs is of secondary importance only. According to his opinion the pollination of flowers by insects would take place just the same if all the flowers were of green color like the leaves. Stimulated by Plateau's publications quite a number of investigators have taken up work along this line, and although the results obtained have led to views that are more or less conflicting, still the fact seems to be established, that a flower visiting insect does not show a preference for any particular color. According to Lovell[6] "the colors of flowers both in general and particular have been determined by their utility rather than by an aesthetic color sense in insects. Insects distinguish between different colors, but they do not receive greater pleasure from one hue than from another." Referring to the fact that among the Compositæ those species that are the most extensively visited by insects display a variety of colors (yellow goldenrods, white yarrow, purple Canada thistle, etc.) Lovell[7] states that "these differently colored species are visited by a large company of Hymenoptera, Lepidoptera, Diptera and Coleoptera, which are influenced by the length of the corolla tube and the degree of conspicuousness obtained by a contrast of colors and by massing."

The tubal florets of our species of Compositæ, although very similar in structure differ considerably in their dimensions (especially in length); they differ also in color, and odor. From a comparison of the lists of visitors of such flowers of equal tube length but of different color and odor some direct information as to the effect of color or odor on insects might be expected. With this end in view, a number of species (37 are dealt with in this paper) have been studied, representing the different tube lengths (from the shortest tube in *Erigeron canadensis* to the longest in *Cirsium altissimum* and *C. lanceolatum*), different colors, (white, yellow, blue and purple) and different odors. For the purpose of obtaining as large numbers of visitors as possible these observations have been carried on for the last 3 seasons, and altogether the following 562 species of insects have been taken at the flowers under consideration. The lists of visitors are rather long for most of the species, over 100 in some, and even 182 in the goldenrod *Solidago juncea*. Quite a number of the more common insects appear as visitors to most of the flowers, and an appearance of the names of all these in full in each of the lists would occupy more space than would seem justifiable. For the

6) John H. Lovell. The colors of northern gamopetalous flowers. American Naturalist, Vol. XXXVII., No. 439, p. 478, (July 1903).
7) Loc. cit., p. 452.

sake of brevity therefore, and in order to avoid unnecessary repitition I have supplied the name of each insect with a number as it appears in the following list, and it will be represented by its number in the list of visitors connected with the account of each species of Compositæ in the second part of this paper.

A. HYMENOPTERA.

Apidæ: (1) *Apis mellifera* L; (2) *Bombus virginicus* Oliv.; (3) *B. vagans* Sm.; (4) *B. consimilis* Cress.; (5) *B. edwardsii* Cress.; (6) *B. affinis* Cress.; (7) *B. pennsylvanicus* De G.; (8) *B. terricola* Kirby; (9) *B. americanorum* Fabr.; (10) *B. perplexus* Cress.; (11) *B. ternarius* Say; (12) *B. juxtus* Cress.; (13) *B. separatus* Cress.; (14) *B. auricomus* Rob.; (15) *Psithyrus variabilis* Cress.; (16) *P. laboriosus* Fabr. (17) *Ceratina dupla* Say; (18) *Clisodon terminalis* Cress.; (19) *Melissodes agilis* Cress.; (20) *M. trinodis* Rob.; (21) *M. nivea* Rob.; (22) *M. obliqua* Say; (23) *M. cnici* Rob.; (24) *M. rustica* Say; (25) *Cœlioxys octodentata* Say; (26) *C. sayi* Rob.; (27) *C. texana* Cress.; (28) *C. rufitarsis* Sm.; (29) *C. ribis* Ckll.; (30) *C. lucrosa* Cress.; (31) *C. mœsta* Cress.; (32) *C. modesta* Sm.; (33) *Megachile pugnata* Say; (34) *M. latimanus* Say; (35) *M. infragilis* Cress.; (36) *M. mendica* Cress.; (37) *M. addenda* Cress.; (38) *M. brevis* Say; (39) *M. montivaga* Cress.; (40) *M. mucida* Cress.; (41) *Heriades carinatus* Cress.; (42) *Alcidamea simplex* Cress.; (43) *Andronicus cylindricus* Cress.; (44) *Osmia atriventris* Cress.; (45) *O. distincta* Cress.; (46) *Anthidium jugatorium* Say; (47) *Stelis fœderalis* Sm.; (48) *S. lateralis* Cress.; (49) *S. sexmaculata* Ashm.; (50) *S. subemarginata* Cress.; (51) *Epeolus bifasciatus* Cress.; (52) *Argyroselenis minima* Rob.; (53) *Triepeolus concolor* Rob.; (54) *T. donatus* Sm.; (55) *T. pectoralis* Rob.; (56) *T. helianthi* Rob.; (57) *T. cressonii* Rob.; (58) *Nomada pilosula* Cress.; (59) *N. articulata* Sm.; (60) *N. vincta* Say; (61) *N. placida* Cress.; (62) *N. rhodoxantha* Ckll.; (63) *N. graenicheri* Ckll.; (64) *N. sphærogaster* Ckll.; (65) *N. simplex* Rob.; (66) *N. denticulata* Rob.; (67) *N. cressonii* Rob.; (68) *N. sayi* Rob.; (69) *N. vicina* Cress.; (70) *Calliopsis andreniformis* Sm.; (71) *Panurginus rudbeckiæ* Rob.; **Andrenidæ:** (72) *Macropis morsei* Rob.; (73) *Andrena multiplicata* Ckll.; (74) *A. hippotes* Rob.; (75) *A. forbesii* Rob.; (76) *A. sigmundi* Ckll.; (77) *A. erythrogastra* Ashm.; (78) *A. carlini* Rob.; (79) *A. vicina* Sm.; (80) *A. nubecula* Sm.; (81) *A. nasonii* Rob.; (82) *A. fragilis* Sm.; (83) *A. commoda* Sm.; (84) *A. geranii* Rob.; (85) *A. milwaukeensis* Græn.;

(86) *A. clypeonitens* Ckll.; (87) *A. peckhami* Ckll.; (88) *A. persimilis* Graen.; (89) *A. hirticincta* Prov.; (90) *A. cressonii* Rob.; (91) *A. flavoclypeata* Sm.; (92) *A. robertsonii* D. T.; (93) *A. rudbeckiæ* Rob.; (94) *A. helianthi* Rob.; (95) *A. grænicheri* Ckll.; (96) *A. aliciæ* Rob.; (97) *A. asteris* Rob.; (98) *A. solidaginis* Rob.; (99) *Agapostemon radiatus* Say; (100) *A. viridulus* Fab.; (101) *A. texanus* Cres.; (102) *Augochlora confusa* Rob.; (103) *A. pura* Say; (104) *Halictus lerouxii* Lep.; (105) *H. provancheri* D. T. (106) *H. ligatus* Say; (107) *H. coriaceus* Sm.; (108) *H. forbesii* Rob.; (109) *H. arcuatus* Rob.; (110) *H. foxii* Rob.; (111) *H. pectoralis* Sm.; (112) *H. tegularis* Rob.; (113) *H. pilosus* Sm.; (114) *H. zephyrus* Sm.; (115) *H. albipennis* Rob.; (116) *H. cressonii* Rob.; (117) *H. sparsus* Rob.; (118) *H. versatus* Rob.; (119) *H. connexus* Cress.; (120) *H. hortensis* Lovell; (121) *Halictus* sp.; (122) *Halictus* sp.; (123) *Sphecodes arvensus* Sm.; (124) *S. clematidis* Rob.; (125) *S. minor* Rob.; (126) *S. davisii* Rob.; (127) *S. prosphorus* Lovell; (128) *S. cressonii* Rob.; (129) *S. stygius* Rob.; (130) *Colletes eulophi* Rob.; (131) *C. armata* Patton; (132) *C. compacta* Cress.; (133) *C. americana* Cress.; (134) *Prosopis affinis* Sm.; (135) *P. modesta* Say; (136) *P. cressonii* Ckll.; **Vespidæ:** (137) *Polistes pallipes* Lep.; (138) *Vespa maculata* L.; (139) *V. vidua* Sauss.; (140) *V. germanica* Fabr.; (141) *V. diabolica Sauss.;* **Eumenidæ:** (142) *Eumenes fraternus* Say; (143) *Odynerus philadelphiæ* Sauss.; (144) *O. walshianus* Sauss.; (145) *O. albophaleratus* Sauss.; (146) *O. campestris* Sauss.; (147) *O. capra* Sauss.; (148) *O. catskillensis* Sauss.; (149) *O. tigris* Sauss.; (150) *O. arvensis* Sauss.; (151) *O. foraminatus* Sauss.; (152) *O. pennsylvanicus* Sauss.; (153) *O. vagus* Sauss.; (154) *O. anormis* Say; (155) *O. conformis* Sauss.; **Crabronidæ:** (156) *Anacrabro ocellatus* Pack.; (157) *Crabro interruptus* Lep.; (158) *C. producticollis* Pack.; (159) *C. montanus* Cress.; (160) *C. brunneipes* Pack.; (161) *C. maculatus* Fab.; (162) *C. chrysarginus* Lep.; (163) *C. sexmaculatus* Say; (164) *C. trifasciatus* Say; (165) *C. obscurus* Sm.; (166) *C. rufifemur* Pack.; (167) *Oxybelus quadrinotatus* Say; (168) *O. niger* Rob.; (169) *O. americanus* Rob.; **Mimesidæ:** (170) *Mimesa cressonii* Pack.; **Philanthidæ:** (171) *Philanthus ventilabris* Fabr.; (172) *P. punctatus* Say; (173) *P. bilunatus* Cress.; (174) *P. politus* Say; (175) *P. solivagus* Say; (176) *P. sanborni* Cress.; (177) *Aphilanthops frigidus* Sm.; (178) *Cerceris fumipennis* Say; (179) *C. nigrescens* Sm.; (180) *C. clypeata* Dahlb.; (181) *C. deserta* Say; (182) *C. fulvipes* Cress.; **Nyssonidæ:** (183) *Gorytes ephippiatus* Pack.; (184) *G. pygidialis* Fox; (185) *Nysson æqualis* Pat-

ton; **Bembecidæ:** (186) *Bembex spinolæ* Lep.; (187) *B. americana* Fabr.; (188) *Monedula ventralis* Say; **Larridæ:** (189) *Astata unicolor* Say; (190) *Lyroda subita* Say; (191) *Larra americana* Cress; (192) *L. quebecensis* Prov.; (193) *L. tarsata* Say; (194) *Tachytes pepticus* Say; (195) *T. mandibularis* Patton; **Sphecidæ:** (196) *Ammophila vulgaris* Cress.; (197) *A. procera* Klug; (198) *A. abbreviata* Fabr.; (199) *A. nigricans* Dahlb.; (200) *Chlorion cœruleum* Drury; (201) *Isodontia philadelphica* Lep.; (202) *Proterosphex ichneumonea* L.; (203) *P. pennsylvanica* L.; (204) *Priononyx atrata* Lep.; **Pompilidæ:** (205) *Pompilus philadelphicus* Lep.; (206) *P. æthiops* Cress.; (207) *P. virginiensis* Cress.; (208) *P. biguttatus* Fabr.; (209) *P. marginatus* Say; (210) *P. interruptus* Say; (211) *Salius unifasciatus* Say; (212) *Ceropales fraterna* Sm.; (213) *C. fulvipes* Cress.; (214) *C. bipunctata* Say; (215) *C. robinsoni* Cress.; **Scoliidæ:** (216) *Myzine sexcincta* Fabr.; (217) *M. interrupta* Say; (218) *Scolia bicincta* Fabr.; **Mutillidæ:** (219) *Mutilla canadensis* Blake; **Chrysididæ:** (220) *Chrysis cœrulans* Fabr.; (221) *C. perpulchra* Cress.; (222) *C. lateridentata* Cress.; **Chalcididæ:** (223) *Leucospis affinis* Say; (224) *Sphilochalcis torvina* Cress.; (225) *Chalcis annulata* Fabr.; **Perilampidæ:** (226) *Perilampus cyaneus* Brullé; (227) *P hyalinus* Say; **Braconidæ:** (228) *Bracon mellitor* Say; (229) *Bracon* sp.; (230) *Chelonus sericeus* Say; (231) *C. fissus* Prov.; (232) *Apanteles cupitheciæ* Ashm.; (233) *Urogaster crassicornis* Prov.; (234) *Agathis femorator* Prov.; (235) *A. hæmatodes* Brullé; (236) *A. semirubra* Brullé; **Ichneumonidæ:** (237) *Ichneumon succinctus* Brullé; (238) *I. seminiger* Cress.; (239) *I. lætus* Brullé; (240) *I. suadus* Cress.; (241) *Phygadeuon crassipes* Prov.; (242) *Cryptus persimilis* Cress.; (243) *C. americanus* Cress.; (244) *Linoceras junceus* Cres.; (245) *Ceratosoma fasciata* Cress.; (246) *Pimpla pedalis* Cress.; (247) *P. pterelas* Say; (248) *Lampronota americana* Cress.; **Evaniidæ:** (249) *Fœnus tarsatorius* Say; (250) *F. incertus* Cress.; **Tenthredinidæ:** (251) *Dolerus similis* Norton; (252) *Monophadnus bardus* Say.

B. DIPTERA.

Tipulidæ: (253) *Geranomyia canadensis* Westw.; **Culicidæ:** (254) *Culex sylvestris* Theobald; **Mycetophilidæ:** (255) *Sciara fuliginosa* Fitch; (256) *C. exigua* Say; **Bibionidæ:** (257) *Dilophus stigmaterus* Say; **Stratiomyidæ:** (258) *Stratiomyia lativentris* Lw.; (259) *S. normula* Lw.; (260) *S. meigenii* Wied.; (261) *S. badia* Walk.; (262) *Odontomyia binotata* Lw.; (263) *O. cincta* Oliv.; (264) *O. trivittata* Say;

(265) *O. vertebrata* Say; (266) *O. virgo* Wied.; (267) *O. pubescens* Day; (268) *Nemotelus unicolor* Lw.; **Tabanidæ:** (269) *Tabanus lasiophthalmus* Macq.; **Bombyliidæ:** (270) *Spogostylum ædipus* Fabr.; (271) *Aldrichia ehrmanni* Coq.; (272) *Exoprosopa decora* Lw.; (273) *E. fasciata* Macq.; (274) *E. fascipennis* Say; (275) *Anthrax halcyon* Say; (276) *A. fulviana* Say; (277) *A. alternata* Say; (278) *A. sinuosa* Wied.; (279) *Bombylius major* L.; (280) *Systœchus vulgaris* Lw.; (281) *Phthiria punctipennis* Walk.; (282) *P.* sp.; (283) *Sparnopolius fulvus* Wied.; (284) *Dolichomyia* sp.; **Empididæ:** (285) *Empis nuda* Lw.; (286) *Rhamphomyia* sp.; **Syrphidæ:** (287) *Paragus bicolor* Fabr.; (288) *P. tibialis* Fallen; (289) *Pipiza pistica* Will.; (290) *Chrysogaster pulchella* Will.; (291) *C. nitida* Wied.; (292) *C. pictipennis* Lw.; (293) *Melanstoma obscurum* Say; (294) *M. mellinum* L.; (295) *Platychirus hyperboreus* Staeg.; (296) *P. peltatus* Meig.; (297) *Eupeodes volucris* O. S.; (298) *Syrphus ribesii* L.; (299) *S. torvus* O. S.; (300) *S. americanus* Wied.; (301) *S. xanthostoma* Will.; (302) *Xanthogramma emarginata* Say; (303) *X. divisa* Will.; (304) *Allograpta obliqua* Say; (305) *Mesogramma polita* Say; (306) *M. marginata* Say; (307) *M. geminata* Say; (308) *Sphærophoria cylindrica* Say; (309) *Baccha fascipennis* Wied.; (310) *Rhingia nasica* Say; (311) *Volucella erecta* Walk.; (312) *Sericompia militaris* Walk.; (313) *Eristalis tenax* L.; (314) *E. æneus* Scop.; (315) *E. dimidiatus* Wied.; (316) *E. meigenii* Wied.; (317) *E. bastardi* Macq.; (318) *E. flavipes* Walk.; (319) *E. transversus* Wied.; (320) *E. vinctorum* Fabr.; (321) *Helophilus latifrons* Lw.; (322) *H. similis* Macq.; (323) *H. lætus* Lw.; (324) *H. chrysostoma* Wied.; (325) *H. distinctus* Will.; (326) *H. conostoma* Will.; (327) *H. bilinearis* Will.; (328) *Mallota posticata* Fabr.; (329) *Triodonta curvipes* Wied.; (330) *Tropidia quadrata* Say; (331) *Xylota ejuncida* Say; (332) *Syritta pipiens* L.; (333) *Spilomyia longicornis* Lw. (334) *S. fusca* Lw.; (335) *S. quadrifasciata* Say; (336) *Milesia virginiensis* Dru.; **Conopidæ:** (337) *Conops xanthopareus* Will.; (338) *Physocephala tibialis* Say; (339) *P. marginata* Say; (340) *P. affinis* Will.; (341) *Zodion fulvifrons* Say; (342) *Z. pygmæum* Will.; (343) *Oncomyia abbreviata* Lw.; (344) *O. loraria* Lw.; **Sepsidæ:** (345) *Prochyliza xanthostoma* Walk.; (346) *Themira putris* L.; (347Q *Sepsis violacea* Meig.; **Trypetidæ:** (348) *Tephritis albiceps* Lw.; (349) *T. clathrata* Lw.; (350) *Euaresta bella* Lw.; **Sapromyzidæ:** (35) *Sapromyza lupulina* Fabr.; **Agromyzidæ:** (352) *Eusiphona mira* Coq.; (353) *Agromyza neptis* Lw.; (354) *A. æneiventris* Fall.; **Oscinidæ:** (355) *Ela-*

chiptera nigriceps Lw.; (356) *Siphonella oscinina* Fall.; (357) *Meromyza americana* Fitch; (358) *Chlorops grata* Lw.; (359) *C. assimilis* Macq.; **Cordyluridæ:** (360) *Scatophaga furcata* Say; (361) *S. stercoraria* L.; **Anthomyidæ:** (362) *Hyetodesia abacta* Gig.—Tos.; (363) *Mydæa* sp.; (364) *Hydrotæa* sp.; (365) *Ophyra leucostoma* Wied.; (366) *Leucomelina garrula* Gig.—Tos.; (367) *Anthomyia pratincola* Panz.; (368) *Anthomyia* sp.; (369) *Phorbia fusciceps* Zett.; (370) *Phorbia* sp.; (371) *Phorbia* sp.; **Muscidæ:** (372) *Stomoxys calcitrans* L. (373) *Pollenia rudis* Fabr.; (374) *Chrysomyia macellaria* Fabr.; (375) *Cynomyia* sp.; (376) *Calliphora erythrocephala* Meig.; (377) *Lucilia cæsar* L.; (378) *L. sylvarum* Meig.; (379) *L. sericata* Meig.; (380) *Lucilia* sp.; (381) *Phormia regina* Meig.; (382) *P. terræ-novæ* Desv.; (383) *Pseudopyrellia cornicina* Fabr.; (384) *Musca domestica* L.; (385) *Graphomyia maculata* Scop.; (386) *Myiospila meditabunda* Fabr.; (387) *Morellia micans* Macq.; **Sarcophagidæ:** (388) *Oncsia* sp.; (389) *Sarcophaga sarraceniæ* Riley; (390) *Sarcophaga* sp.; (391) *Sarcophaga* sp.; (392) *Sarcophaga* sp.; (393) *Sarcophaga* sp.; (394) *Sarcophaga* sp.; (395) *Helicobia helicis* Town.; (396) *Helicobia* sp.; **Dexiidæ:** (397) *Mochlosoma* sp.; (398) *Myiocera cremides* Walk.; (399) *Ptilodexia tibialis* Desv.; **Tachinidæ:** (400) *Cistogaster immaculata* Macq.; (401) *Gymnosoma fuliginosa* Desv.; (402) *Phorantha occidentis* Walk.; (403) *Alophora æneoventris* Will.; (404) *A. fumosa* Coq.; (405) *A. subopaca* Coq.; (406) *Myiophasia ænea* Wied.; (407) *Polidea areos* Walk.; (408) *Leucostoma atra* Town.; (409) *Hyalomyodes triangulifera* Lw.; (410) *Epigrimyia polita* Town.; (411) *Siphona geniculata* De G.; (412) *Senotainia rubriventris* Macq.; (413) *S. trilineata* v. d. W.; (414) *Belvosia bifasciata* Fabr.; (415) *Ocyptera carolinæ* Desv.; (416) *O. dosiades* Walk.; (417) *Linnæmyia comta* Fallen; (418) *Panzeria radicum* Fabr.; (419) *Macromeigenia chrysoprocta* Wied.; (420) *Gymnochæta alcedo* Lw.; (421) *Exorista nigripalpis* Town.; (422) *E. affinis* Fall.; (423) *E. confinis* Fall.; (424) *Euphorocera claripennis* Macq.; (425) *Phorocera doryphoræ* Riley; (426) *Sturmia albifrons* Walk.; (427) *S. occidentalis* Coq.; (428) *Tachina robusta* Town.; (429) *T. mella* Walk.; (430) *T. rustica* Fall.; (431) *Blepharipeza leucophrys* Wied.; (432) *Winthemia quadripustulata* Fabr.; (433) *Metachæta helymus* Walk.; (434) *Opsidia gonioides* Coq.; (435) *Hilarella siphonina* Zett.; (436) *Brachycoma sarcophagina* Town.; (437) *Gonia capitata* De G.; (438) *Spallanzania hesperidarum* Will.; (439) *Chætogædia analis* v. d. W.; (440) *Micro-*

phthalma disjuncta Wied.; (441) *Trichophora ruficauda* v. d. W.; (442) *Pelcteria robusta* Wied.; (443) *P. tessellata* Fabr.; (444) *Archytas analis* Fabr.; (445) *Echinomyia algens* Wied.

C. LEPIDOPTERA.

Papilionidæ: (446) *Papilio glaucus* L.; (447) *P. turnus* L.; (448) *P. polyxenes* Fabr.; **Pieridæ:** (449) *Pontia protodice* Bsd. Lec.; (450) *P. rapæ* L.; (451) *Eurymus philodice* Gdt.; (452) *Eurema linda* Edw. (?); **Nymphalidæ:** (453) *Speyeria idalia* Dru.; (454) *Argynnis cybele* Fabr.; (455) *A. aphrodite* Fabr.; (456) *A. alcestis* Edw.; (457) *Brenthis myrina* Cram.; (458) *B. bellona* Fabr.; (459) *Charidryas nycteis* D. & H.; (460) *Phyciodes tharos* Dru.; (461) *Polygonia comma* Harr.; (462) *Euvanessa antiopa* L.; (463) *Vanessa atalanta* L.; (464) *V. huntera* Febr.; (465) *V. cardui* L.; (466) *Basilarchia astyanax* Fabr.; (467) *B. archippus* Cram.; **Agapetidæ:** (468) *Cercyonis alope* Fabr.; **Lymnadidæ:** (469) *Anosia plexippus* L.; **Lycænidæ:** (470) *Thecla calanus* Hbn.; (471) *Thecla* sp.; (472) *Chrysophanus thœ* Bsd.; (473) *Cyaniris ladon* Cram.; (474) *C. neglecta* Edw.; **Hesperiidæ:** (475) *Ancyloxypha numitor* Febr.; (476) *Atrytone zabulon* Bsd. Lec.; (477) *A. hobomok* Harr.; (478) *A. pocohontas* Scud.; (479) *Thymelicus mystic* Scud.; (480) *T. cernes* Bsd. Lec.; (481) *Polites peckius* Kirby; (482) *Limochrœs manataaqua* Scur.; (493) *Epargyreus tityrus* Fabr.; **Sphingidæ:** (484) *Deilephila lineata* Fabr.; **Syntomidæ:** (485) *Scepsis fulvicollis* Hbn.; (486) *Lycomorpha pholus* Dru.; **Arctiidæ:** (487) *Utetheisa bella* L.; **Noctuidæ:** (488) *Feltia subgothica* Haw.; (489) *Mamestra* sp.; (490) *Heliophila unipuncta* Haw.; (491) *H. albilinea* Hbn.; (492) *Heliothis obsoleta* Hbn.; (493) *Autographa simplex* Gn.; (494) *Tarache candefacta* Hbn.; (495) *Drasteria crechtea* Cram.; **Geometridæ:** (496) *Orthofidonia vestaliata* Gn.; **Sesiidæ:** (497) *Sesia tipuliformis* Clck.; **Pyraliidæ:** (498) *Nomophila noctuella* D. & S.; (499) *Crambus laqueatellus* Clem.; (500) *Phycitis* sp.; **Tortricidæ:** (501) *Enarmonia interstinctana* Clem.; **Pterophoridæ:** (502) *Oxyptilus tenuidactylus* Fitch; (503) *Platyptilia acanthodactyla* Hbn.; (504) *Pterophorus monodactylus* L.; **Gelechiidæ:** (505) *Gelechia* sp.

D. COLEOPTERA.

Carabidæ: (506) *Euphorticus pubescens* Dej.; (507) *Lebia atriventris* Say; (508) *L. scapularis* Dej.; (509) *Blechrus glabratus* Duft.; **Coccinellidæ:** (510) *Megilla maculata* De G.; (511) *Hippodamia*

13-punctata L.; (512) *Coccinella 9-notata* Hbst.; **Elateridæ:** (513) *Cardiophorus obscurus* Lec.; **Buprestidæ:** (514) *Acmæodora pulchella* Hbst.; **Lampyridæ:** (515) *Ellychnia corrusca* L.; (516) *Chauliognathus pennsylvanicus* De G.; **Malachiidæ:** (517) *Malachius thevenetii* Horn.; (518) *Attalus terminalis* Er.; **Cleridæ:** (519) *Trichodes nuttalli* Kirby; **Scarabæidæ:** (520) *Trichius piger* Febr.; **Cerambycidæ:** (521) *Batyle suturalis* Say; (522) *Cyllene robiniæ* Forst.; (523) *Euderces picipes* Fabr.; (524) *Acmæops bivittata* Say; (525) *Typocerus velutinus* Oliv.; **Chrysomelidæ:** (526) *Cryptocephalus quadruplex* Newm.; (527) *Diabrotica 12-punctata* Oliv.; (528) *D. vittata* Fabr.; (529) *D. virgifera* Lec.; (530) *Crepidoderus cucumeris* Harr.; **Oedemeridæ:** (531) *Asclera ruficollis* Say; **Mordellidæ:** (532) *Mordella melæna* Germ.; (533) *M. 8-punctata* Fabr.; (534) *Mordellistena comata* Lec.; **Anthicidæ:** (535) *Corphyra collaris* Say; **Meloidæ:** (536) *Nemognatha vittigera* Lec.; (537) *Epicauta pennsylvanica* De G.; **Curculionidæ:** (538) *Phytonomus punctatus* Fabr.; (539) *Orchestes pallicornis* Say; (540) *Centrinus prolixus* Lec.

E. HEMIPTERA.

Corimelænidæ: (541) *Corimelæna atra* Am. & S.; (542) *C. lateralis* Fabr.; (543) *C. pulicaria Germ.;* **Pentatomidæ:** (544) *Cosmopepla carnifex* Fabr.; (545) *Euchistus variolarius* Pol. Beauv.; (546) *E. tristigmus* Say; **Coreidæ:** (547) *Alydus quinquespinosus* Say; **Lygæidæ:** (548) *Ligyrocoris sylvestris* L.; (549) *Lygæus bicrucis* Say; (550) *L. turcicus* Fabr.; **Capsidæ:** (551) *Miris ruficornis* Fall.; (552) *Leptoterna dolobrata* L.; (553) *Calocoris rapidus* Say; (554) *Lygus pratensis* L.; (555) *L. scutellatus* Dist.; (556) *Pœcilocapsus lineatus* Fabr.; (557) *P. goniphorus* Say; (558) *Plagiognathus politus* Uhler; (559) *Plagiognathus* sp.; **Phymatidæ:** (560) *Phymata wolffii* Stal.; **Nabidæ:** (561) *Nabis marginatus* Uhler **Reduvidæ:** (562) *Sinea diadema* Fabr.

LOEW'S CLASSIFICATION.

Loew[8] has proposed a classification of anthophilous insects based on the degree of adaptation to flowers as determined by structural characters, (tongue length, pollen collecting apparatus)

8) E. Loew. Beobachtungen ueber d. Insektenbesuch an Freilandspflanzen, etc. 1884.
See also Knuth's Handb. d. Bluetenbiologie, Vol. I., pp. 228-231 (Engl. transl. pp. 192-195).

and food habits. In comparing the lists of visitors of the different flowers by statistical methods I have found Loew's classification very helpful. He divides the flower visiting insects into the following groups:

EUTROPOUS INSECTS. Completely adapted flower visitors of the greatest value for pollination.

Hymenoptera: Long-tongued bees.

Lepidoptera: Hawk moths (Sphingidæ).

HEMITROPOUS INSECTS. Partially adapted flower visitors of moderate value for pollination.

Hymenoptera: Short-tongued bees and certain wasps (family Eumenidæ, *Bembex*, *Ammophila* and related genera among the fossorial wasps, and *Parnopes* among the Chrysididæ).

Diptera: Three families of specialized flies (Conopidæ, Syrphidæ and Bombyliidæ).

Lepidoptera: Butterflies and moths (except the hawk moths which belong to the first group).

Coleoptera: Specialized beetles (*Nemognatha*).

ALLOTROPOUS INSECTS. Unequally and only slightly adapted flower visitors of little value for pollination.

This group includes the remaining beneficial flower visiting insects.

A fourth group of *dystropous insects* (not adapted to pollination) is made up of harmful visitors such as flower destroying grasshoppers, beetles, etc., or useless visitors such as ants, etc. This group is of hardly any importance in the matter discussed in this paper and will not be considered at all.

A grouping of the 562 insects of our list according to Loew furnishes the following arrangement:

EUTROPOUS.

HYMENOPTERA. 69 Long-tongued bees, Nos. 1—69.

LEPIDOPTERA. 1 hawk-moth, No. 484.

Altogether 70 eutropous visitors.

HEMITROPOUS.

HYMENOPTERA. 67 short-tongued bees, Nos. 70—136.

26 wasps belonging to the families Eumenidæ, Bembecidæ and Sphecidæ, Nos. 142—155; 186—188; 196—204.

DIPTERA. 73 flies belonging to the families Bombyliidæ, Syrphidæ and Conopidæ, Nos. 270—284; 287—336; 337—344.

LEPIDOPTERA. 59 butterflies and moths, Nos. 446—483; 485—505. (All of the Lepidoptera except the hawk-moth No. 484, which is eutropous.)

COLEOPTERA. 1 long-tongued beetle, No. 536 (*Nemognatha vittigera*).

Altogether 226 hemitropous visitors.

ALLOTROPOUS.

HYMENOPTERA. 57 wasps belonging to the families Vespidæ, Crabronidæ, Mimesidæ, Philanthidæ, Nyssonidæ, Larridæ, Pompilidæ, Scoliidæ and Mutillidæ, Nos. 137—141; 156—185; 189—195; 205—219.)

3 cuckoo-flies, Nos. 220—222.

28 parasitic Hymenoptera, Nos. 223—250.

2 sawflies, Nos. 251—252.

DIPTERA—120 flies (all the flies of the list, except the hemitropous Bombylids, Syrphids and Conopids considered above).

COLEOPTERA. 34 beetles (all the beetles of the list, except the hemitropous Meloid No. 536), Nos. 506—535, 537—540.

HEMIPTERA. 22 bugs, Nos. 541—562.

Altogether 266 allotropous visitors.

FLORAL STRUCTURE.

INFLORESCENCE.

In the Compositæ a number of florets are grouped in such a manner as to present many advantages, both to the flowers as regards their effective cross-pollination, as also to the insects by offering them an ample and easily gathered supply of pollen and nectar. These points have been discussed very thoroughly by Sprengel[9], Delpino[10], H. Mueller[11], and some recent writers. Lovell[12] refers to this inflorescence as "Nature's greatest triumph in flower building."

STYLE.

After emerging from the anther-cylinder the branches of the style become divergent in most of the species under consideration, and thereby expose the stigmatic papillæ, which form a lining on the inner surfaces of the stylar branches, or occur along the sides of the latter. Hildebrand[13] has made us acquainted with the structural and mechanical peculiarities of the stylar branches in quite a number of composite flowers representing different genera. In the European *Eupatorium cannabinum* L. these parts of the flower are slender, and long, and very often come in contact with those of a neighboring flower, thereby transporting pollen-grains from one flower directly to the stigmatic papillæ of

9) Sprengel, loc. cit.

10) Federico Delpino, Ulteriori osservazioni, etc., pp. 111-125.

11) H. Mueller, Die Befruchtung d. Blumen, etc. pp. 378-380, (engl. edit. pp. 315-318).

12) John H. Lovell, loc. cit., p. 448.

13) F. Hildebrand. Ueber die Geschlechtsverhaeltnisse bei den Compositen, 1869.

its neighbor, and giving rise to a mode of cross-pollination called geitonogamy by Kerner[14]. The same conditions prevail in our 3 species of *Eupatorium* which are considered in the second part of this paper.

Referring to *Aster* Kerner[15] states that geitonogamy takes place between ray florets, and disk florets occupying the outer row of the disk. In our species of *Aster* the disk flowers are situated so far above the ray flowers that a meeting of the stylar branches of two of these neighboring flowers is entirely out of the question. From a repeated examination of the flowers of several species of *Aster* besides those treated in this paper I feel convinced, that in the asters of our region geitonogamy does not occur in the manner indicated. Kerner[16] also mentions the fact that in *Aster* automatic self-pollination may be brought about in a discal floret when its stylar branches cross each other, and pollen adhering to one of these branches is deposited on the stigmatic papillæ of the other branch. Knuth[17] has never observed such a crossing of the stylar branches in *Aster*. In our species of *Aster* under discussion two groups can be recognized, one comprising *A. lateriflorus*, *A. paniculatus*, *A. furcatus*, and *A. macrophyllus* in which such a crossing occurs, and the other group, consisting of *A. prenanthoides*, *A. Drummondii*, *A. puniceus*, *A. lævis*, and *A. novæ-angliæ* without any such movements of the stylar branches. In these latter species the stylar branches at first become separated to a slight extent, remaining in contact with their apices only, but in the older flower divergence becomes more pronounced and the tips also move away from each other. With the first named species in which the stylar branches effect a crossing the case is entirely different. At the beginning divergence sets in to the same extent as in the other group, but after 2 or 3 days a movement in the opposite direction (convergence) begins and the stylar branches are carried past each other, whereby they remain in close contact with their corresponding lateral portions. It is interesting to note that those species in which automatic self-pollination may result from the crossing of the stylar branches have shorter tubes than those of the second group. In the first the tube length (length of the upper distended portion of the tube) ranges from 1 to 1½ mm., in the others from 1¾ to 4 mm.

A. Kerner v. Marilaun. Pflanzenleben, 2nd ed., 1896, Vol. II, p. 274.
15) Loc. cit., Vol. II., p. 294.
16) Loc. cit., Vol. II., p. 223.
17) P. Knuth. Handbuch d. Bluetenbiologie, Vol. II., p. 580. Handbook of flower pollination, Vol. II., p. 581.

TUBE LENGTH.

All of the species of Compositæ dealt with belong to the Tubuliforæ, in other words the inflorescence is made up entirely of tubular florets, as in *Eupatorium, Liatris, Antennaria, Tanacetum, Cacalia, Arctium* and *Cirsium,* or at least in its central portion, the so-called disk. In those species in which ray florets are present, the latter contain neither nectar nor pollen. For this reason insects visiting such inflorescences in search of food confine their attention to the tubular florets, and we shall therefore consider the length of the tube of these florets in our endeavor to determine the effect of tube length on the make-up of the visitors.

The corolla of a tubal floret consists in most cases of two distinct parts, a lower narrow portion, and an upper distended portion with its five lobes. Owing to its narrowness, and to the additional fact that in many instances its lumen is more or less taken up by the style and the five filaments, there is little or no room left in the lower portion for the reception of the insect's tongue. In such florets the latter is therefore not able to advance farther than to the bottom of the upper portion. Nectar is secreted at the base of the lower part. but it rises in the latter, and accumulates at the bottom of the upper widened part, where it is accessible to tongues possessed of the necessary length to reach it. This upper part, from the middle of which the anther-cylinder enclosing the stylar branches protrudes, presents the shape of a cup, a bell, or a cylinder, according to the increase of length over width. As stated above the length (depth) of this part of the corolla determines in many florets, as for example in *Eupatorium, Aster, Solidago, Erigeron, Cacalia, Arctium* and *Cirsium,* the depth to which an insect's tongue can penetrate. and in such cases the figures given further on for tube length refer to the length of this upper portion.

A comparison of the results obtained in the 9 species of *Aster* studied shows how along with the increase in tube length there is in general an increase in the percentage of long-tongued insects, and a decrease in the percentage of the short-tongued ones. The difference in color of the rays in the different species will be considered in the course of this paper.

	Tube length	Number of visitors	Allo-tropous %	Hemi. tropous %	Eutropous %
Aster lateriflorus ...	1 mm.	86	52.3	44.2	3.5
paniculatus....	1¼ mm.	92	39.1	55.4	5.5
furcatus.......	1½ mm.	86	25.6	58.1	16.3
macrophyllus..	1½ mm.	95	33.7	49.5	16.8
prenanthoides..	1¾ mm.	64	34.4	56.2	9.4
Drummondii...	1¾ mm.	81	25.9	61.7	12.4
puniceus.......	3 mm.	77	24.7	59.7	15.6
lævis..........	3 mm.	72	16.7	61.1	22.2
novæ-angliæ...	4 mm.	46	6.5	63.0	30.5

In *Aster lateriflorus*, the species with the shortest tube (1 mm.), the width equals the length, the tube is cup-shaped. Insects with comparatively short tongues can reach the bottom, and access is still more facilitated by the fact that the lobes of the corolla are reflexed, and therefore do not stand in the way of the visitors.

In *A. paniculatus* (length of tube 1¼ mm., width ¾ mm.) the tube is bell-shaped, and the corollar lobes are divergent. The latter occupy a position intermediate between horizontal and erect, and the same is the case in *A. furcatus* (1½ mm. length), *A. macrophyllus* (1½ mm.), and *A. prenanthoides* (1¾ mm.). In the remaining species the corollar lobes are erect, or even somewhat inclined towards the middle, as in *A. Drummondii,* and such a position of the lobes in these species with longer tubes strengthens the effect of increase in tube length of restricting the visits of the shorter tongues. As regards the latter a glance at the table above shows that they are not entirely absent from the florets with long tubes, *Aster novæ-angliæ* (tube length 4 mm.) for example still showing a percentage of 6,5 of allotropous visitors. The Compositæ of our flora possessing the greatest tube length are thistles of the genus *Cirsium*, and in these we find the percentage of allotropous insects amounting to 8,3 in *C. lanceolatum*, and 5,9 in *C. altissimum*. These are as a rule pollen-eating beetles or flies, and since in the Compositæ pollen is offered in abundance outside of the tube, the greater length of the latter does not prevent such insects from appearing at these flowers. But their number is small, and it is a well known fact that the more deep-seated the nectar the smaller in general the number of visitors as a result of the exclusion of the shorter tongued species. This is demonstrated very clearly by the following table, in which the 37 species of Compositæ under discussion are arranged in 6 groups according to tube length, and the average number of visitors per species is given.

	Tube length	Average number of visitors.
11 species............	½—1 mm.	86
12 "	1¼—2 mm.	76
4 "	2½—3 mm.	68
3 "	3½—4 mm.	47
5 "	4½—5 mm.	42
2 "	6 mm.	29

Erigeron canadensis with its extremely small florets has the shortest tube (½ mm.) among our Compositæ. No eutropous visitors figure on its list, and the allotropous (56.9%) outnumber the hemitropous visitors (43.1%). The allotropous visitors are also in the majority on the flowers of *Aster laterifiorus*, and of all of our native species blooming in summer, whose tube length does not exceed 1 mm. In *Aster paniculatus* (tube length 1¼ mm.) on the other hand the hemitropous visitors (55.4%) predominate, and this is the case in all of our species with longer tubes. The flowers of *Antennaria neglecta*, the earliest of our Compositæ appear in the spring, and have a tube agreeing in length (1 mm.) with that of *Aster laterifiorus, etc.*, but they show quite a difference in the make-up of their visitors. In *Antennaria neglecta* the *hemitropous* (63.6%) outnumber the allotropous visitors (31.8%) while in *Aster laterifiorus* etc., the opposite is the case. Our anthophilous insect-fauna of early spring differs in many points from that of the summer months. During the flowering season of *Antennaria neglecta* none of the 52 allotropous solitary wasps are on the wing that figure so prominently as visitors of our asters, goldenrods, etc. The allotropous flies of the family Tachinidæ are represented in the general list of visitors of the Compositæ to the number of 46, and only 4 of these appear early enough to pay their attention to the flowers of *Antennaria neglecta*. These facts explain the difference in the proportion of allotropous to hemitropous visitors in those vernal and æstival flowers that otherwise agree in structure and dimensions (tube length). In other words the proportion of poorly adapted to more adapted visitors is determined not by the characters of the flower alone, but also by the composition of the anthophilous insect-fauna to which the flower is exposed, and this is subject to seasonal changes.

COLOR.

At the beginning of this paper I have called attention to the difference of opinion among the various observers as to the effect of the colors of flowers on the insect visitors. The evidence produced within the last decade is mostly unfavorable to Hermann Mueller's theory, according to which certain types of insects show a preference for certain colors. Lovell[18], who has treated the color question in its various aspects in a most thorough manner, reaches the conclusion, that long-tongued bees (which were believed to favor blue), and butterflies (considered having a preference for red) "are influenced more by the form of the flower than by its color." Prof. T. D. A. Cockerell[19], has given us some very interesting information on the relation of the bees of the genus *Perdita* to flowers, mainly Compositæ, and he considers the dimensions of the tube (length and width) of the greatest importance in this respect.

I shall proceed to compare flowers agreeing in tube length, but differing in color, and shall at first consider the native species, reserving the introduced species for a later discussion.

Tube length 1 mm.

There are 3 species* with white flowers (*Eupatorium perfoliatum, Aster lateriflorus* and *Erigeron annuus,* the latter two with white rays, and a yellow disk), and 2 with yellow flowers (*Solidago canadensis,* and *S. juncea.*) The average percentage of allotropous, hemitropous, and eutropous visitors for the yellow, as also for the white flowers is as follows

	Allotr.	Hemitr.	Eutr.
Yellow	56.9	36.1	7.0
White	52.9	41.7	5.4

These figures come pretty close together, the difference is certainly too small to be of any importance. It will be noted how in both groups the allotropous visitors predominate, a fact emphasized above under tube length.

Tube length 1½ mm.

Here we have a yellow (*Solidago graminifolia*), a white (*Aster furcatus*) with white rays, and a yellow disk), and a blue (*Aster macrophyllus* with blue rays, and a yellow disk) flower.

	Allotr.	Hemitr.	Eutr.
Yellow	38.5	50.4	11.1
White	25.6	58.1	16.3
Blue	33.7	49.5	16.8

18) John H. Lovell, loc. cit., pp. 456-479.
19) T. D. A. Cockerell. The bees of the genus Perdita F. Smith. Proc. Acad. Nat. Sc. Phil., 1896, p. 41.
*) All of them blooming synchronously, and therefore exposed to the same insect-fauna. For details see the lists of visitors following an account of the species in the second part of this paper.

The blue flower shows about the same percentage of long-tongued bees (eutropous) as the white, and even a greater percentage of short-tongued (allotropous) visitors, and this does not agree with the theory of color preference.

Tube length 3 mm.

1 yellow *(Rudbeckia hirta)*, and 2 blue *(Aster puniceus* and *A. lævis*, each with blue rays, and a yellow disk).

	Allotr.	Hemitr.	Eutr.
Yellow	31.2	54.5	14.3
Blue	20.7	60.4	18.9

In this case the blue flowers have a somewhat larger percentage of long-tongued bees (18.9), but if we consider each of the blue species separately we find 15.6% eutropous visitors in *A. puniceus* and 22.2% in *A. lævis*. The blue *A. puniceus* agrees more closely with the yellow *Rudbeckia hirta* than with the blue *A. lævis.*

Tube length 4 mm.

1 yellow *(Rudbeckia laciniata)*, and 1 purple flower *(Aster novæ-angliæ* with purple rays, and a yellow disk).

	Allotr.	Hemitr.	Eutr.
Yellow	9.1	59.1	31.8
Purple	6.5	63.0	30.5

There is a very slight difference between the two, and of the most interest is the fact that the figures for the eutropous (long-tongued) insects are about the same in both species.

Tube length 4½ mm.

2 yellow *(Helianthus strumosus*, and *H. giganteus)*, and 1 purple *(Eupatorium purpureum)*.

	Allotr.	Hemitr.	Eutr.
Yellow	13.0	49.7	37.3
Purple	7.6	69.8	22.6

Here in the yellow flowers the long-tongued bees (37.3%), outnumber those in the purple flower (22.6) to a considerable extent, and this is just the opposite of what might be expected according to the theory of color preference.

Tube length 5 mm.

1 yellow *(Heliopsis scabra)*, and 1 purple species *(Liatris spicata)*.

	Allotr.	Hemitr.	Eutr.
Yellow	23.8	47.6	28.6
Purple	4.3	60.9	34.8

In this instance it is in the purple flower that we find a higher percentage of long-tongued visitors. In the observations on *Liatris spicata*, made in Racine Co., they cover 2 days only, and for this reason the list, consisting of 23 visitors, can hardly be considered complete enough to be of much value for comparison.

INTRODUCED SPECIES.

Among the species dealt with in this study, there are 7 which have found their way into our flora from Europe, all of which have succeeded in gaining a strong, and permanent foothold. According to the length of their tubal florets they may be arranged in the following order:

Tube length.	Species.
1 mm.	*Achillea millefolium* (white).
1 mm.	*Anthemis Cotula* (white rays, and yellow disk).
1 mm.	*Chrysanthemum leucanthemum* (white rays, and yellow disk).
1 mm.	*Tanacetum vulgare* (yellow).
1½ mm.	*Cirsium arvense* (purple).
3½ mm.	*Arctium Lappa* (purple).
6 mm.	*Cirsium lanceolatum* (purple).

Tube length 1 mm.

We have already considered the average percentages for the 3 native white-flowered species having a tube 1 mm. in length. A comparison of these with the averages for the corresponding introduced species (the first 3 named above) shows how remarkably close the two sets of species agree with each other.

	Allotr.	Hemitr.	Eutr.
Native	52.9	41.7	5.4
Introduced	53.8	42.7	3.5

The same may be said of the yellow *Tanacetum vulgare* when compared with the yellow goldenrods *Solidago canadensis* and *S. juncea*. Here are the figures:

	Allotr.	Hemitr.	Eutr.
Native	56.9	36.1	7.0
Introduced	53.0	38.2	8.8

Tube length 1½ mm.

There are 3 native species belonging to this group, and *Cirsium arvense* is the only introduced species with the same tube leigth. The average percentages are as follows:

	Allotr.	Hemitr.	Eutr.
Native	32.6	52.7	14.7
Introduced	37.2	51.3	11.5

This introduced species with its purple flowers comes closest to the yellow-flowered *Solidago graminifolia*, as the following figures show:

	Allotr.	Hemitr.	Eutr.
Cirsium arvense	37.2	51.3	11.5
Solidago graminifolia	38.5	50.4	11.1

Tube length 3½ mm.

Only 1 introduced species, *Arctium Lappa* belongs here, and there is no corresponding species among those studied. It compares well with the 2 native species having a slightly longer tube (4 mm.), according to the following:

	Allotr.	Hemitr.	Eutr.
Native	7.8	61.1	31.1
Introduced	6.9	63.8	29.3

Tube length 6 mm.

Our flora contains 1 native thistle (*Cirsium altissimum*), and 1 introduced thistle (*C. lanceolatum*), the florets of which are of exactly the same size, and structure. A comparison of the 2 shows the following results:

	Allotr.	Hemitr.	Eutr.
Native	5.9	52.9	41.2
Introduced	8.3	58.4	33.3

From a consideration of these introduced species we are led to infer, that in their relations to our anthophilous insects, they do not differ from our native species. The flowers of such an introduced species receive the attention of a set of visitors corresponding to that of any of our native species presenting the same floral characters.

ROBERTSON'S FIGURES FOR SOUTHERN ILLINOIS.

Following the comparison of the native and introduced species of our region I present a table in which the figures taken from Robertson's lists of visitors for Carlinville, Macoupin Co., in southern Illinois[20], are placed alongside of those obtained for Milwaukee. This table considers 11 species common to Milwaukee Co., Wis., and Macoupin Co., Ill. In Robertson's papers an account is also given of *Helianthus strumosus*, and of the 3 species of *Eupatorium*, occurring in our region, and treated in this paper,

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20) Chas. Robertson. Flowers and insects. Rosaceæ and Compositæ Trans. Acad. Sc. St. Louis, Vol. VI., No. 14, 1894.
Chas. Robertson. Flowers and insects, loc. cit., Vol. VII., No. 6, 1896.

but his lists of visitors of these species are rather short, and for this reason I have not made use of them for comparison.

			Allotr. %	Hemitr. %	Eutr. %
1.	*Aster paniculatus*,	Milwaukee, Wis......	39.1	55.4	5.5
	" "	Carlinville, Ill........	34.0	55.0	11.0
2.	*Aster novæ-angliæ*,	Milwaukee, Wis......	6.5	63.0	30.5
	" "	Carlinville, Ill........	....	68.6	31.4
3.	*Solidago canadensis*,	Milwaukee, Wis......	56.7	35.5	7.8
	" "	Carlinville, Ill........	52.1	41.1	6.8
4.	*Solidago graminifolia*,	Milwaukee, Wis......	38.5	50.4	11.1
	" "	Carlinville, Ill........	35.7	50.0	14.3
5.	*Erigeron philadelphicus*,	Milwaukee, Wis......	30.7	52.0	17.3
	" "	Carlinville, Ill........	34.0	52.8	13.2
6.	*Rudbeckia hirta*,	Milwaukee, Wis......	31.2	54.5	14.3
	" "	Carlinville, Ill........	18.6	64.3	17.1
7.	*Rudbeckia laciniata*,	Milwaukee, Wis......	9.1	59.1	31.8
	" "	Carlinville, Ill........	17.7	58.8	23.5
8.	*Lepachys pinnata*,	Milwaukee, Wis......	15.1	48.5	36.4
	" "	Carlinville, Ill........	9.8	46.3	43.9
9.	*Helenium autumnale*,	Milwaukee, Wis......	21.8	47.8	30.4
	" "	Carlinville, Ill........	15.1	45.5	39.4
10.	*Cacalia reniformis*,	Milwaukee, Wis......	34.0	58.0	8.0
	" "	Carlinville, Ill........	20.5	66.7	12.8
11.	*Cirsium lanceolatum*,	Milwaukee, Wis......	8.3	58.4	33.3
	" "	Carlinville, Ill........	....	58.1	41.9

The average percentages for these 11 species are as follows:

	Allotr. %	Hemitr. %	Eutr. %
Milwaukee, Wis...........	26.5	52.9	20.6
Carlinville, Ill.............	21.6	55.2	23.2

According to these figures the relations of these composite flowers to the anthophilous insect-fauna are about the same in both regions, so far as the proportion of short-tongued and long-tongued visitors is concerned. There is a somewhat larger percentage of the latter, and a corresponding smaller percentage of the former in the results from southern Illinois, but whether this is due to a larger percentage of long tongues, and a smaller percentage of short tongues of the entire anthophilous insect-fauna of that region in connection with the more southern latitude I am unable to state.

BUTTERFLIES AND MOTHS (LEPIDOPTERA).

These insects figure as visitors to all of the flowers studied, except *Erigeron canadensis*, and *Chrysanthemum leucanthemum*. The number of species of these visitors ranges from 1 in *Erigeron annuus*, *Cacalia reniformis*, and *Senecio aurea* up to 25 in *Solidago gramini folia*. They were observed to the number of 10 or more on the following flowers:

Tube length	1 mm.	*Eupatorium perfoliatum*	(white),	10	Lepidoptera
" "	1½ mm.	*Aster furcatus*	(white),	10	"
" "	1½ mm.	*Solidago graminifolia*	(yellow)	25	"
" "	1½ mm.	*Cirsium arvense*	(purple),	11	"
" "	3 mm.	*Aster puniceus*	(blue),	13	"
" "	4 mm.	*Aster novæ-angliæ*	(purple),	13	"
" "	4½ mm.	*Helianthus strumosus*	(yellow),	10	"
" "	4½ mm.	*Eupatorium purpureum*	(purple),	23	"
" "	5 mm.	*Liatris spicata*	(purple),	10	"
" "	6 mm.	*Cirsium altissimum*	(purple),	10	"

2 of these species have white, 2 yellow, 1 blue and 5 purple flowers. The Lepidoptera have, as a rule long, and very slender tongues, and accordingly favor long, and tubular flowers. Together with an increase in tube length in the flowers of the Compositæ we witness an increase in the number of flowers of red (purple) color, and these are usually visited by a greater percentage of long-tongued insects, butterflies and moths as well as long-tongued bees and flies. Judging from the evidence offered by our Compositæ there is nothing to indicate that the butterflies and moths show a preference for any of these flowers on account of its color. The greatest number (25) of such visitors is recorded (see above) for *Solidago graminifolia* a species with yellow flowers, next comes the purple-flowered *Eupatorium purpureum* with 23 Lepidoptera, and then follow *Aster novæ-angliæ* with purple flowers, and *Aster puniceus* with blue flowers, each of these species having 13 such visitors according to my lists. In *Solidago graminifolia* the flowers are fragrant to such an extent that in some parts of the country the plant is known under the name of "sweet-scented goldenrod." These flowers are very attractive to insects, and most decidedly so to butterflies and moths.

ODOR.

In the flowers just mentioned there is undoubtedly a connection between the effect of the odor, and the great number of insects, of species as well as of individuals that pay their attention to these flowers. In *Arctium Lappa*, for example, conspicuousness can hardly be taken into consideration; there is on the contrary an extremely modest display of color (purple) in the inflorescence, but a distinct fragrant odor is perceptible, and the flowers, especially when these plants are gathered in groups are well visited. In our 2 species of *Eupatorium*, in which the white capitula are arranged in a flat-topped inflorescence there is quite a difference in the number of insects at the flowers. *Eupatorium perfoliatum* has sweet-scented flowers that are very attractive, and 113 species, many of them represented by numerous individuals, were noticed as visitors. In Maine Lovell[21], has observed more butterflies on this species than on any other Composite of his region. In *Eupatorium urticæfolium* on the other hand with a very faint odor I succeeded in obtaining 58 species of visitors only, and there is not such an assemblage of individuals at the flowers as in the preceding species. Of course the greater length of the tube in this species (2 mm., only 1 mm. in *E. perfoliatum*) has something to do with the smaller number of visitors, but quite a number of our species with longer tubes are more extensively visited. The examples cited so far refer to flowers emitting a sweet odor. In some of our species of Compositæ the flowers produce a more or less disagreeable, or even fetid odor, and this seems to attract a smaller number of insects than a fragrant odor. Of the yellow flowers of *Tanecetum vulgare* Knuth[22], states that they are visited by a large number of insects, but H. Mueller's[23] list contains 27 visitors only. In the vicinity of Milwaukee they are poorly visited, and in spite of repeated observations I have not been able to bring the number of the list above 34. This number seems insignificant as compared with the 141 visitors of the goldenrod *Solidago canadensis*, and the 182 visitors of another goldenrod *Solidago juncea*, the tubal florets of which correspond in color and dimensions to those of *Tanecetum*. *Anthemis Cotula* furnishes an additional example of a flower with a disagreeable odor, and a poor attendance, at least so far as the number of individuals is concerned. Much time was spent on this species during a vacation at Cedar Lake, Washington

21) John H. Lovell, loc. cit. p. 452.
22) P. Knuth. Handbuch d. Bluetenbiologie, Vol. II., p. 619, (engl. edit. Vol. II., p. 622.)
23) H. Mueller. Befruchtung d. Blumen durch Insekten, p. 397.

Co., Wis., and 64 species of insects taken at the flowers. All of the species were numerically poorly represented, with the exception of the Syrphid-flies *Eristalis transversus*, and *E. meigenii*, which were quite in evidence.

It has been previously pointed out how an increase in long-tongued visitors runs along with an increase in tube length of the florets. The following table contains the average percentages (allotropous, hemitropous, and eutropous visitors) for different tube lengths. I have arranged the species of Compositæ discussed in this paper in 6 groups. The earliest species *Antennaria neglecta* appears together with an insect-fauna of quite a different make-up than the fauna of late spring and summer, as set forth above, and this species is therefore not considered along with the others in the table.

	Allotr. %	Hemitr. %	Eutr. %
10 species, tube length ½—1 mm.	55.5	41.4	3.1
12 " " " 1¼—2 mm.	32.9	55.1	12.0
4 " " " 2½—3 mm.	23.0	53.1	23.9
3 " " " 3½—4 mm.	7.4	62.4	30.2
5 " " " 4½—5 mm.	12.2	56.9	30.9
2 " " " 6 mm.	7.1	55.7	37.2

To this I add a table with the average percentages for the butterflies and moths (Lepidoptera).

	Lepidoptera. %
10 species, tube length ½—1 mm.	2.4
12 " " " 1¼—2 mm.	8.7
4 " " " 2½—3 mm.	9.4
3 " " " 3½—4 mm.	19.1
5 " " " 4½—5 mm.	26.9
2 " " " 6 mm.	33.4

There is a decrease in the short-tongued (allotropous) visitors from 55.5% to 7.1%, and an increase in the long-tongued bees* from 3.1% to 37.2%. The hemitropous visitors occupying an intermediate position between the other 2 groups show in general a moderate increase. Of course we can not expect the figures derived from our observations to show a steady increase or decrease corresponding to every slight difference in tube length, and accordingly we sometimes run across an increase where a decrease is expected, and vice versa. This is due to more than one reason. In the first place it must be kept in mind that a list of visitors is

* For a tube length of 3½-4mm., the average of 30.2% for the eutropous visitors refers to the long-tongued bees plus 1 hawk-moth (a visitor of *Aster novæ-angliæ*).
The figure for the long-tongued bees alone is 29.7%.

always more or less incomplete, even in such cases where it represents the results of very careful, and often repeated observations. Another fact to be considered is that there is a varying percentage of pollen-eating, short-tongued visitors at flowers, the tube length of which excludes them from obtaining nectar. Their presence has nothing to do with tube length, but their number figures in the list, and the percentages representing the proportion of short- to long-tongued visitors obtained from such a list are not indicative of the effect of tube length alone.

According to the figures contained in the two tables above the percentages for the long-tongued bees (eutropous) show a more rapid increase of visits to flowers with shorter tubes, i. e., tubes below 4 mm. in length than those for the butterfiies, and moths (Lepidoptera). From 4 mm. on the visits of the latter insects assume greater proportions, and the percentage of their visits to the 2 thistles of the genus *Cirsium* with a tube length of 6 mm. nearly equals that of the long-tongued bees. The butterflies and moths favor flowers with long and narrow tubes, and we may well understand, how a steady increase in tube length in our Compositæ might produce typical butterfly-flowers, in which the nectar would be inaccessible to even the longest tongues among our bees.

In closing our remarks on the effect of tube length, it may be stated that, according to the results obtained from a study of our Compositæ the proportion of short-tongued to long-tngued visitors in these flowers is determined by tube length more than by any other character of the flower. The number of visitors, in species as well, as in individuals, depends on tube length (decrease in number with increase in tube length), as also on other floral characters, such as odor, supply and taste of pollen and nectar (insects possess a "gustatory memory," as pointed out by Forel[24]) and color. As regards the latter, the evidence procured from our observations of the Compositæ is not favorable to Mueller's theory of color preference.

PART 2.

This part contains an account of the blooming period, structure, relations to insects, etc., of the flowers of the 37 species of Compositæ, considered in this paper. As previously stated (p. 21) a number in the list of visitors accompanying a discussion of each plant-species, refers to a species of insect bearing that number in the general list of visitors (pp. 21-27).

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24) A. Forel. The senses of insects. Engl. transl. by Macleod Yearsley.

Aster (Tourn.) L.

1. Aster lateriflorus (L.) Britton.* Starved Aster.

The flowering period of this species extends from about August 15 to October 9. The heads are small, 10 to 12 mm. in diameter, each with about a dozen white, usually reflexed rays. In the older flowers these rays become rolled up spirally. The very narrow tube of the ray floret is 2 mm. long, and the style protrudes to a length of 2 mm. from the mouth of the floret. All of the parts of such a ray floret are white. There are from 10 to 14 disk florets, which are nearly white when young, but later on assume a reddish-purple coloration. The lower narrow part of the disk floret has a length of 2½ mm., while the upper distended part forms a cup of 1 mm. depth, and of the same width. The droplets of nectar, which may be seen at the bottom of these shallow cups are accessible to rather short-tongued visitors; and the fact that the lobes of the corolla, being reflexed, are out of the way of the visiting insects renders access still more easy. The anther-cylinder with the style surpasses the corolla to a distance of 3 mm. At first the branches of the styles are in contact with each other throughout their entire length, but following the retraction of the anther-cylinder these branches become separated, remaining in contact with their tips only. In the older flower a crossing of these branches takes place, thereby favoring self-pollination in case cross-pollination has not been effected previously.

The following visitors* were observed on the flowers:

EUTROPOUS.

Bees: 13 male, s.; 17 male, s.; 35 male s.

HEMITROPOUS.

Bees: 89, female, s. and c. p.†; 99, female, s.; 100, female, s.; 102, male, female, s. and c. p.; 103, female, s.; 104, female, s.; 105, male and female, s. and c. p.; 107, male and female, s.; 108, male, s.; 112, male, s.; 114, female, s. and c. p.; 119, female, s. and c. p.; 121, female, s.; 122, male and female, s.; 128, female, s.; 129, female, s.; 133, female, s.; 134, female, s.; 135, female, s.

Wasps: 142; 147; 149; 151; 201—all s.

Flies: 287; 298; 305; 306; 307; 313; 322; 332; 333; 342—all s., or f. p.

Butterflies and moths: 450; 473; 485; 493—all s.

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* Nomenclature according to the seventh (latest) edition of Gray's Manual.

* See the general list, p. 1 and Loew's classification p.

† s=sucking; c. p.=collecting pollen; f. p.=feeding on pollen.

ALLOTROPOUS.

Wasps: 137; 138; 140; 141; 161; 163; 165; 172; 179; 205; 206; 209; 217—all s.

Parasitic wasps: 234; 247—all s.

Flies: 368; 371; 372; 373; 376; 377; 378; 380; 383; 384; 385; 387; 391; 395; 400; 408; 416; 421; 423; 425; 439; 442; 444;—all s. or f. p.

Beetles: 507; 527; 529;—all s., or f. p.

Bugs: 541; 552; 553; 554—all s.

Entrop.	3	=	3.5%
Hemitrop.	38	=	44.2%
Allotrop.	45	=	52.3%

2. **Aster paniculatus** Lam. Tall White Aster.

This has been observed in bloom from August 20 to October 14. The heads with their white rays, and light yellow disk florets range in width from about 16 to 20 mm. In its form the upper portion of the disk floret is more bell-shaped, and slightly deeper than that of the preceding species, having a length of about 1¼ mm., and a width of ¾ mm. The lobes of the corolla are distinctly spreading. There is a crossing of the stylar branches in the older flowers, and there is also a contrast in color noticeable between the younger yellow disk flowers, and the older brownish ones.

The list of visitors containing 92 species is as follows:

EUTROPOUS.

Bees: 1, worker, s.; 2, male, s.; 13, male and worker, s. and c. p.; 17, male, s.; 40, female, s.

HEMITROPOUS.

Bees: 89, female, s. and c. p.; 97, female, s. and c. p.; 99, female, s.; 100, female, s. and c. p.; 103, female, s.; 105, male, s.; 106, male and female, s. and c. p.; 107, male, s.; 114, male and female, s. and c. p.; 115, male, s.; 118, female, s.; 119, female, s. and c. p.; 122, male, s.; 123, female, s.; 124, female, s.; 126, male, s.; 128, male and female, s.; 133, female, s. and c. p.; 135, female, s.; 136, female, s.

Wasps: 147; 149; 186—all s.

Flies: 276; 283; 288; 300; 304; 305; 306; 307; 308; 313; 315; 316; 317; 318; 319; 322; 323; 330; 332; 333—all s. or f. p.

Butterflies and moths: 449; 450; 461; 462; 463; 466; 469; 493—all s.

ALLOTROPOUS.

Wasps: 137; 138; 161; 163; 164; 165; 171; 172—all s.

Parasitic wasps: 239; 244—both s.

Flies: 372; 373; 374; 376; 377; 378; 383; 384; 385; 395, 396; 400; 401; 403; 408; 413; 417; 436; 438; 441; 442; 443; 444—all s. of f. p.
Beetles: 527; 537—both f. p.
Bug: 554, s.

Eutrop.	5 = 5.5%
Hemitrop.	51 = 55.4%
Allotrop.	36 = 39.1%

3. **Aster furcatus** Burgess. Smooth-stemmed Aster.

Flowering period from around August 6 to August 25. The rays are white, and the heads measure from 20 to 22 mm. in diameter. A count of 4 heads was taken, and in these the number of ray florets ranged between 11 and 13, and of disk florets between 23 and 29, with an average of 12 for the first, and 25 for the latter. In the ray floret the style protrudes to a length of 3½ mm., from the mouth of the tube, 1½ mm. being taken up by the slender stylar branches.

At first the disk florets are light yellow, but after a few days a change to reddish-brown (wine color) takes place. The bell-shaped upper part of such a floret is 1 mm. wide at the mouth, and 1½ mm. deep, and the corolla lobes are spreading. Shortly after emerging from the anther-cylinder the very slender stylar branches become divergent, but later a distinct crossing of the branches is effected. The sweet odor in these flowers is rather faint.

The following 86 visitors were observed:

EUTROPOUS.

Bees: 1 worker, s.; 2, worker, s. and c. p.; 4, male, female and worker, s. and c. p.; 17, female, s.; 18, male, s.; 25, male, s.; 26, male, s.; 32, male. s.; 35, female, c. p.; 36, male, s.; 39, male, s.; 44, female, s.; 55, female, s.; 58, female, s.

HEMITROPOUS.

Bees: 70, female, s.; 72, female, s.; 80, female, s. and c. p.; 87, female, s. and c. p.; 89, female, s. and c. p.; 99, male, s.; 102, male and female, s. and c. p.; 103, female, s.; 104, male and female, s. and c. p.; 105, male and female, s. and c. p.; 107, male and female, s. and c. p.; 114, female, s.; 115, male, s.; 118, female, s.; 120, female, s. and c. p.; 121, female, s.; 122, male and female, s. and c. p.; 125, female, s.; 130, female, s.; 135, male and female, s.; 136, male, s.
Wasps: 142; 148; 149; 151; 153; 196—all s.
Flies: 274; 306; 307; 309; 311; 313; 315; 318; 319; 322; 326; 330; 332—all s. or f. p.
Butterflies and moths: 450; 451; 460; 466; 469; 470; 474; 475; 485; 490—all s.

ALLOTROPOUS.

Wasps: 137; 139; 141; 164; 165; 194—all s.
Parasitic wasp: 238, s.
Flies: 372; 377; 378; 385; 389; 400; 415; 416; 442; 443; 444—all s. or f. p.
Beetle: 533, f. p.
Bugs: 546; 547; 554—all s.

Eutrop.	14	= 16.3%
Hemitrop.	50	= 58.1%
Allotrop.	22	= 25.6%

4. **Aster macrophyllus** L. Large-leaved Aster.

The flowers of this species have been observed throughout a rather extended blooming period, from about July 24 to October 11. The heads are larger than in the preceding species, having a width of 25 to 30 mm. In color the rays are rather variable, different shades between light violet and blue being noticeable. In several heads the number of ray florets was found to be from 13 to 14, and of disk florets from 27 to 37.

In color, gradual change of color, and structure the disk floret agrees very closely with that of *A. furcatus*, the bell is of the same length, and width as in that species, and the somewhat longer corollar lobes are also spreading. In shape the bell in both of these species resembles that of *A. paniculatus*, but in the latter species it is shorter, and its yellow color is of a lighter hue. In *A. macrophyllus* the stylar branches are just as slender, and as long as in *A. furcatus*, and cross each other in the older flowers in the same manner.

The fragrant odor of the flowers is more noticeable in this species than in any of the other species of Aster considered in this paper, except *A. novæ-angliæ*.

These flowers are very attractive to insects, of which the following 95 species have been taken:

EUTROPOUS.

Bees: 1, worker, s.; 4, male and worker, s.; 7, female, s.; 10, male, s.; 16, male, s.; 17, female, s.; 20, female, s. and c. p.; 29, male and female, s.; 31, female, s.; 32, male, s.; 35, male and female, s. and c. p.; 36, male, s.; 39, male, s.; 42, female, s.; 44, female, s.; 58, male and female, s.

HEMITROPOUS.

Bees: 70, male and female, s.; 72, male and female, s.; 87, female, s. and c. p.; 89, male and female, s. and c. p.; 102, male and female, s.

and c. p.; 104, male and female, s. and c. p.; 105, male and female, s. and c. p.; 107, male and female, s. and c. p.; 108, female, s. and c. p.; 109, male, s.; 115, female, s. and c. p.; 116 male and female, s. and c. p.; 119, female, s.; 120, female, s. and c. p.; 122, male and female, s. and c. p.; 125, female, s.; 134, female, s.; 135, female, s.; 136, female s.

Wasps: 142; 143; 144; 149; 151; 153; 196—all s.

Flies: 300; 302; 306; 307; 308; 313; 314; 315; 316; 318; 319; 322; 332; 343; 344—all s. or f. p.

Butterflies and moths: 469; 473; 474; 487; 500; 503—all s.

ALLOTROPOUS.

Wasps: 137; 157; 179; 182—all s.

Parasitic wasps: 245; 246—both s.

Flies: 348; 356; 367; 369; 372; 373; 378; 379; 380; 383; 385; 391; 400; 415; 416; 438; 444—all s. or f. p.

Beetles: 510; 518; 519; 527; 533; 537—all s. or f. p.

Bugs: 543; 553; 554—all s.

Eutrop.	16	= 16.8%
Hemitrop.	47	= 49.5%
Allotrop.	32	= 33.7%

5. **Aster prenanthoides** Muhl. Crooked-stem Aster.

Blooming period from about August 12 to October 14. The heads examined measured about 30 mm. across, and were surrounded by 17 to 20 light blue rays. Shull[25], counted the florets in 658 heads, and obtained an average of 28 ray florets, and 50 disk florets. The yellow bell-shaped florets of the disk undergo the usual change of color to reddish-brown. The bell with its slightly spreading lobes has a length of about 1¾ mm., with a width of 1 mm. Divergence of the stylar branches takes place to a marked degree, and there is no crossing of these branches as in the species of Aster considered heretofore.

64 visitors:

EUTROPOUS.

Bees: 1, worker, s.; 2, worker, s. and c. p.; 4, male and worker, s.; 17, female, s.; 24, female, s. and c. p.; 35, male and female, s. and c.p.

HEMITROPOUS.

Bees: 71, male, s.; 89, female, s. and c. p.; 97, female, s. and c. p.; 99, male and female. s.; 102, male and female, s. and c. p.; 104, female, s.; 105, male and female, s. and c. p.; 108, male, s.; 114, male, s.; 118, female, and c. p.; 130, female, s. and c. p.; 132, female, s.

25) George Harrison Shull. A quantitative study of variation in the bracts, rays, and disk florets of *Aster Shortii* Hook, *A. novæ angliæ* L., *A. puniceus* L., and *A. prenanthoides* Muhl., from Yellow Springs, Ohio. American Naturalist, Vol. XXXVI, No. 422, pp. 111-152, (1902).

Wasps: 147; 149; 186—all s.

Flies: 292; 298; 306; 307; 313; 314; 315; 316;; 317; 318; 319; 322; 330; 333; 335—all s. or f. p.

Butterflies and moths: 450; 451; 463; 464; 474; 493—all s.

ALLOTROPOUS.

Wasps: 137; 161; 162;—all s.

Parasitic Wasp: 246 s.

Flies: 360; 371; 372; 377; 379; 385; 391; 400; 405; 416; 438; 442; 444—all s. or f. p.

Beetles—518; 527; 528; 534—all s. or f. p.

Bug: 554. s.

Eutrop.	6 =	9.4%
Hemitrop.	36 =	56.2%
Allotrop.	22 =	34.4%

6. **Aster Drummondii** Lindl. Drummond's Aster.

The flowers make their appearance around August 11, and may be found as late as October 14. The heads are smaller than in *A. macrophyllus*, and are surrounded by 12 or more light blue rays. In this species the upper portion of the light yellow discal floret is more cylindrical than in the preceding species, being of nearly equal width (1 mm.) throughout, and presenting a length of 1¾ mm. The lobes of the corolla are erect, or even slightly inclined towards the middle. A change in color to reddish-brown takes place in the older floret. In this species the branches of the style do not effect a crossing. 81 visitors were taken as follows:

EUTROPOUS.

Bees: 1, worker, s.; 2, male and female, s.; 4, male and worker, s. and c. p.; 6, male and worker, s. and c. p.; 7, male, s.; 16, male, s.; 17, female, s. and c. p.; 24, female, s. and c. p.; 35, female, s. and c. p.; 36, male, s.

HEMITROPOUS.

Bees: 70, male and female, s.; 80, female, s.; 89, female, s. and c. p.; 97, female, s. and c. p.; 99, female, s.; 100, female, s.; 102, male and female, s. and c. p.; 104, female, s.; 105, male and female, s.; 107, male, s.; 113, female, s.; 114, male and female, s.; 116, female, s.; 118, female, s. and c. p.; 119, female, s.; 122, male, s.; 126, male, s.; 132, female, s.

Wasps: 143; 147; 149; 186; 196; 201—all s.

Flies: 283: 298; 299; 306; 307; 308; 313; 314; 315; 316; 317; 318; 319; 322; 332; 335; 344—all s. or. f. p.

Butterflies and moths: 449; 450; 461; 464; 469; 480; 485; 490; 493—all s.

ALLOTROPOUS.

Wasps: 172; 173—both s.
Parasitic wasp: 247, s.
Flies: 369; 372; 373; 374; 377; 378; 379; 383; 384; 385; 398; 403; 413; 417; 442; 444—all s. or f. p.
Beetle: 527, s.
Bug: 554, s.

Eutrop.	10 = 12.4%
Hemitrop.	50 = 61.7%
Allotrop.	21 = 25.9%

7. **Aster puniceus** L. Red-stalk Aster.

Flowers of this aster have been found from August 3 to November 5. The diameter of the heads with their light blue rays runs from about 30 to 35 mm. Shull[26] found an average of 36 ray florets and 69 disk florets. The upper, distended part of the discal floret has a cylindrical shape, and is 3 mm. long, and 1¼ mm. wide with erect lobes. No crossing of the stylar branches occurs in these flowers.

Following is the list of 77 vistors:

EUTROPOUS.

Bees: 1, worker, s.; 2, female, worker, s. and c. p.; 4, worker, s. and c. p.; 6, worker, s. and c. p.; 7, male, s.; 11, worker, s.; 13, female and worker, s.; 17, female, s. and c. p.; 24, female, s. and c. p.; 28, female, s.; 34, male and female, s. and c. p.; 35, female, s. and c. p.

HEMITROPOUS.

Bees: 89, female, s. and c. p.; 95, female, s. and c. p.; 97, female, s. and c. p.; 99, male and female, s. and c. p.; 104, female, s. and c. p.; 105, female, s. and c. p.; 107, male, s.; 113, female, s. and c. p.; 119, female, s. and c. p.; 133, female, s.
Wasps: 147; 149; 186; 202—all s.
Flies: 272; 275; 276; 283; 293; 304; 308; 312; 313; 314; 315; 316; 318; 319; 321; 322; 330; 332; 338—all s. or f. p.
Butterflies and moths: 449; 450; 451; 457; 460; 463; 464; 469; 477; 478; 485; 492; 493—all s.

ALLOTROPOUS.

Wasps: 137; 172; 180—all s.
Flies: 372; 373; 374; 376; 377; 384; 385; 402; 404; 408; 411; 438; 439; 442; 443; 445—all s. or f. p.

Eutrop.	12 = 15.6%
Hemitrop.	46 = 59.7%
Allotrop.	19 = 24.7%

26) Shull, loc. cit.

8. **Aster lævis** L. Smooth Aster.

In size, structure, and color the flowers of this species agree quite closely with those of *A. puniceus.* Blooming period from about August 8 to November 5, the latest date on which these flowers have been observed. The heads examined contained 18 to 24 light blue ray florets, and 30 to 34 yellow discal florets. In the older flowers the latter assume a dark reddish-brown color. The upper cylindrical portion of the discal floret is 3 mm. long, and its lobes are erect. As in *A. puniceus* the stylar branches are divergent, and never cross each other.

72 visitors:

EUTROPOUS.

Bees: 1, worker, s.; 2, worker, s. and c. p.; 4, male and worker, s.; 7, worker, s.; 13, male, s.; 16, male, s.; 17, female, s. and c. p.; 23, female, s.; 24, female, s. and c. p.; 25, female, s.; 31, female, s.; 35, female, s. and c. p.; 36, female, s.; 53, female, s.; 56, female, s.; 57, male, s.

HEMITROPOUS.

Bees: 89, female, s. and c. p.; 97, female, s. and c. p.; 99, male and female, s. and c. p.; 100, female, s. and c. p.; 102, male and female, s.; 104, female, s.; 105, female, s.; 107, male and female, s.; 108, male, s.; 112, male, s.; 116, male, s.; 132, female, s.; 135, female, s.

Wasps: 155; 196; 204—all s.

Flies: 293; 298; 299; 306; 307; 308; 313; 314; 315; 316; 317; 318; 319; 321; 322; 330; 332; 335; 343—all s. or f. p.

Butterflies and moths—449; 450; 451; 463; 464; 469; 473; 481; 493—all s.

ALLOTROPOUS.

Flies: 372, 373; 381; 383; 384; 392; 438; 443—all s. or f. p.

Beetles: 508; 515; 527; 528—all s. or f. p.

Eutrop.	16	= 22.2%
Hemitrop.	44	= 61.1%
Allotrop.	12	= 16.7%

9. **Aster novæ-angliæ** L. New England Aster.

Blooming period from about August 15 to October 11. The rays are purple and the discal florets dark yellow, and Shull[27] gives an average of 42 for the former and 62 for the latter. The discal floret in its upper part is 4 mm. long with a diameter of 1 mm. at its entrance, and its lobes are erect. After going through the change of color the disk is dark reddish-brown. In this species

27) Shull, loc. cit.

as in the four preceding ones no crossing of the stylar branches takes place.

The following 46 visitors were observed at the flowers:

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 2, female and worker, s. and c. p.; 4, female and worker, s. and c. p.; 7, male and worker, s. and c. p.; 9, male, s.; 13, male and female, s.; 15, female, s.; 16, male and female, s.; 17, female, s. and c. p.; 24, female, s. and c. p.; 34, male and female, s. and c. p.; 35, male and female, s. and c. p.; 56, female, s.

Hawk-moth: 484, s.

HEMITROPOUS.

Bees: 99, female, s.; 100, male and female, s.; 104, female, s.; 118, female, c. p.; 135, male. s.

Wasp: 186 s.

Flies: 272; 283; 298; 306; 307; 313; 315; 318; 319; 322; 332—all s. or f. p.

Butterflies and moths: 448; 450; 451; 460; 463; 464; 467; 469; 474; 481; 485; 493—all s.

ALLOTROPOUS.

Flies: 372; 376—both f. p.

Bettle: 527, f. p.

Eutrop.	14 =	30.5%
Hemitrop.	29 =	63.0%
Allotrop.	3 =	6.5%

Eupatorium L.

Three species are represented in the flora of Milwaukee County, two of them with white, and the third with purple flowers. They differ in the length of the tubal florets, and accordingly we find a different set of visitors in each of the three. In view of the fact that the white species with the shortest tube (*E. perfoliatum*), and the purple one with the longest tube (*E. purpureum*) are found growing together in profusion, and blooming synchronously, and are consequently exposed to exactly the same insect fauna, they are fits objects for comparison in regard to the effect of tube length and color on the visitors.

10. **Eupatorium perfoliatum** L. Boneset.

This species has a flowering season extending from about July 22 to September 16. A head is 3 to 4 mm. wide, and is made up of 12 to 15 white sweet-scented florets. By the grouping of a large number of heads a broad flat inflorescence is formed. In its upper part the floret widens out to a cup 1 mm. in width, and of the same length with spreading lobes. The slender stylar branches attain a length of 3 mm., and gradually become strongly divergent so as to come in contact with the stylar branches of neighboring florets, thereby giving rise to a mode of cross-pollination called geitonogamy. As a rule these flowers receive the attention of a numerous set of visitors. The following 113 species have been noted at the flowers:

EUTROPOUS.

Bees: 1, worker, s.; 6, worker, s. and c. p.; 7, male, s;. 24, female, s. and c. p.; 35, female, s. and c. p.; 38, female, s. and c. p.

HEMITROPOUS.

Bees: 89, male and female, s. and c. p.; 105, male, s.; 113, female, s.; 114, male, s.; 115, male, s.; 118, female, s. and c. p.; 119, female, s.; 124, female, s.; 128, male, s.; 135, female, s.

Wasps: 142; 147; 149; 154; 198; 201; 202—all s.

Flies: 273; 274; 275; 281; 287; 306; 308; 313; 314; 315; 316; 319; 330; 332; 333; 335; 337—all s. or f. p.

Butterflies and moths: 450; 451; 458; 467; 469; 472; 477; 482; 487; 488—all s.

ALLOTROPOUS.

Wasps: 137; 157; 160; 162; 163; 164; 167; 169; 171; 172; 173; 174; 179; 180; 191; 192; 194; 205; 206; 210; 212; 216; 217—all s.

Cuckoo-fly: 220, s.

Parasitic wasps: 226; 230; 233; 235; 245—all s.

Flies: 257; 262; 269; 347; 369; 372; 373; 374; 377; 378; 381; 383; 384; 389; 400; 403; 407; 408; 412; 413; 434; 438; 442; 443; 444—all s. or f. p.

Beetles: 509; 519; 522; 527; 537; 540—all s. or f. p.

Bugs: 553; 554; 560—all s.

Eutrop.	6 = 5.3%
Hemitrop.	44 = 38.9%
Allotrop.	63 = 55.8%

11. **Eupatorium urticæfolium** Reichard. White Snakeroot.

This is *E. ageratoides* L. of the former edition of Gray's Manual. Its first flowers make their appearance around August 14, about 3 weeks later than those of the other 2 species, and its blooming period terminates around October 6. The white florets, of which 15 to 18 constitute a head are more cylindrical in their upper parts than those of the preceding species, being 2 mm. long and 1 mm. wide. The lobes of the corolla spread out nearly horizontally. Gradually the stylar branches reach a length of 5 mm. and become widely divergent, thereby favoring geitonogamy.

Repeated observations during 3 seasons have furnished the following iist of 58 visitors:

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 4, male, female and worker, s. and c. p.; 13, worker, s.; 17, male, s.; 34, female, s.; 35, female, s. and c. p.; 36, female, s. and c. p.

HEMITROPOUS.

Bees: 99, male, s.; 105, female, s. and c. p.; 107, male, s.; 114, male and female, s. and c. p.; 118, female, s. and c. p.; 121, female, s. and c. p.; 132, female, s.

Wasps: 149; 202—both s.

Flies: 270; 283; 288; 298; 304; 307; 313; 315; 316; 319; 322; 330; 332; 333; 334—all s. or f. p.

Butterflies and moths: 455; 460; 467; 475; 493; 501—all s.

ALLOTROPUS.

Wasp: 218, s.

Flies: 254; 360; 369; 372; 377; 378; 379; 384; 385; 398; 400; 401; 413; 443; 444—all s. or f. p.

Beetles: 528; 530; 538—all s.

Bugs: 554; 559—both s.

Entrop.	7	= 12.1%
Hemitrop.	30	= 51.7%
Allotrop.	21	= 36.2%

12. **Eupatorium purpureum** L. Joe-Pye Weed.

The blooming period, lasting from about July 20 to September 16 covers rather completely that of *E. perfoliatum.* A head is composed of 15 to 18 florets and measures only 3 to 4 mm. across. The decidedly sweet-scented flowers are light purple, and the whole inflorescence (florets, bracts and pedicels) has a purple appearance. The floret is represented by a narrow tube 4 mm. in length and only about ¾ mm. wide at the mouth of the floret, with the corollar lobes erect, or barely spreading. In this species there is ample opportunity for geitonogamy to take place between florets of the same head, as also of neighboring heads, since the stylar branches become profusely interwoven. Change of color to a darker hue of purple appears in the advanced stages of the flowers. Altogether the heads are much more loosely grouped than in our white-flowered species of *Eupatorium* and the inflorescence does not represent a flat surface as in those species. These factors, and especially the length and narrowness of the tube are unfavorable to the visits of the less adapted short-tongued insects.

53 visitors were observed.

EUTROPOUS.

Bees: 1, worker, s.; 2, male, s.; 4, female, s. and c. p.; 6, worker, s.; 7, male and female, s. and c. p.; 9, worker, s.; 11, male and female, s.; 17, male and female, s.; 24, male and female, s. and c. p.; 33, female, s.; 34, female, s. and c. p.; 35, female, s.

HEMITROPOUS.

Bees: 105, male and female, s. and c. p.
Wasps: 186; 203, 204—all s.
Flies: 273; 274; 275; 280; 303; 306; 307; 313; 316; 339—all s. or f. p.
Butterflies and moths: 450; 451; 454; 457; 458; 460; 461; 462; 463; 464; 467; 469; 472; 477; 478; 482; 485; 487; 488; 489; 490; 493; 497—all s.

ALLOTROPOUS.

Flies: 372; 378; 443—all s. or f. p.
Beetle: 527, f. p.

Eutrop.	12	= 22.6%
Hemitrop.	37	= 69.8%
Allotrop.	4	= 7.6%

13. **Liatris spicata** (L.) Willd. Gay Feather.

The observations were made on August 14 and 29, in Racine Co., Wis., where this plant is a rather conspicuous inhabitant of the prairie formation. Its blooming time extends from about July 29, to September 4. In color, structure, and its relations to insects this species agrees pretty well with *L. pycnostachya* Mich., an account of which has been published by Robertson[28]. The slender erect stem, which often attains a height exceeding 1 m. is adorned at its summit with a long spike of densely crowded heads, each of which contains about 6 reddish-purple florets. Such a floret represents a tube about 1½ mm. wide at its entrance, and of a total length of 7 mm., 2 mm. of which is taken up by the slightly divergent corollar lobes. The bottom can therefore be reached by an insect's tongue 5 mm. in length. As in the case of *L. pycnostachya* the visitors are mostly long-tongued bees, and butter-

28) Chas. Robertson. Flowers and insects. Trans. Acad. Sci. St. Louis, Vol. VI., No. 14, p. 454.

flies. The Bombylid fly *Exprosopa fasciata* is also a regular visitor, but not appearing in such abundance as on the flowers of *L. pycnostachya* in southern Illinois, as stated by Robertson.

The following 23 insects were taken on the flowers:

EUTROPOUS.

Bees: 7, male, s; 9, male, female and worker, s. and c. p.; 13, male, female and worker, s. and c. p.; 14, female, s. and c. p.; 19, female, s. and c. p.; 20, female, s. and c. p.; 34, female, s. and c. p.; 37, female, s. and c. p.

HEMITROPOUS.

Bee: 101, female, c. p.

Flies: 273; 308; 313—all s. or f. p.

Butterflies and moths: 450; 451; 453; 454; 457; 468; 469; 480; 481; 490—all s.

ALLOTROPOUS.

Beetle: 516, f. p.

Eutrop.	8 =	34.8%
Hemitrop.	14 =	60.9%
Allotrop.	1 =	4.3%

Solidago L.

The different species of goldenrod of our region show comparatively little diversity in color and structure of the flowers. All of them are yellow, although the shade of this color differs somewhat in the various species. One of our species, *Solidago (Euthamia) graminifolia* stands alone with its tube length of 1½ mm. (1 mm. in the remaining species), and the strong fragrance of its flowers also renders it conspicuous among the rest. The influence of these characters on the make-up of its visitors is quite in evidence. The goldenrod flowers are, as a rule, exceedingly attractive to insects.

14. Solidago juncea Ait. Early Goldenrod.

This, our earliest species has been found in bloom from July 9 on to September 15. In its upper portion the discal floret forms a cup barely 1 mm. long, and about ¾ mm. wide. The slender lobes of the corolla have about the same length as the cup, and are reflexed.

The list of visitors comprises 182 species.

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 4, male, s.; 11, worker, s.; 12, worker, s. and c. p.; 20, male and female, s. and c. p.; 24, female, s. and c. p.; 25, male, s.; 30, female, s.; 31, female, s.; 34, male and female, s.; 35, male and female, s. and c. p.; 42, female, s.; 52, female, s.; 59, female, s.; 65, female, s.

HEMITROPOUS.

Bees: 72, female, s.; 80, male and female, s. and c. p.; 87, female, s. and c. p.; 89, male, s.; 99, female, s.; 102, female, s.; 104, male and female, s. and c. p.; 105, male and female, s. and c. p.; 106, male and female, s. and c. p.; 109, female, s.; 115, male and female, s.; 116, female, s. and c. p.; 118, female, s. and c. p.; 122, female, c. p.; 123, male and female, s.; 124, female, s.; 125, female, s.; 128, male and female, s.; 130, male and female, s.; 131, male, s.; 135, female, s.; 136, male, s.

Wasps: 142; 143; 147; 149; 151; 153; 186; 188; 196; 197; 201; 204—all s.

Flies: 272; 275; 277; 278; 280; 288; 291; 292; 293; 298; 300; 304; 306; 307; 308; 313; 315; 316; 317; 318; 319; 330; 331; 332; 333; 334—all s. or f. p.

Butterflies and moths: 454; 461; 463; 464; 471; 476; 493; 505—all s.

ALLOTROPOUS.

Wasps: 137; 141; 157; 158; 159; 161; 162; 163; 164; 165; 167; 169; 170; 171; 172; 173; 177; 179; 180; 185; 189; 192; 194; 208; 209; 210; 211; 212; 213; 216—all s.

Cuckoo-flies: 220; 222—both s.

Parasitic wasps: 223; 224; 225; 226; 228; 229; 231; 236—all s.

Flies: 253; 254; 256; 259; 260; 262; 266; 350; 359; 366; 367; 368; 369; 370; 372; 373; 377; 378; 381; 384; 385; 389; 390; 391; 392; 395; 398; 400; 401; 406; 409; 413; 416; 424; 425; 430; 440; 442; 443; 444; 445—all s. or f. p.

Beetles: 506; 512; 518; 519; 521; 525; 527; 532; 533; 534; 537—all s. or f. p.

Bugs: 542; 543; 545; 547; 554; 557; 561—all s.

Eutrop.	15	=	8.2%
Hemitrop.	68	=	37.4%
Allotrop.	99	=	54.4%

15. **Solidago canadensis** L. Canada Goldenrod.

The flowers make their appearance around July 27, and have been found as late as November 5. The discal floret is a trifle wider than that of the preceding species, but otherwise there is hardly any difference noticeable.

141 visitors have been recorded for Milwaukee.

EUTROPOUS.

Bees: 1, worker, s.; 2, male and worker, s. and c. p.; 4, male and worker, s. and c. p.; 12, worker, s. and c. p.; 15, male, s.; 17, female, s.; 21, female, s. and c. p.; 24, female, s. and c. p.; 35, female, s. and c. p.; 41, female, s. and c. p.; 69, male, s.

HEMITROPOUS.

Bees: 80, male and female, s. and c. p.; 87, female, c. p.; 88, female, s. and c. p.; 89, male and female, s. and c. p.; 97, male and female, s.; 98, female, c. p.; 104, male, s.; 114, male, s.; 122, male, s.; 123, male and female, s.; 125, female, s.; 128, male, s.; 130, female, s. and c. p.; 131, female, s. and c. p.; 135, female, s.; 136, male, s.

Wasps: 142; 147; 149; 151; 188; 196; 199; 201—all s.

Flies: 275; 276; 277; 283; 287; 289; 298; 306; 307; 308; 309; 313; 315; 318; 319; 320; 322;332; 333; 335—all s. or f. p.

Butterflies and moths: 460; 469; 471; 473; 485; 490—all s.

ALLOTROPOUS.

Wasps: 137; 141; 156; 157; 161; 162; 167; 170; 172; 176; 178; 179; 180; 183; 184; 190; 191; 192; 193; 194; 195; 206; 208; 210; 211; 212; 214; 216; 218; 219—all s.

Parasitic wasps: 223; 230; 234; 237; 241; 242; 243; 244; 245; 248—all s.

Saw-fly: 251, s.

Flies: 254; 256; 259; 352; 357; 363; 365; 367; 369; 375; 388; 400, 406; 408; 414; 416; 417; 419; 420; 421; 426; 427; 429; 430; 431; 434; 435; 438; 439—all s. or f. p.

Beetles: 520; 522; 525; 527; 537—all s. or f. p.

Bugs: 543; 550; 554; 557; 558—all s.

Eutrop.	11	= 7.8%
Hemitrop.	50	= 35.5%
Allotrop.	80	= 56.7%

During a vacation at Cedar Lake, Washington Co., Wis., I observed the following 135 visitors on this goldenrod:

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 4, worker, s. and c. p.; 6, worker, s. and c. p.; 17, female, c. and c. p.; 47, female, s.

HEMITROPOUS.

Bees: 80, male and female, s. and c. p.; 102, female, s.; 104, male and female, s.; 105, female, s. and c. p.; 109, male and female, s. and c. p.; 110, male, s.; 119; female, s. and c. p.; 122, male, s.; 123, male, s; 124, female, s.; 126, male, s.; 127, male, s.; 128, male and female, s.; 134, male, s.; 135, female, s. and c. p.; 136, male, s.

Wasps: 142; 147; 149; 151; 152; 188; 196; 198; 200; 201—all s.

Flies: 290; 304; 307; 308; 313; 317; 318; 319; 321; 323; 328; 332; 333; 340; 344—all s. or f. p.

Butterflies and moths: 470; 473; 486; 490; 501—all s.

ALLOTROPOUS.

Wasps: 137; 141; 156; 157; 158; 159; 161; 162; 164; 165; 170; 172; 173; 179; 180; 181; 183; 185; 191; 192; 194; 195; 207; 209; 214—all s.

Parasitic wasps: 220; 223; 226; 240; 249; 251—all s.

Flies: 254; 256; 258; 259;261; 262; 263; 264; 265; 266; 350; 353; 369; 370; 377; 378; 381; 385; 387; 388; 389; 391; 393; 395; 397; 399; 400; 401; 407; 408; 409; 413; 415; 416; 418; 420; 430; 432; 433; 440; 442; 444—all s. or f. p.

Beetles: 519; 525; 532; 534; 537—all s.

Bugs: 543; 551; 553; 554; 559; 561—all s.

Eutrop.	5	=	3.7%
Hemitrop.	46	=	34.1%
Allotrop.	84	=	62.2%

16. **Solidago graminifolia** (L.) Salisb. Fragrant Goldenrod.

Flowering period from about August 9 to October 2. The larger size of the tubal floret, and the sweet odor of the flowers has been referred to above. When watching a group of these flowers one is often impressed by the number of butterflies and moths that gather around them. Visitors to the number of 135 were taken as follows:

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 2, male and worker, s. and c. p.; 4, male and worker, s. and c. p.; 7, male, s.; 9, male, s.; 13, male and worker, s.; 15, male, s.; 16, male and female, s.; 19, male, s.; 24, female, s. and c. p.; 31, male and female, s.; 32, female, s.; 35, male, s; 36, female, s.; 37, female, s.

HEMITROPOUS.

Bees: 80, female, s. and c. p.; 88, female, s. and c. p.; 89, female, s .and c. p.; 97, male and female, s. and c. p.; 99, male and female, s.; 102, male and female, s.; 104, male, s.; 105, male and female, s. and c. p.; 107, female, s.; 116, female, s.; 120, male and female, s. and c. p.; 122, male, s.; 123, female, s.; 134, female, s.; 136, male and female, s.

Wasps: 147; 148; 149; 155; 186; 187; 188; 202—all s.

Flies: 275; 283; 288; 304; 305; 306; 307; 313; 314; 315; 316; 317; 318; 319; 321; 322; 330; 332; 335; 344—all s. or f. p.

Butterflies and moths: 450; 451; 453; 457; 462; 463; 464; 465; 466; 467; 469; 471; 472; 480; 481; 483; 485; 487; 488; 490; 492; 493; 495; 498; 499—all s.

ALLOTROPOUS.

Wasps: 137; 138; 141; 162; 166; 171; 175; 180; 192; 209; 216; 217—all s.

Parasitic wasp: 232, s.

Flies: 254; 351; 360; 366; 369; 372; 373; 374; 376; 377; 379;

380; 383; 384; 385; 386; 387; 388; 389; 391; 392; 393; 395; 413; 434; 442; 443; 444—all s. or f. p.

Beetles: 519; 522; 527—all s. or f. p.

Bugs: 541; 543; 544; 545; 546; 549; 553; 554—all s.

Eutrop.	15 = 11.1%
Hemitrop.	68 = 50.4%
Allotrop.	52 = 38.5%

Erigeron L.

Three species are treated in this paper, which differ considerably among each other in the characters of their flowers. *E. canadensis* is remarkable for the inconspicuousness, and small size of its flowers, being the only species among the Compositæ studied, in which not a single long-tongued bee was noticed as a visitor. *E. annuus* has white-rayed heads with longer tubes than the species just mentioned, and *E. philadelphicus* with its rose-colored rays possesses the longest tubes of the three.

17. Erigeron canadensis L. Horse-weed.

This was seen blooming from July 21 to November 5. Kirchner [29] has furnished a description of the floral characters based on his study of plants growing in Germany. The heads of the plants examined were smaller than those observed by Kirchner, being 4 mm. long, and 2 mm. wide. They are surrounded by a circle of very small ray florets, the erect white rays of which are only ¾ mm. long, and therefore hardly noticeable even at a very short distance. In the light yellow disk floret the corolla has 4 short lobes, and its upper bell-shaped part is only ½ mm. long and ¼ mm. wide. The sweetish odor is very faint, but when these flowers grow together in profusion they are to some extent attractive to insects. Nearly all of the 58 insects of the list were observed at Cedar Lake, Washington Co., Wis., and only a few at Milwaukee. It is noteworthy that the Chalcid-flies *Perilampus cyaneus* and *P. hyalinus* seem to have a certain preference for these flowers They were regular attendants, day after day, at Cedar Lake, and were also present at Milwaukee.

HEMITROPOUS.

Bees: 99, male, s.; 102, male, s.; 104, male, s.; 107, male, s.; 109, female, s.; 112, female, s. and c. p.; 113, male and female, s.; 114, male and female, s.; 115, male, s.; 118, female, s.; 119; female, s. and

29) O. Kirchner. Beitraege zur Biologie der Blueten, p. 65.

c. p.; 120, female, s. and c. p.; 122, male and female, s. and c. p.; 127, male, s.

Wasps: 142; 143; 149; 151; 154—all s.

Flies: 287; 304; 306; 307; 308; 332—all s. or f. p.

ALLOTROPOUS.

Wasps: 141; 157; 158; 159; 165; 180; 181; 182; 191—all s.

Cuckoo-flies: 220; 221—both s.

Parasitic wasps: 226; 227; 249—all s.

Flies: 255; 350; 354; 369; 389; 391; 392; 394; 395; 408; 416; 430—all s. or f. p.

Beetle: 512, s.

Bugs: 543; 551; 553; 554; 557; 559—all s.

Eutrop.	0 =	0%
Hemitrop.	25 =	43.1%
Allotrop.	33 =	56.9%

18. **Erigeron annuus** (L) Pers. Sweet Scabious.

Blooming period from about June 14 throughout the season until destroyed by heavy frosts. Flowers were found as late as November 5. Kirchner[30] has observed this species in Germany. The white rays are very numerous (about 100 according to Kirchner), and gradually assume a horizontal position.

In the bright yellow discal florets the upper widened portion of the corolla measures ½ mm. across, and 1 mm. in depth. The corollar lobes are short and slightly spreading.

69 visitors were taken:

EUTROPOUS.

Bees: 16, male, s.; 17, female, s. and c. p.; 42, female, s. and c. p.; 45, female, s.; 59, female, s.

HEMITROPOUS.

Bees: 72, male, s.; 92, male and female, s.; 99, female, s. and c. p.; 102, female, s. and c. p.; 104, male, s.; 107, female, s.; 112, female, s. and c. p.; 114, female, s.; 115, male and female, s. and c. p.; 116, male and female, s. and c. p.; 118, female, s. and c. p.; 119, female, s.; 120, female, s.; 121, male, s.; 122, female, s.; 126, female s.; 134, female, s.; 135, male and female, s. and c. p.; 136, female, s. and c. p.

Wasps: 151; 152—both s.

Flies: 300; 306; 307; 308; 319; 332; 343—all s. or f. p.

Butterfly—477, s.

30) O. Kirchner, loc. cit., pp. 64-65.

ALLOTROPOUS.

Wasps: 158, 159, 167—all s.
Flies: 266; 268; 350; 354; 357; 369; 377; 379; 392; 395; 398; 400; 401; 403; 406; 409; 410; 413; 416; 430; 441—all s. or f. p.
Beetles: 520; 533; 534; 539—all s. or f. p.
Bugs: 543; 545; 550; 552; 554; 556; 558—all s.

Eutrop.	5 = 7.3%
Hemitrop.	29 = 42.0%
Allotrop.	35 = 50.7%

19. **Erigeron philadelphicus** L. Philadelphia Fleabane.

This, the earliest of the species has been observed in bloom from May 29 to July 28. The heads with their numerous reddis-purple rays are quite showy. The bell of the discal floret has a length of 1¾ mm., and a width of ¾ mm. at its entrance, and the lobes are somewhat divergent. The list of visitors is made up of 75 species.

EUTROPOUS.

Bees: 17, male and female, s. and c. p.; 31, male, s.; 35, male and female, s. and c. p.; 42, male, s.; 44, female, s. and c. p.; 45, female, s.; 48, male, s.; 49, female, s.; 50, male and female, s.; 59, female, s.; 62, male, s.; 66, male, s.; 68, male, s.

HEMITROPOUS.

Bees: 70, female, s.; 82, female, s.; 83, female, s. and c. p.; 90, female, s. and c. p.; 92, male, s.; 100, female, s. and c. p.; 102, female, s. and c. p.; 106, female, s. and c. p.; 107, female, s. and c. p.; 112, female, s. and c. p.; 116, female, s. and c. p.; 122, male and female, s. and c. p.; 123, female, s.; 124, female, s.; 134, male, s.; 135, male, s.; 136, female, s. and c. p.
Wasps: 145; 147; 149; 196; 201—all s.
Flies: 271; 288; 298; 300; 302; 303; 306; 307; 308; 310; 319; 332; 341—all s. or f. p.
Butterflies and moths: 479; 480; 481; 496—all s.

ALLOTROPOUS.

Wasp: 140, s.
Flies: 256; 266; 268; 364; 376; 377; 395; 400; 410; 413; 415; 441—all s. or f. p.
Beetles: 519; 520; 524; 526; 534—all s. or f. p.
Bugs: 553; 554; 556; 557; 559—all s.

Eutrop.	13 = 17.3%
Hemitrop.	39 = 52.0%
Allotrop.	23 = 30.7%

Antennaria Gaertn.

All of the species are diœcious.

20. Antennaria neglecta Greene. Field Cat's-foot.

This is the earliest of the Compositæ of our region. I have found it blooming from April 26 to May 15.

In the staminate flower the cup has a diameter of nearly 1 mm. at the entrance and a length of fully 1 mm. Its corollar lobes are spreading. The lower portion of the corolla (between cup and rudimentary ovary) is 2½ mm. long, and very narrow. Numerous sweeping hairs appear on the upper part of the style, and especially on its very short branches, but there is not a trace of stigmatic papillæ. A head of staminate florets is 5 to 6 mm. wide, and 6 to 7 mm. long, and a number of these heads (usually 6) form an inflorescence about 15 mm. in diameter, the marginal florets of which are the first to open.

In the pistillate flower the corolla is entirely wanting, and the flower consists of a slender style 7 mm. in length, and an ovary 1 mm. long. The style is much thinner than that of the staminate flower, and its long slender branches are entirely without sweeping hairs, but are furnished with numerous stigmatic papillæ on their inner surfaces. The heads composed of pistillate flowers are longer, and more slender than those with staminate flowers, and are more loosely grouped in forming an inflorescence.

Both staminate, as well as pistillate flowers are abundantly visited by insects, especially by Andrenidæ and Syrphidæ.

66 visitors were taken:

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 64, female, s.; 68, male, s.

HEMITROPOUS.

Bees: 74, male, s.; 75, male and female, s. and c. p.; 76, female, s.; 77, male and female, s.; 78, female, s. and c. p.; 79 female, s. and c. p.; 81, male, s.; 85, female, s.; 90, male and female, s. and c. p.; 91, male, s.; 99, female, s.; 102; female, s. and c. p.; 104, female, s. and c. p.; 105, female, s. and c. p.; 106, female, s. and c. p.; 109, female, s. and c. p.; 110, female, s.; 114, female, s. and c. p.; 115, female, s. and c. p.; 117, female, s.; 118, female, s. and c. p.; 120, female, s. and c. p.; 122, female, s.; 124, female, s.; 125, female, s.; 128, female, s.

Flies: 279; 293; 294; 297; 300; 314; 315; 316; 317; 319; 322; 324; 327—all s. or f. p.

Butterflies: 461; 463; 464—all s.

ALLOTROPOUS.

Wasp: 141, s.
Flies: 267; 345; 346; 355; 360; 369; 373; 376; 381; 383; 387; 395; 418; 422; 428; 437—all s. or c. p.
Beetles: 510; 517—both s.
Bugs: 543; 551—both s.

Eutrop.	3 = 4.6%
Hemitrop.	42 = 63.6%
Allotrop.	21 = 31.8%

Heliopsis Pers.

21. Heliopsis scabra Dunal. Rough Ox-eye.

Blooming from around June 30 to August 13. The heads are about 5 cm. in diameter, and have the rays, as well as the disk florets yellow. In color, and general appearance they resemble the sunflowers but come about 3 weeks ahead of *Helianthus strumosus*, and *H. tracheliifolius*, our earlies species of sunflowers. The discal floret has a tube of equal width throughout (1 mm.), and of 5 mm. length with erect coroliar lobes. Nectar rises in the tube to a certain extent, and for this reason it may be accessible to an insect whose tongue is shorter than 5 mm., as for example *Phthiria punctipennis*. and *Eusiphona mira*, two small flies which are regular visitors to *Heliopsis scabra*, and to other composite flowers of a similar type.

The following 42 visitors were observed.

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 9, female, s. and c. p.; 17, male and female, s. and c. p.; 20, male, s.; 27, male and female, s.; 28, male, s.; 31, male, s.; 33, male and female, s. and c. p.; 34, male and female, s. and c. p.; 35, male and female, s. and c. p.; 36, female, s. and c. p.; 46, male and female, s. and c. p.

HEMITROPOUS.

Bees: 87, female, s. and c. p.; 96, female, s. and c. p.; 99, female, s. and c. p.; 100, female, s. and c. p.; 102, male and female, s. and c. p.; 113, female, s. and c. p.
Flies: 272; 280; 281; 307; 308; 319—all s. or f. p.
Butterflies and moths: 451; 454; 459; 460; 464; 469; 480; 497—all s.

ALLOTROPOUS.

Wasp: 163, s.
Flies: 352; 369; 397; 442—all s. or f. p.
Beetles: 513; 534—both f. p.
Bugs: 550; 557; 559—all s.

Eutrop. .... 12 = 28.6%
Hemitrop. .... 20 = 47.6%
Allotrop. .... 10 = 23.8%

Rudbeckia L.

22. **Rudbeckia hirta** L. Black-eyed Susan.

These flowers occur from about July 1 on, and may be found throughout the remainder of the season, specimens with flowers having been observed on November 5. There is a very decided contrast in color between the yellow rays, and the dark-brown disk. In the florets of the latter the tubes are about ¾ mm. wide, and 3 mm. deep, with slightly divergent lobes.

77 visitors are on the list.

EUTROPOUS.

Bees: 17, female, s.; 19, male, s.; 20, male, s.; 27, male and female, s.; 34, male, s.; 51, male, s.; 52, male and female, s.; 57, male, s.; 58, male, s.; 59, female, s.; 61, male, s.

HEMITROPOUS.

Bees: 70, male, s.; 82, female, s.; 87, male and female, s. and c. p.; 93, female, s. and c. p.; 102, male, s.; 104, male and female, s. and c. p.; 105, female, s. and c. p.; 106, male and female, s. and c. p.; 109, female, s. and c. p.; 110, female, s. and c. p.; 111, female, s. and c. .p; 112, female, s.; 113, female, s. and c. p.; 115, female, s. and c. p.; 120, female, s. and c. p.; 122, female, s.

Wasps: 145; 151; 186; 188; 196—all s.

Flies: 275; 279; 281; 283; 284; 300; 306; 307; 308; 313; 315; 319; 332; 341; 343—all s. or f. p.

Butterflies and moths: 458; 460; 470; 502; 503; 505—all s.

ALLOTROPOUS.

Wasps: 172; 173—both s.

Flies: 253; 262; 263; 265; 266; 349; 352; 377; 398; 399; 401; 413; 415; 416; 438—all s. or f. p.

Beetles: 512; 514; 519; 536—all s. or. f. p.

Bugs: 548, 554; 559—all s.

Eutrop. .... 11 = 14.3%
Hemitrop. .... 42 = 54.5%
Allotrop. .... 24 = 31.2%

23. **Rudbeckia laciniata** L. Green-headed Cone-flower.

Blooming period from about July 10 to August 25. The rays are yellow, and the disk is of the same color. There is quite a difference in size between the tube of this and of the preceding species; the length amounts to 4 mm; and the width to 1½ mm. in the upper, and 1 mm in the lower portion. In this species the lobes of the corolla are erect.

The following 44 insects were observed:

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 3, male, s.; 4, worker, s. and c. p.; 9, male, s.; 11, male, s.; 12, male, s.; 13, female, s.; 15, male, s.; 17, female, s.; 19, male, s.; 20, male, s.; 34, male and female, s. and c. p.; 35, female, s.; 54, female, s.

HEMITROPOUS.

Bees: 96, male and female, s. and c. p.; 102, female, s.; 105, female, s.; 107, female, s.; 108, female, s. and c. p.

Wasps: 186; 196; 203—all s.

Flies: 272; 274; 281; 304; 307; 315; 316; 319; 332—all s. or f. p.

Butterflies and moths: 450; 451; 454; 460; 466; 469; 478; 488; 490—all s.

ALLOTROPOUS.

Flies: 352; 372; 377; 442—all s. or f. p.

Eutrop.	14 = 31.8%
Hemitrop.	26 = 59.1%
Allotrop.	4 = 9.1%

Lepachys Raf.

24. Lepachys pinnata (Vent.) T. & G. Gray-headed Cone-flower.

I have found this species in bloom from July 11 to August 25. Here, too, as in *Rudbeckia hirta* there is a color contrast between the drooping yellow rays, and the brownish disk. The tube is only 2 mm. long, and its dark-brown lobes are entirely reflexed. The mouth of the floret, which is only ⅔ mm. wide is nearly filled out by the anther-cylinder. After pushing out the pollen, the stylar branches separate, and become very strongly divergent. A faint sweet odor is perceptible in the flowers. Robertson[31] informs us that at Carlinville (southern Illinois) the bee *Melissodes obliqua* is the most abundant, and most important pollinator. In our region this bee is of rather infrequent occurrence, but I have seen it regularly, although in small number on these flowers.

Only 33 visitors were taken.

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31) Chas. Robertson. Flowers and insects. Trans. Acad. Sci. St. Louis, Vol. VI, No. 14, p. 468.

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 2, male, s.; 4, female, s. and c. p.; 11, worker, s. and c. p.; 12, male, s.; 13, female, s. and c. p.; 19, male and female, s. and c. p.; 20, male and female, s. and c. p.; 22, female, s. and c. p.; 34, male and female, s. and c. p.; 35, male and female, s. and c. p.; 36, female, s. and c. p.

HEMITROPOUS.

Bees: 86, female, s. and c. p.; 99, male, s.; 105, female, s. and c. p.; 106, female, s. and c. p.; 119, female, s. and c. p.
Wasps: 186; 188—both s.
Flies: 306; 307; 313; 319; 332; 341—all s. or f. p.
Butterflies and moths: 451; 467; 494—all s.

ALLOTROPOUS.

Flies: 262; 352—both f. p.
Beetle: 516, f. p.
Bugs: 553; 554—both s.

Eutrop.	12 = 36.4%
Hemitrop.	16 = 48.5%
Allotrop.	5 = 15.1%

Helianthus L.

In our local species of sunflowers there exists to all appearances a remarkable uniformity in the structure of the flowers, especially so in regard to the tube length of the discal florets. The differences noticeable in the different species pertain to the size of the heads, the lighter or darker shades of yellow in the rays, the number of the latter and the yellow or brownish color of the disk.

25. **Helianthus strumosus** L. Pale-leaved Wood Sunflower.

Its blooming period extends from about July 20 to August 18. The tube of the discal floret has a length of 4½ mm. and is of equal width (1¼ mm.) throughout in its upper portion, but narrows considerably near the bottom. The tube is crowned by erect lobes 1½ mm. in length.

At Milwaukee the following 63 visitors were obtained.

EUTROPOUS.

Bees: 1, worker, s.; 4, female, s. and c. p.; 9, male, s.; 11, male, s.; 12, worker, s. and c. p.; 13, male, s.; 16 male, s.; 17, female, s. and c. p.; 19, male and female, s. and c. p.; 20, male and female, s. and c. p.; 23, male, s.; 24, male, s.; 25, male and female, s.; 26, male, s.; 33, female,

s. and c. p.; 34, male, s.; 35, male and female, s. and c. p.; 38, female, s. and c. p.; 41, female, s. and c. p.; 43, female, s. and c. p.; 54, female, s.; 55, female, s.; 57, female, s.; 63, male and female, s.

HEMITROPOUS.

Bees: 86, female, s. and c. p.; 87, female, s. and c. p.; 94, male and female, s. and c. p.; 96, male and female, s. and c. p.; 99, male, s.; 102, male and female, s.; 104, male and female, s. and c. p.

Wasps: 186; 196—both s.

Flies: 272; 275; 281; 283; 298; 306; 307; 313; 315; 319; 330; 332; 341—all s. or f. p.

Butterflies adn moths: 450; 451; 454; 460; 463; 466; 469; 488; 490; 493—all s.

ALLOTROPOUS.

Flies: 352; 365; 377; 381; 443—all s. or f. p.

Beetle: 514, f. p.

Bug: 553, s.

Eutrop.	24 =	38.1%
Hemitrop.	32 =	50.8%
Allotrop.	7 =	11.1%

At Cedar Lake, Washington Co., Wis., the following 69 species were noted at the flowers.

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 2, worker, s. and c. p.; 4, male and female, s. and c. p.; 7, worker, s. and c. p.; 8, female, s. and c. p.; 11, worker, s. and c. p.; 12, worker, s. and c. p.; 17, female, s.; 19, female, s. and c. p.; 20, female, s. and c. p.; 25, male, s.; 27, male, s.; 28, male, s.; 29, female, s.; 30, male, s.; 32, male, s.; 33, male and female, s. and c. p.; 34, male and female, s. and c. p.; 35, male and female, s. and c. p.; 36, female, s. and c. p.; 42, female, s. and c. p.; 46, male and female, s. and c. p.; 54, female, s.; 60, male, s.; 63, female, s.

HEMITROPOUS.

Bees: 70, female, s.; 86, female, s. and c. p.; 87, male and female, s. and c. p.; 94, male and female, s. and c. p.; 96, female, s. and c. p.; 99, female, s.; 100, female, s. and c. p.; 102, female, s. and c. p.; 104, male and female, s.; 105, male and female, s. and c. p.; 107, female, s. and c. p.; 111, female, s. and c. p.; 115, male, s.

Wasps: 147; 196; 198—all s.

Flies: 274; 280; 298; 304; 307; 312; 313; 316; 317; 318; 319—all s. or f. p.

Butterflies: 450; 451; 454; 460; 464; 473—all s.

ALLOTROPOUS.

Wasps: 141; 161; 173—all s.

Flies: 259; 397; 442—all s.

Beetles: 514; 534; 537—all s. or f. p.
Bugs—553; 554—both s.

Eutrop.	25 = 36.3%
Hemitrop.	33 = 47.8%
Allotrop.	11 = 15.9%

26. **Helianthus giganteus** L. Giant Sunflower.

The flowers have been observed from July 27 to August 31. The tube of the discal floret is slightly wider than that of the preceding species, but otherwise the same dimensions exist. These flowers do not seem to be as attractive to insects as those of *H. strumosus,* and I have not been able to raise the list of visitors above 24 species.

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 2, worker, s.; 4, male and worker, s. and c. p.; 6, worker, s. and c. p.; 7, male and female, s.; 13, male, female and worker, s.; 20, made and female, s. and c. p.; 34, male, s.; 63, male, s.

HEMITROPOUS.

Bees: 86, female, s. and c. p.; 94, male and female, s. and c. p.; 96, female, s.; 102, female, s.
Wasp: 151, s.
Flies: 283; 307; 313; 319—all s. or f. p.
Butterflies: 448; 450; 451—all s.

ALLOTROPOUS.

Flies: 377; 384—both s. and f. p.
Beetle: 527, f. p.

Eutrop.	9 = 37.5%
Hemitrop.	12 = 50.0%
Allotrop.	3 = 12.5%

Helenium L.

27. **Helenium autumnale** L. Sneeze-weed.

My observations cover the period between August 10 and September 7. All of the parts of the flowers are yellow. The length of the ray florets with their broad 3 lobed rays amounts to 1 cm., and their styles protrude 3 mm. beyond the mouths of the florets. In the discal floret the tube reaches a length of 2½ mm. and a width of ⅔ mm. The stylar branches become divergent, and finally spread out horizontally.

46 visitors were noted as follows:

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 2, worker, s. and c. p.; 4, male and worker, s. and c. p.; 9, male, s.; 12, worker, s. and c. p.; 13, male, s; 16, male, s.; 17, female, s. and c. p.; 19, male, s.; 28, female, s.; 32, male and female, s.; 34, male and female, s. and c. p.; 35, female, s. and c. p.; 56, male, s.

HEMITROPOUS.

Bees: 86, male, s.; 99, male, s.; 100, male, s.; 102, male and female, s.; 105, male and female, s. and c. p.; 106, female, s.; 107, male, s.; 114, female, s. and c. p.; 122, female, s.

Wasps: 186; 188; 201—all s.

Flies: 275; 283; 302; 313; 316; 319; 332—all s. or f. p.

Butterflies: 450; 472; 480—all s.

ALLOTROPOUS.

Flies: 366; 369; 372; 374; 379; 444—all s. or f. p.

Beetle: 527, f. p.

Bugs: 545; 554; 559—all s.

Eutrop.	14 = 30.4%
Hemitrop.	22 = 47.8%
Allotrop.	10 = 21.8%

Achillea (Vaill.) L.

28. **Achillea Millefolium** L. Common Yarrow.

A native of Europe and Asia, this plant is of common occurrence in our neighborhood, blooming from about June 14 to at least the middle of September. An account of this species, is given by Hermann Mueller[32], based on material studied in Germany. The heads are very small, but are massed in considerable number, and form a flat inflorescence. The rays are white, and only 2 mm. long. In the discal florets the tube is 1 mm. deep, and only ¾ mm. wide at the mouth of the floret. The following list of 80 species is due to observations made at Milwaukee, and at Cedar Lake, Washington Co., Wis.

EUTROPOUS.

Bees: 17, female, s. and c. p.; 35, female, s. and c. p.

HEMITROPOUS.

Bees: 102, female, s. and c. p.; 106, female, s. and c. p.; 112, female, s. and c. p.; 113, female, s. and c. p.; 116, female, s. and c. p.;

32) H. Mueller. Die Befruchtung der Blumen, pp. 391-394.

118, female, s. and c. p.; 120, female, s. and c. p.; 121, female, s. and c. p.; 122, female, s. and c. p.; 135, male and female, s.; 136, female, s.

Wasps: 142; 143; 149; 152—all s.

Flies: 300; 301; 304; 306; 307; 308; 313; 316; 319 324; 332; 343—all s. or f. p.

Butterflies and moths: 466; 470; 502; 504—all s.

ALLOTROPOUS.

Wasps: 156; 159; 161; 164; 165; 167; 168; 173; 180—all s.

Parasitic wasps: 223; 226; 250—all s.

Flies: 259; 260; 263; 265; 266; 268; 286; 346; 362; 367; 368; 369; 373; 377; 378; 380; 381; 385; 387; 391; 394; 395; 400; 410; 415; 444—all s. or f. p.

Beetles: 519; 520; 523; 534—all s. or f. p.

Bugs: 549; 550; 551; 553; 554—all s.

Eutrop.	2 =	2.5%
Hemitrop.	31 =	38.7%
Allotrop.	47 =	58.8%

Anthemis (Mich.) L.

29. **Anthemis Cotula** L. May-weed.

This European weed has also become firmly established with us, and is in blossom from about July 12 to the end of the season. The heads with their white rays are 2 cm. or more in diameter, and contain numerous bright yellow disk florets, the tube of which is 1 mm. long in its cup-shaped portion, and nearly as wide. The strong disagreeable odor seems to be less attractive to insects than a fragrant odor, judging from the small number present. At Cedar Lake, Washington Co., Wis., the following list of 64 visitors was made up:

EUTROPOUS.

Bees: 34, female, s. and c. p.; 35, female, s. and c. p.

HEMITROPOUS.

Bees: 70, male, s.; 99, female, s. and c. p.; 102, female, s. and c. p.; 104, male and female, s. and c. p.; 105, male and female, s. and c. p.; 109, female, s.; 112, female, s. and c. p.; 113, female, s. and c. p.; 115, female, s. and c. p.; 117, female, s. and c. p.; 118, female, s. and c. p.; 119, female, s. and c. p.; 124, female, s.

Wasp: 149, s.

Flies: 277; 279; 290; 298; 306; 307; 308; 313; 315; 316; 317; 319; 324; 330; 332—all s. or f. p.

Butterflies—450; 451—both s.

ALLOTROPOUS.

Wasps: 173; 180; 181; 194—all s.
Flies: 346; 354; 358; 365; 367; 369; 372; 373; 377; 379; 383; 384; 395; 400; 401; 408; 413; 415; 442—all s. or f. p.
Beetles: 507; 510; 512—all s. or f. p.
Bugs: 543; 553; 554; 555; 559—all s.

Eutrop.	2 =	3.2%
Hemitrop.	31 =	48.4%
Allotrop.	31 =	48.4%

Chrysanthemum (Tourn.) L.

30. Chrysanthemum Leucanthemum L. Ox-eye Daisy.

We have here another example of a foreign (European) plant, which has gained a strong foothold in our flora. The flowers have been found from June 20 to November 5. Hermann Mueller[33] and several other European authors have given a detailed account of the mode of pollination of this species, and its relation to insects. The head measures 40 mm. in diameter, 16 mm. of which are taken up by the yellow disk. The broad white rays with a length of 12 mm. render the head very conspicuous. The dimensions of the cup of the tubal floret are 1 mm. length, and nearly 1 mm. width. A rather faint sweetish odor is present in these flowers.

61 visitors:

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 17, female, s. and c. p.; 35, male and female, s. and c. p.

HEMITROPOUS.

Bees: 102, female, s.; 104, male, s.; 105, female, s. and c. p.; 112, female, s. and c. p.; 118, female, s. and c. p.; 122, female, s. and c. p.; 123, female, s.; 128, male, s.; 134, female, c. p.; 136, female, s.
Wasps: 151, 155—both s.
Flies: 288; 298; 300; 306; 307; 308; 313; 316; 319; 322; 332; 343; 344—all s. or f. p.

ALLOTROPOUS.

Flies: 256; 259; 266; 268; 349; 350; 354; 361; 369; 373; 377; 384; 385; 391; 395; 396; 413; 415; 416; 426; 438—all s. or f. p.
Beetles: 511; 519; 527—all s. or f. p.
Bugs: 544; 545; 548; 553; 554; 559; 560; 561; 562—all s.

Eutrop.	3 =	4.9%
Hemitrop.	25 =	41.0%
Allotrop.	33 =	54.1%

33) H. Mueller, loc. cit. pp. 394-395.

Tanacetum L.

31. Tanacetum vulgare L. Tansy.

A European species which occurs in several places around Milwaukee growing in patches, and which has been noticed in bloom from August 3 to September 18. We have received much information regarding the pollination of these flowers from H Mueller[34], and others. In the flat inflorescence the small yellow heads are crowded in the same manner as in *Achillea*. The upper part of the tube with its short erect corollar lobes is small, hardly more than ⅔ mm. wide, and about 1 mm. deep. The scent of the flowers is strong, and rather disagreeable, and visitors are not abundant on the flowers growing in our surroundings.

The following 34 were observed:

EUTROPOUS.

Bees: 1, worker, s.; 7, male, s.; 35, female, s. and c. p.

HEMITROPOUS.

Bees: 104, male, s.; 114, male, s.
Flies: 290, 306; 308; 315; 316; 330; 332—all s. or f. p.
Butterflies and moths: 451; 480; 481; 491—all s.

ALLOTROPOUS.

Wasp: 137, s.
Parasitic wasp: 226, s.
Flies: 356; 360; 369; 371; 372; 373; 374; 377; 379; 381; 391; 395—all s. or f. p.
Beetles: 527; 528—both s. and f. p.
Bugs: 553; 554—both s.

Eutrop.	3	=	8.8%
Hemitrop.	13	=	38.2%
Allotrop.	18	=	53.0%

Cacalia L.

32. Cacalia reniformis Muhl. Great Indian Plantain.

In our surroundings these flowers bloom from about July 2 to September 6. The heads, each containing 5 white fragrant tubular florets are gathered in large flat inflorescences. The bell of the tube is 2 mm. deep, its corollar lobes are spreading, and even strongly reflexed in the later stage. In the older flowers the branches of the style curl backwards.

50 visitors were taken.

34) H. Mueller, loc cit., p. 397-398.

EUTROPOUS.

Bees: 1, worker, s.; 2, worker, s. and c. p.; 7, worker, s. and c. p.; 9, worker, s. and c. p.

HEMITROPOUS.

Bees: 87, male and female, s. and c. p.; 104, male, s.; 105, female, s. and c. p.; 106, female, s.; 112, male and female, s.; 113, female, s. and c. p.; 115, male and female, s. and c. p.; 119, female, s.; 120, female, s.; 121, female, s.; 122, female, s.; 135, female, s.

Wasps: 142; 146; 147; 149; 150; 152; 153; 154; 201—all s.

Flies: 306; 307; 308; 313; 316; 319; 332—all s. or f. p.

Butterfly: 470, s.

ALLOTROPOUS.

Wasps: 156; 157; 177; 180; 181—all s.

Flies: 258; 262; 266; 369; 372; 373; 378; 381; 385; 438—all s. or f. p.

Beetle: 534, s.

Bug: 554, s.

Eutrop.	4 =	8.0%
Hemitrop.	29 =	58.0%
Allotrop.	17 =	34.0%

Senecio (Tourn.) L.

33. **Senecio aureus** L. Golden Ragwort.

Flowering period from about May 26 to June 17. A head is composed of 9 to 13 rays and 60 to 70 disk florets, and measures about 25 mm. across. The golden yellow rays with a length of 9 mm., and a width of 2 mm. are quite showy. In the yellow discal floret the bell is 2 mm. deep, and about 1 mm. wide, and it narrows gradually in its lower part. The lobes are only ¾ mm. long, and slightly spreading. There is a very distinct odor in the flowers, resembling that of the Chamomile.

The list comprises only 33 visitors, as follows:

EUTROPOUS.

Bees: 17, female, s.; 62, female, s.; 67, male and female, s.

HEMITROPOUS.

Bees: 81, female, s. and c. p.; 84, female, s.; 90, female, s. and c. p.; 99, female, s. and c. p.; 102, female, s. and c. p.; 104, female, s. and c. p.; 105, female, s. and c. p.; 106, female, s. and c. p.; 107, female, s. and c. p.; 116, female, s. and c. p.; 118, female, s.; 122, female, s. and c. p.; 124, female, s.

Flies: 293; 307; 308; 315; 319; 322; 332; 341—all s. or f. p.

Butterfly: 476, s.

ALLOTROPOUS.

Saw-fly: 252, s.
Flies: 285; 353; 369; 378; 410—all s. or. f. p.
Beetles: 531; 535—both s.

Eutrop.	3 = 9.1%
Hemitrop.	22 = 66.7%
Allotrop.	8 = 24.2%

Arctium L.

34. Arctium Lappa L. Great Burdock.

This European weed is exceedingly common in our region, blooming from around July 2 to November. It produces heads with very inconspicuous purple tubes. The dimensions of the latter are 3½ mm. depth and 1¼ mm. width, and the lobes of the corolla are erect and about 1½ mm. long. In spite of the remarkably small amount of color displayed by these flowers, they succeed in attracting quite a number of visitors, and this is probably due to their fragrance. The following 58 insects (with the exception of *Melissodes nivea* taken at Milwaukee) were observed at Cedar Lake, Washington Co., Wis.

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 2, worker, s. and c. p.; 4, female and worker, s. and c. p.; 6, worker, s. and c. p.; 7, female, s. and c. p.; 9, worker, s. and c. p.; 11, male and worker, s. and c. p.; 12, worker, s. and c. p.; 13, worker s. and c. p.; 20, male, s.; 23, female, s. and c. .; 33, female, s. and c. p.; 34, female, s. and c. p.; 35, female, s. and c. p.; 40, female, s.; 45, female, s.; 54, female, s.

HEMITROPOUS.

Bees: 99, female, s. and c. p.; 100, female, s. and c. p.; 102, female, s. and c. p.; 105, female, s. and c. p.; 107, female, s. and c. p.; 108, female, s. and c. p.; 109, female, s. and c. p.; 114, female, s. and c. p.; 118, female, s. and c. p.; 119, female, s. and c. p.; 120, female, s. and c. p.; 122, female, s. and c. p.

Wasp: 198, s.

Flies: 277; 279; 295; 298; 300; 307; 308; 313; 316; 317; 318; 319; 322; 324; 330; 332—all s. or f. p.

Butterflies: 450; 451; 452; 454; 475; 480; 481; 483—all s.

ALLOTROPOUS.

Wasps: 137; 141—both s.
Beetles: 519; 525—both f. p.

Eutrop.	17 = 29.3%
Hemitrop.	37 = 63.8%
Allotrop.	4 = 6.9%

Cirsium (Tourn.) Hill.

35. **Cirsium altissimum** (L.) Spreng. Tall Thistle.

Blooming period from about July 29 to September 4. The entire length of the purple corolla amounts to 28 mm., which is divided up among the diefferent parts as follows: 15 mm. for the lower, very narrow portion of the tube, 6 mm. for the upper distended portion, and 7 mm. for the slender lobes of the corolla. The outermost (peripheral) lobe of each corolla is 1 mm. longer than the remaining 4, in other words the slit between this lobe end each of its neighbors extends down to a greater distance than the slits between the other lobes. Consequently insects approaching these flowers from the outer side, as they usually do may reach the bottom of the tube easier than otherwise. In this case a tongue 5 mm. in length is able to drain the tube.

Following is the list of 34 visitors:

EUTROPOUS.

Bees: 1, worker s.; 4, worker, s. and c. p.; 6, worker, s.; 7, male, female and worker, s. and c. p.; 9, male, s.; 13, male and female, s.; 14, female, s. and c. p.; 15, female, s.; 17, female, s.; 20, female, s.; 23, female, s. and c. p.; 28, male, s.; 34, female, s. and e. p.; 54, female, s.

HEMITROPOUS.

Bees: 113, female, c. p.; 114, female, c. p.; 117, female, e. p.; 119, female, c. p.; 120, female, e. p.

Flies: 297; 313; 332—all s. or f. p.

Butterflies: 446; 448; 450; 453; 454; 456; 464; 467; 469; 480—all s.

ALLOTROPOUS.

Beetles: 520; 527—both f. p.

Eutrop.	14	= 41.2%
Hemitrop.	18	= 52.9%
Allotrop.	2	= 5.9%

36. **Cirsium lanceolatum** (L.) Hill. Common Thistle.

This European species has become a well known inhabitant of our fields and pastures and blooms from about July 19 until the end of the season, when the last flowers are destroyed by a severe frost. H. Mueller[34] has studied the pollination of this species in Germany. The florets agree in every respect with those of the

34) H. Mueller, loc. cit., p. 389.

species just considered. *(C. altissimum)* so closely that a further description is unnecessary. Insects to the number of 24 were observed as follows:

EUTROPOUS.

Bees: 4, worker, s. and c. p.; 7, worker, s. and c. p.; 9, male and worker, s. and c. p.; 17, female, s. and c. p.; 20, male, s.; 23, male and female, s. and c. p.; 33, female, s. and c. p.; 34, female, s. and c. p.

HEMITROPOUS.

Bees: 99, male, s.; 100, female, s.; 104, male, s.
Flies: 303; 307—both f. p.
Butterflies and moths: 447; 448; 453; 454; 468; 469; 480; 481; 492—all s.

ALLOTROPOUS.

Beetles: 516; 517—both f. p.

Eutrop.	8 =	33.3%
Hemitrop.	14 =	58.4%
Allotrop.	2 =	8.3%

37. **Cirsium arvense** (L.) Scop. Canada Thistle.

The flowers of this troublesome weed, a native of Europe, have been observed from June 22 to September 27. Of this species also we have an account published by H. Mueller[35], and later observations by various European authors. Gynodiœcism (pseudohermaphrodite pistillate and staminate flowers on different plants) has been reported from different parts of Europe, but I have not come across any such distribution of the sexes in the plants of our surroundings. The color of the florets varies from purplish to white, but the first named is the prevailing one. The slender lobes of the corolla are 4½ mm. long, and the bell-shaped upper part of the tube has a width of 1 mm. at the entrance, and a length of 1½ mm. A distinct sweet odor renders the flowers rather attractive to insects; the following 113 species of which were taken:

EUTROPOUS.

Bees: 1, worker, s. and c. p.; 5, worker, s. and c. p.; 7, worker, s. and c. p.; 11, worker, s. and c. p.; 12, worker, s. and c. p.; 13, worker, s. and c. p.; 17, female, s. and c. p.; 18, female, s.; 23, female, s. and c. p.; 34, female, s. and c. p.; 35, male, s.; 41, female, s. and c. p.; 59, female, s.

35) H. Mueller, loc. cit., pp. 387-389.

HEMITROPOUS.

Bees: 70, male, s.; 73, female, s.; 87, male and female, s. and c. p.; 99, female, s. and c. p.; 100, female, s. and c. p.; 102, female, s. and c. p.; 104, male and female, s. and c. p.; 105, male, s.; 106, female, s. and c. p.; 109, male and female, s. and c. p.; 110, female, s.; 114, female, s. and c. p.; 117, female, s. and c. p.; 118, female, s. and c. p.; 119, female, s. and c. p.; 121, female, s. and c. p.; 122, female, s. and c. p.; 124, female, s.; 126, female, s.; 135, female, s.

Wasps: 147; 151; 196; 198—all s.

Flies: 290; 294; 296; 298; 300; 304; 306; 307; 308; 313; 316; 317; 318; 319; 322; 324; 325; 326; 329; 330; 336; 838; 344—all s. or f. p.

Butterflies and moths: 449; 450; 463; 464; 465; 466; 467; 470; 480; 483; 502—all s.

ALLOTROPOUS.

Wasps: 137; 140; 141; 157; 163; 164; 165; 173; 179; 180; 183; 192; 194; 216—all s.

Flies: 255; 258; 259; 263; 265; 266; 369; 372; 373; 377; 382; 385; 387; 389; 391; 415; 416; 442; 444—all s. or f. p.

Beetles—510; 519; 520; 525; 532; 533; 534—all s. or f. p.

Bugs: 550; 559—both s.

Eutrop.	13	= 11.5%
Hemitrop.	58	= 51.3%
Allotrop.	42	= 37.2%

NOTES ON SOME FAR NORTHERN GRASSES.

By Charles T. and Beirne B. Brues.

The present notes are based on a small but interesting collection of grasses which have recently come into the possession of the Milwaukee Public Museum. They form part of a general collection of flowering plants collected by J. S. Warmbath in the southern part of Grinnell Land, along the eastern coast of Ellesmere Island at Lat. 79° N. and Long. 75° W. The area collected over extends from Bache Peninsula for about two degrees southward to Cape Sabine, and altogether six species of grasses were obtained. As so little is known definitely of the flora of this region, we have thought it of interest to publish the following list.

Alopecurus alpinus J. E. Smith.

The culms vary in height from 7 to 22 cm., averaging about 12 cm. None of the spikes are over 18 mm. in length, and many are less than 1 cm. long, while their width is generally 7 to 8 mm., except in the very small spikes.

Phippsia algida (Soland.) R. Br.

The plants are barely 2 cm. in height with panicles 6 to 8 mm. in length, considerably exceeded by some of the leaves.

Poa abbreviata R. Br.

The culms are from 4 to 14 cm. high, even the smallest tufts bearing numerous panicles, none less than 1.25 cm. long.

Poa laxa Haenke.

The plants average nearly 2 dm. in height and bear numerous panicles 4 to 5 cm. in length. All show the characteristic grayish moss-green color to the leaves, while the panicles are strongly yellow.

Poa cenisia All.

The culms are 2.5 to 3 dm. in height, with panicles 8 cm. long. All the specimens are represented by thick tufts formed by the present species and *Alopecurus alpinus* growing in very close association.

Poa alpina L.

The plants are only 6 to 9 cm. high, with most of the panicles 2 to 3 cm. in length, barely exceeding the leaves.

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The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6, 1857.

OFFICERS AND DIRECTORS.

George P. Barth, President..................302 21st Street, Milwaukee
Henry L. Ward, Vice-President..... .....Public Museum, Milwaukee
Richard A. Muttkowski, General Secy. .....Public Museum, Milwaukee
Paul H. Dernehl, Treasurer.............Majestic Building, Milwaukee
Edgar E. Teller, Director............ ..3321 Sycamore St., Milwaukee

PUBLISHING COMMITTEE.

George W. Peckham, Henry L. Ward,
Charles T. Brues.

MEETINGS.

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room in the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

PUBLICATION.

The "Bulletin of the Wisconsin Natural History Society."

Matter intended for publication should be sent to the editor of the Bulletin, C. T. Brues, Bussey Institution, Forest Hills, Boston, Mass.

MEMBERSHIP DUES.

Active Members, $3.00 per annum; Junior Members, $1.00 per annum; Corresponding Members, $2.00 per annum; Life Members, one payment of fifty dollars.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 7. OCTOBER, 1909. Nos. 3—4.

PROCEEDINGS.

Milwaukee, April 8, 1909.

Meeting of the combined sections.

President Teller in the chair and 19 persons present.

The minutes of the last section meeting read and approved.

The evening was devoted to a general discussion of Forestry.

Mr. Alfred C. Burrill opened this with some remarks on the forest regions of the United States describing the several typical kinds of forests occurring within our boundaries, illustrating each with a series of lantern slides. Mr. Henry L. Ward then followed with a short account of some cases where changes in forest conditions have affected the animal faunae of certain regions. He also cited a contrasting case where a flock of sheep on an island off the California coast had so destroyed the vegetation that the island became a waste of sand dunes. He was followed by Mr. George W. Colles who spoke on forest conditions, particularly in Mexico.

After considerable informal discussion Mr. Colles introduced a resolution on forest destruction which was adopted by the section meeting to be later proposed at the next regular meeting of the society. The meeting then adjourned.

Milwaukee, April 24, 1909.

Regular monthly meeting of the society.

President Teller in the chair and about 40 persons present.

The business meeting was postponed until after the lecture of the evening which was on Bird Architecture, by Mr. H. L. Ward, Director of the Milwaukee Public Museum.

Mr. Ward reviewed the results of various students of bird architecture in their efforts to determine whether the building of nests was directed by instinct or by reason. He quoted liberally from many authors, including Wilson, Audubon, Dickson and Wallace who believed that intelligent volition ruled. Wallace could find no evidence of instinct, saying "I can not find a particle of evidence to show the existence of anything beyond those lower reasoning and imitative powers, which animals are universally admitted to possess."

The most careful observer of all, Herrick, who with note book and camera had followed the construction of nests from their inception writes: "Few more typical examples of instinctive behavior can be witnessed in higher animals than in the serial acts which the adaptive and often beautiful nest of the wild bird is produced."

Mr. Ward thought that the true solution lay in a union of instinct and intelligence. That the impulse to build was instinctive, that the motions accompanying the work were perhaps habitual but that intelligence was shown in certain adaptions to conditions.

A series of colored lantern slides showing the marvelous bowers constructed by the Australasian Bower Birds were shown and described as architectural works not connected with the nests. Then followed a series of nests illustrating the various types of these structures.

After a five minutes intermission the regular business meeting was held, although the annual meeting had to be postponed as only 13 of the necessary 15 members as quorum for such meeting were present.

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

The secretary then read the resolution adopted by the section meeting which was adopted by the society:

WHEREAS, The cutting of our forests is now proceeding at a much more rapid rate than the forests can be restored; and

WHEREAS, It is of the most vital importance to the future of the country that this excessive cutting of our native forests should be checked; and

WHEREAS, The price of lumber to the customer has increased by leaps and bounds during the past twenty years with nothing but future increases in sight; and

WHEREAS, The lumber industry of this country is the largest in the world and needs no protection against foreign competition; and

WHEREAS, It is of vital importance to the public at large to secure a sufficient supply of lumber for use in building and manufacture without further wasteful denudation of our present forest area; and

WHEREAS, The present import duty on lumber and that proposed in the new tariff bill now before congress has not a shadow of defense or warrant in the public interest; therefore be it

Resolved, That it is the sense of the Wisconsin Natural History Society that the conservation of our forest resources no less than the interest of the consumers of lumber demand the free entrance of foreign lumber into the United States; and

Resolved, That this society is opposed to any tariff, duty or other restriction upon the free importation of foreign lumber; and

Resolved, That we hereby urge upon the senators and representatives of this state in congress assembled that they vote for and strive by any legitimate means to secure the placing of lumber on the free list in the tariff bill now under consideration; and

Resolved, That the secretary of this society be, and is hereby, instructed to communicate copies of this resolution to each Wisconsin senator and representative in congress.

Dr. Barth then moved the adoption of an amendment to the by-laws to permit the admission of junior members, as follows: "that the following section to be known as section 5 of our by-laws be added to such by-laws, the numerical order of the following sections to be changed to correspond to this addition.

Section 5. Persons who have not yet reached their majority may become junior members of this society upon the payment of annual dues of one dollar during their minority, which dues shall entitle such junior members to a copy of the bulletin. Junior members shall have no vote. Upon reaching their majority any junior member may become a regular member of the society upon making application for membership upon the regular blank provided for that purpose."

After considerable discussion on the part of Messrs. Colles, Doerflinger, Russel, Burrill, Ward and Brues the motion was passed. The meeting then adjourned.

Milwaukee, May 13, 1909.

Meeting of the combined sections.

President Teller in the chair and 12 persons present.

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

The secretary then read the following resolutions introduced by Mr. Burrill, which were referred to the next general meeting for consideration:

Resolved, That the Wisconsin Natural History Society is in favor of the state reservation of all colonies of bank swallows *(Clivicola riparia)* having thirty or more holes per colony, said reservations to remain under the special care of the game wardens of the state for at least one year longer than reserved colonies shall contain living pairs of bank swallows. Further, be it

Resolved, That the State Game Warden be empowered to further the spread of the species in or near all suitable river banks as suggested by Circular No. 56 of the U. S. Bureau of Biological Survey, April 27, 1909, for the propagation of martins and other swallows; and that a copy of these resolutions be sent to the State Game Warden at Madison.—*Alfred C. Burrill, Petitioner.*

Whereas, The Wisconsin Natural History Society would stand for the scientfic protection and propagation of all useful wild life; be it

Resolved, That the Wisconsin Natural History Society is in favor of a state experimental farm for the propagation of game and useful wild life, to co-operate if possible with a farm of similar nature created in 1909, by the Legislature of the State of New York, or with such other farms established within the United States or its Territories.

Resolved, That a copy of these resolutions be communicated by the Secretary to the local game associations, Humane Society, Game Warden Department, and such other persons as may seem desirable to the Society, together with the request that the matter be discussed in said organizations and persons, and that suggestions be submitted to this Society.—*Alfred C. Burrill, Petitioner.*

Mr. Howland Russel spoke on Parasitic Flowering Plants, giving a classification and description of the various types of these extremely interesting adaptations. His talk was illustrated by blackboard diagrams and figures.

Mr. C. T. Brues then gave a general account of Parasitic Insects, referring to the polyphyletic origin of parasitism among insects and referring to the more important groups where parasitic adaptations occur.

Dr. S. Graenicher followed with an account of Parasitic Bees and other bee parasites. He gave a general account of parasitism with the description of some specific cases.

After a rather lengthy discussion on the part of several members concerning the proper application of the word "parasitism" the meeting adjourned.

Milwaukee, May 27, 1909.

Regular monthly meeting of the society.

President Teller in the chair.

About 40 people present.

The minutes of the last general and annual meeting were read and approved.

President Teller announced a business meeting to take place after the lecture of the evening, which was by Mr. Alfred C. Burrill, lecturer at the Milwaukee Public Museum. Mr. Burrill's theme was "Our Greatest National Peril: The Waste of Soil."

Mr. Burrill said that aside from the depletion of the soil from its necessary chemical elements by too reckless farming, there is another, much greater waste, by erosion, due to deforestration primarily, and secondarily to destruction of the ground cover by animals. In the first instance the lecturer dwelt upon the destruction of forests by human agents. The careless methods of the lumbermen in the felling and transportation of the trees were shown; how the ground cover is torn by hauling the trunks, or how young trees are destroyed by the falling giants. Rains and floods flowing into these drains soon form natural beds that in time widen to great gullies through the unceasing erosion. Attention was called to the Alleghanian and Rocky Mountain forests as illustrating this particular feature. The Bad Lands of S. Dak., the canons of the Colorado and the Carson Sink at the mouth of that erratic river are other instances. As other than human agents Mr. Burrill mentioned fire and wind. An annual loss of hundreds of millions of dollars through fires in North America was cited. Destruction by wind, such as the uprooting of trees and thus preparing the way for the wearing floods, was passed over as a minor though by no means unimportant feature.

The second part of the lecture was devoted to animal erosion. The overcrowding of ranges with sheep and cattle and the consequent trampling and close feeding utterly destroy the ground cover; in forests the dust raised by the animals has tended to suffocate acres of the finest trees. The rain, finding its way to the uncovered roots, undermines the trees and fells them. On deforested hillsides the ground cover soon gives way to erosion and fine land is overwhelmed at the bottom. The trampling of cattle at river fords and drinking places were mentioned as some of the quickest means of producing erosion. At the seashore and the shores of lakes and large rivers the destruction of the natural barriers of trees and bushes has occasioned the formation of great sand-dunes which in their steady advance overcome forests, pastures and farm-lands. The constant fight led by the National Government against the sand dunes was shown vividly by the lecturer. Cape Cod, the Columbia river, localities in Kansas and along the Colorado and other rivers are some of the instances.

Mr. Burrill then concluded with the statement that the only remedies are severe husbanding of the remaining forests to regulate the flow of water, and terrace-farming in deforested localities to prevent erosion. A simile was drawn between the United States and China, and a like fate predicted for our country, if better and more sensible methods were not soon introduced. The lecture was illustrated with about 150 colored slides. Mr. Burrill also exhibited a series of pamphlets treating of the subject, some of them narrating what various States are doing for the preservation and irrigation of their soils.

After five minutes intermission a business meeting was held. The resignation of Mr. Paul C. Rohde was read and accepted. Resolutions presented by Mr. Burrill at the last section meeting were read and action postponed till the next general meeting. The reports of the secretary and treasurer were read and approved. There being a quorum present the election of officers was then held. President Teller expressed his desire to withdraw from the presidency which he had held for nine years. A communciation of similar import from Mr. Finger, the treasurer, was read. Mr. Brues said that he would be unable to hold the secretaryship any longer since he expected to leave for Harvard in September to teach in the university there.

A committee on nominations was appointed consisting of Dr. S. Graenicher, Dr. George P. Barth, and Dr. George W. Peckham. Nominations by the committee were as follows: Mr. William MacLaren for treasurer, Richard A. Muttkowski for secretary, and Mr. Edgar E. Teller for Director. No nominations for president and vice-president were submitted. Individual nominations for president: Dr. George P.

Barth, Dr. S. Graenicher, and Mr. Henry L. Ward. Dr. George P. Barth was elected president by ballot. Mr. Ward was then nominated for vice-president. There being only a single candidate for each other office, Dr. George W. Peckham moved that the secretary be instructed to cast a single ballot for the candidates. Seconded. After a spirited discussion this motion was advanced to a vote and accepted; whereupon the secretary cast a ballot for

Dr. George P. Barth—President.
Henry L. Ward—Vice-President.
William MacLaren—Treasurer.
Richard A. Muttkowski—General Secretary.
Edgar E. Teller—Director.

A vote of thanks was given to the retiring officers for their unfailing devotion to the society.

Upon motion the meeting then adjourned.

Milwaukee, June 10, 1909.

Instead of the usual section meeting the Natural History Society held its first annual dinner at the Hotel Charlotte. This was attended by 43 members. An entertaining program had been arranged for the occasion.

Milwaukee, June 24, 1909.

Regular meeting of the society.

President Barth in the chair.

50 people present.

Minutes of the postponed annual meeting read and approved.

The resolutions presented to the meeting of the combined section on May 13th, by Mr. Burrill were read and favorable action taken. The following committee was appointed to edit the resolutions in proper form: Chairman, Alfred C. Burrill; members, Dr. S. Graenicher, Henry L. Ward.

A communication from Secretary Cannon of the Citizens Business League was then read asking to confer regarding an invitation to be extended to the American Association for the Advancement of Science to meet in Milwaukee in 1910. A committee was appointed by President Barth to confer with Mr. Cannon. H. L. Ward, Chairman; members, Edgar E. Teller, Dr. George W. Peckham.

No other unfinished business being on hand, Dr. Graenicher then opened the evening's symposium on the House-Fly, with the topic: "The Diptera and the Systematic Position of the House-Fly." Dr Graenicher spoke briefly of the importance the Diptera have acquired within the last decade. Beginning with the yellow fever mosquito and the tse-tse fly down to the house-fly he told of the danger of these insects and the fight against them. He explained the systematic position of the house-fly, its life history, and described its near relatives, such as the stable-fly, the horse-fly and others.

Mr. H. Clowes then gave a general talk on "The House-Fly: Its Economy and Anatomy. The anatomy was shown in a series of lantern slides made from drawings by the speaker. Several models illustrating the life history were presented to the audience. Mr. Clowes correlated the anatomy of the house-fly to its capacity for spreading disease-bearing germs. Potential multiplication was cited as of the greatest economic importance and was shown vividly in a number of striking figures. Among remedies cleanliness was mentioned as the most important.

After the lectures President Barth appointed the following constitutional or standing committees:

1. On Program for Regular Meetings.
   Chairman—Henry L. Ward.
   Senior member—Dr. S. Graenicher.
   Junior member—Miss Helen Sherman.
2. On Program for Section Meetings.
   Chairman—George W. Colles.
   Senior member—Howland Russel.
   Junior member—I. N. Mitchell.
3. Publishing Committee.
   Chairman—Dr. George W. Peckham.
   Senior member—Henry L. Ward.
   Junior member—Charles T. Brues.

Upon motion the meeting then adjourned.

Milwaukee, July 8, 1909.

Meeting of the combined sections.

President Barth in the chair. 22 people present.

Minutes of the last section meeting read and approved.

Dr. George P. Barth spoke on The Nesting Habits of the Crabronidæ. He stated that since the publication of a recent paper he had discovered many facts which support and some that oppose his own recorded observations and those of other authors. The speaker exhibited a series of glass tubes showing the living contents of various nests. In addition a number of blackboard diagrams served to heighten the interest shown in the lecture.

Mr. A. C. Burrill then spoke of the Distribution of the Flora of Milwaukee County. Specifically, the lecturer treated the forest trees, basing his observations on a series of colored lantern slides showing present and past conditions in all parts of the county.

The formation of knolls in tamarack swamps, and the theory that life occurs in waves, were informally discussed by Messrs. Teller, Burrill, Barth and Muttkowski.

Upon motion the meeting then adjourned.

Milwaukee, August 26, 1909.

Meeting of the combined sections.

President Barth in the chair. Sixteen members present.

Mr. Charles T. Brues gave the talk of the evening on the Puget Sound Marine Station—its location and equipment, and the Invertebrate Fauna of the Sound. As an introduction the speaker distributed a series of photographs illustrating conditions of the locality.

Mr. Brues then gave a general survey of the collections obtained during his sojourn of six weeks at the station. He contrasted the marine fauna of the Atlantic and Pacific coasts, saying that the latter shows more variety and greater abundance than the Eastern coast in the same latitude, though the temperature averaged the same. Marine collecting was two-fold, littoral and deep. The great difference between tides, twelve feet between high and low tide was very favorable for collecting littoral species. Many fine invertebrates, that were left stranded by the outflowing tide, were picked up on the gravel beach. For the collection of the deeper fauna a shrimp dredge had been furnished by the Station, by means of which many rare and interesting specimens were brought up.

Mr. Brues called attention to the abundance of barnacles in the Sound saying that practically everything not moving was covered with colonies of these crustacea; they also fastened themselves to crabs and mollusks. A fine series of chitons, mollusks of the genus *Placophora*, ranging in size from one to eight inches, was exhibited by the speaker; he also showed a similar series of barnacles, shrimps of various species, hydroids, sponges, etc. Parasitism was touched upon, as that of a small crab on the sea-clams, and *Sacculina* on shrimps.

From marine collecting Mr. Brues passed to collecting on the Islands and the main-land. The speaker named some of the distinguishing features of the fauna and flora of the region. As especially striking he showed a number of large slugs that he had collected on one of the islands. A species of salamander was exhibited which shows closer affinity to the European *Triton* than to its American relatives.

Mr. Brues concluded his narrative with the exhibiton of a specimen of seaweed, the stalk of which measures over twenty feet in length, ending in a swollen spherical float bearing long ribbon-shaped thallus leaves.

Some of the speaker's remarks were informally discussed by the members.

The thanks and appreciation of the members were extended to Mr. Brues by regular vote.

Upon motion the meeting then adjourned.

Milwaukee, Sept. 9, 1909.

Meeting of the combined sections.

President Barth in the chair. 13 people present.

Minutes of the last section meeting read and approved.

R. A. Muttkowski opened the evening's symposium on Albinism and Melanism. Mr. Muttkowski spoke with special reference to the Lepidoptera. As causes of albinism and melanism he enumerated humidity, temperature, food geographical position and light. In considering the effects he dwelt on the composition of the colors of Lepidoptera, and noted which colors are affected by the various cases. He called attention to the fact that influences may begin at any time in the life history of the species. The speaker exhibited melanic specimens of *Anosia plexippus*, *Catocala cara* and *cerogama;* albinic specimens of *Eurymus eurytheme*, *Deilephila lineata*, and a number of others.

Mr. Henry L. Ward then followed with an account of Albinism and Melanism as evidenced in mammals and birds. Mr. Ward called attention to the fact that colors characterize many species and most subspecies of these animals, and to the importance of the subject as affording a key to some evolutionary phenomena.

He then gave a short resumé of the division of colors into groups, structural and pigmental, the subdivision of the latter into lipochromes and melanins and the supposed origin of these pigments. The importance of the melanins was mentioned, comprising most of the pigmental colors found in these two classes of animals other than the reds and the yellows and also forming the basis of many structural colors whose iridenscence is displayed against the dark back-grounds formed.

The antithesis of melanin, or black, is white which with a few rare exceptions is structural and is explained as due to the fine granular structure of the feather or hair, in which each grain is supposed to be enveloped in air or gas which breaks up and reflects the light in every direction. While these grains usually are colorless they are not always so. Examples of the effect of fine comminution of ice, glass, black slate etc., were referred to as familiar examples. This whiteness being constant from any angle of view fell under Gadow's group of *objective structural* colors in distinction to his *subjective structural* colors in embracing the changeable or iridescent colors.

The importance of an understanding of the factors that determine color changes because of connection with its evolutionary significance was mentioned and attention was called to the fact that some of the very early mammalogists recognized a transition from melanism in the tropics to albinism in the arctic region coupled with a great increase in size of what they considered one species of bear.

He then quoted at length several passages from F. A. Allen's essay "On the Mammals and Winter Birds of East Florida, etc.," showing that this author at that comparatively early date (1871) recognized that the geographical variation in color of birds was due to climatic differences and that the greatest factor in this was humidity; the more humid the region the deeper, and the more arid the locality the paler the colors. Mr. Ward then referred to recent experiments carried on by C. W. Beebe at the New York Zoological Gardens which showed that melanistic changes could be produced during the life of the individual bird by subjecting it to an abnormal degree of humidity.

The melanistic and albinistic tendencies were considered by the speaker as more important than sporadic cases of complete albinism or melanism, which were considered probably pathologic in nature.

Attention was called to the prevelance of white pelage and plumage in the Arctic region where is served not only a protective or aggressive role but also subjected the animals to less loss of bodily heat by radiation than would darker colors.

Various examples of dichromatism, the grey squirrel, leopard, reddish egret, screech owl, etc., were mentioned and a number of specimens illustrative of both albinism and melanism were exhibited.

Dr. George P. Barth then took up the subject of albinism and melanism in man. He spoke of the normal occurrence of melanin in the human tissues and mentioned Abel and Davis' calculations of the quantity of melanin in the negro's skin and hair (1 gram) as opposed to the enormous quantity found in some pathological growths (300 grams having been recovered from a melanotic sarcoma of the liver.) He touched slightly on the chemistry of the melanins and quoted Von Fürth's theory of its formation, to-wit: Melanin and the melanoid bodies are developed by the action of intracellular oxidases (tyrosinase) upon the aromatic or chromagen groups of the protein molecule. A physiological increase is present in certain conditions.

Dr. Barth then went into the experiments of Loeb on the transplantation of both pigmented and unpigmented skin grafts to denuded areas which proved that in no case is the skin of another species found to be successfully grafted in man; in all cases the cells undergo necrosis. Homotropism, an attraction of cells to others of a like order, or a chemotropism may account for the greater rapidity with which a denuded surface is covered by new skin after a graft.

Albinism is merely the lack of the presence of the coloring matter melanin in the tissues. It is always present at birth and therefore inherited; but as to whether it has any value in supporting theories of heredity or of Mendelism is not established, as no observations have been made with this object in view. It may have the same value as certain other conditions often transmitted to offspring such as polydactylism, absence of parts, peculiarity of features, etc.

In conclusion, Dr. Barth discussed briefly the symtomatology of albinism and disease vitiligo.

Dr. Graenicher instanced the occurrence of albinic and melanic forms in field clover.

Reproduction was informally discussed by the following members: Messrs. Carpenter, Mann, who related his experiences in breeding foxes, Ward, Whitnall, Muttkowski, and Colles.

Upon motion the meeting then adjourned.

Milwaukee, Sept. 30, 1909.

Regular meeting of the society.

President Barth in the chair. About 75 persons present.

Mr. Ward reported for the committee appointed at the June meeting to confer with Secretary Cannon of the Citizen's Business League regarding an invitation to be extended to the American Association for the advancement of Science. He said that he had written to Secretary Howard of the Association regarding the requirements for a meeting and in reply received a memorandum to the effect that 34 rooms, each equipped with stereopticon, charts and other facilities for demonstration, and capable of holding from 300—500 people each would be required. This memorandum had been mailed to Secretary Cannon in August; no reply had been sent till that date and Mr. Ward considered that the matter had been dropped by the business league.

The application of Mr. Arthur Gallun, 1000 North Water street, was then read. Mr. Gallun was subsequently elected an active member by the directors.

Mr. H. L. Ward then gave the evening's talk on the St. Croix river collecting expedition of the Public Museum during the past summer and the region passed through. He opened with a general account of the purpose of the trip, of the geological formation of the territory traversed by the expedition, and some remarks as to the characteristics of the people of the region. The starting point of the expedition was at Upper St. Croix Lake, where a week was spent in collection and completing the equipment; namely three flat-bottomed boats, one of which had to be built. From the Lake the expedition entered the river. After a day a log jam one mile in length was reached at Gordon and the boats and luggage were transferred below the jam by wagon. At St. Croix Dam a stop of six days was made for collecting, after which the boats were hauled over the dam into the rapids below. These were met with in many places, and except for an occational wedging of a boat in the rocks did not prove very difficult. Fish Trap and Kettle River Rapids were the roughest. A third stop was made at the mouth of the Nemakagan and also at Pansy, a hamlet farther down the river. The next stop was at the mouth of the Yellow river, where four interesting days were spent.

Then came the Kettle River Rapids, which had been heralded widely as the most dangerous in the region. Here the more perishable luggage was transferred to wagons, to be hauled seven milês overland to meet the boats below the rapids. Unfortunately connections were not made and the boats were poled back against the current by the guide to reload the freight. At Rush City bridge the expedition had a first glimpse of river house-boats, called "Wahnegans" by the natives. While camping here Mr. Ward discovered a series of 102 mounds covering about 265 paces, which were apparently thrown up by a pocket gopher; some of these mounds were two feet in height.

At Nevers Dam the expedition found about 15,000,000 log feet of timber held back by the dam. A portage was made here. The large expanse of drowned forest caused by the dam proved of great interest to the expedition and a number of photographs were taken. Equally interesting was the power house at St. Croix Falls, built at an expense of $3,000,000, which supplies Minneapolis and St. Paul with electricity.

After hauling the boats around the Falls the most interesting region the Dells of the St. Croix, was reached; this region is preserved to the public as an inter-state park. The chief geologic feature of the Dells are the numerous pot-holes on the Minnesota side, and, from a scenic standpoint, a gigantic Maltese cross in the rock on the Wisconsin side. The final stop was made at Farmington, where the expedition spent several days. Members of the expedition were: Messrs. Ward and his son, Shrosbree, Katze-Miller, Dr. Graenicher, Rohde, and the guide, Clarke.

Upon motion the meeting then adjourned.

THE CLERIDÆ OF THE PUBLIC MUSEUM OF THE CITY OF MILWAUKEE.

By Albert B. Wolcott.

Through the kindness of Dr. S. Graenicher and Mr. Richard A. Muttkowski, the writer recently had the privilege of making a study of the Cleridæ in the collection of the museum.

The following annotated list records all the species represented, with descriptions of three recognized as new to science, the types of which are contained in the collection.*

Subfam I. TILLINÆ.

1. Monophylla terminata Say *(Elasmocerus* Lec.) Male. Female. Mo.; Tex.

Very variable in size, a male from Missouri being but 4.2 mm. in length, while a female from the same state is 9 mm. in length, size, however, is not dependent upon sex, as the male *averages* as large as the opposite sex. Another female, also from Missouri, is much paler than any that the writer has seen previously, the head in front and beneath, the five basal joints of antennæ, the pronotum (except a small slightly infuscate area at middle of disk), the pro-, meso- and metasternum, the abdomen (except apical segment), and the legs are entirely pale testaceous. Aside from color the specimen differs in no way from the typical form.

2. Tillus collaris Spin. Male. Female. Tex.

The examples which the writer refers to this species agree very closely with Spinola's description and figure (Mon. Cler., I, p. 98, t. 2, f. 6, 1844), differing in only one structural character; the color is subject to some variation in extent. In the original

* Note.—The localities "Tex." and "Wis." cited in the present paper, most probably mean New Braunfels, Tex., and Milwaukee Co., Wis., although this is not absolutely certain in any case. The specimens form a part of a collection accumulated by Mr. F. Rauterberg, which is unfortunately not furnished with concise locality labels, but nearly all his specimens from these two states come from the places named.—[Editor.]

description the *eleventh* (first lateral) stria of elytra is said to become obsolete behind the middle, whereas in the specimens before me each elytron has but ten striæ, the *tenth* in these becomes obsolete behind the middle. The structure of the antennæ is as described by Spinola, the basal joint is large, the second, third and fourth small, the fifth to tenth much larger, about one-third longer than wide and triangular in form, the eleventh joint one-third longer than the tenth. Thus they agree with Spinola's species in having the seven outer joints serrate. The species occurring in Mexico, in which the outer eight joints are serrate, is in all probability a different insect. In typical specimens the color is black, the disk of the thorax alone being red; here the specimens are black varying to piceous, the entire prothorax, coxæ and base of femora pale red, with the head between the eyes dull red. The specimens agree with the type in size, ranging from 4.17—5.5 mm. in length. This species might easily be mistaken for a small species of *Cymatodera*. The form of the claws, finely granulated eyes and entire labrum should, however, suffice to distinguish it generically.

3. **Cymatodera pubescens** sp. nov.

Dark brown, body beneath, abdomen, antennæ and legs pale reddish brown, clothed with very fine, short but very dense recumbent yellowish pubescence. Head and thorax minutely and very sparsely punctate, eyes prominent. Antennæ slightly longer than head and thorax, joint two, three, and four small, joint two smaller than joint three and equal to joint four, joints five to ten larger, elongate, scarcely serrate, joint eleven one-third longer than joint ten. Prothorax one-half longer than wide, much wider at apex than at base, apical constriction very feeble, basal constriction very strong, apical and basal transverse impressed lines nearly obsolete, ante-scutellar impression wanting. Scutellum orbicular. Elytra at base nearly twice as wide as base of prothorax, humeri distinct, sides parallel, apices conjointly rounded, disk feebly convex, each elytron with ten rows of rather coarse, closely placed, subquadrate punctures which become but slightly smaller posteriorly and extend very nearly to extreme apex, intervals convex, at base subequal in width to punctures, posteriorly slightly wider, finely irregularly punctate. Body beneath coarsely rather sparsely punctate; abdomen finely more densely punctate; under surface and legs clothed with pubescence similar to dorsal surface but more sparse. Length 7.7 mm.

Male.—Fifth ventral segment, broadly, rather strongly arcuately emarginate; sixth short, narrower than last dorsal, rounded with the apex at middle prolonged forming a broad obtusely terminated tooth which extends beyond the last dorsal segment: Last dorsal broadly, arcuately emarginate the outer angles obtusely rounded.

One specimen, Texas. Type in collection of the Museum.

Allied to *uniformis* Schaeffer and the species of the *puncticollis* group by the structure of the antennæ, but very distinct from all these by the secondary sexual characters of the abdomen; it differs further from *uniformis*, to which it is closest related, in having the pubescence very fine, not coarse, the prothorax very finely not coarsely punctate and the ante-scutellar impression entirely wanting.

4. **Cymatodera turbata** Horn. Tex.

5. **Cymatodera brunnea** Melsh. Male. Female. Tex.

6. **Cymatodera bicolor** Say. Male. Female. Wis.; N. Y.

In one of the specimens from Wisconsin and one of those from New York the prothorax is broadly marked with black at apex and base in the usual manner, but the flanks from the middle to the base are also broadly black, thus approaching two specimens from New York which resemble *inornata* in color so closely as to be easily mistaken for that species. In these the entire pronotum is black with the exception of the dilated portion of the side, which is pale; both specimens are females and have the apical segment of abdomen pale yellowish.

7. **Cymatodera inornata** Say. Female. Wis.

8. **Cymatodera comans** Wolc. MS. Male. Tex.

Both the specimens in the collection are males. The description of this species, which will soon appear, being now in press, is based upon specimens taken in Utah and Arizona.

9. **Cymatodera texana** Gorh. Female. Tex.

Rather closely allied to *C. fuscula* Lec., and known only from Texas. The specimen from Jalapa, Mexico, mentioned by

Gorham (Biol. Centr.-Amer. III, pt. 2, p. 134) has since been recognized as being *fuscula*. The secondary sexual characters of the abdomen are not given in the original description of *texana*, hence a comparison of the types is necessary to thoroughly establish the distinctness of the two species; *texana* is, however, in the opinion of the writer, entitled to stand as a valid species. In this species the elytral striæ are longer, the prothorax much less distinctly punctured and the elytra have besides the pale median fascia (as in *fuscula*) the apices pale or each with a pale maculation at the apex. This marking is, however, of an evanescent nature, as excellently shown by the series in the collection.

10. **Cymatodera undulata** Say. Male. Female. Wis.; Ohio; Kans.

11. **Cymatodera balteata** Lec. Male. Female. Tex.

This species has for a long time stood in our lists as a variety of *undulata*. It is, however, a distinct species, the sexual characters of the male abdomen being quite different, the prothorax is less strongly constricted at apex and base, and the elytral punctures are much coarser and deeper. In the male the fifth ventral segment is very deeply arcuato-emarginate; the sixth ventral much longer than wide, the sides nearly parallel, feebly arcuate, apex very deeply emarginate, angles prominent, obtuse, the sides carinate from apex nearly to base, middle deeply longitudinally sulcate from apex to base; last dorsal narrower but longer than last ventral, sides gradually narrowing to apex, which is subtruncately rounded with a small but distinct triangular emargination at middle, disk with deeper longitudinal sulcation at middle.

12. **Cymatodera ovipennis** Lec. Female. N. Mex.

Subfam. II. CLERINÆ.

13. **Thanasimus dubius** Fabr. Wis.

14. **Thanasimus undatulus** Say, var. *nubilis* Klug. Tenn.; Mich.; L. Sup.; Colo.

All the specimens are of the variety, which only differs from the typical form in having the elytra black (not narrowly red) at base. The Tennessee specimens are in the three examples smaller than those from the other localities.

15. Thanasimus nigriventris Lec. Wis.; Mich.; Wash.

A species of wide distribution, occurring from Ontario to Vancouver Island and southward through nearly all the States west of the Mississippi River to Mexico and Guatemala, but showing practically no variation in color and markings in specimens from all localities.

16. Clerus spinolæ Lec. Tex.; Cal.

In all the specimens in collection the postmedian spots form a broad fascia, which in one specimen is scarcely interrupted at the suture. The length varies from 7.7 to 14 mm. This is, the writer believes, the first time this species has been recorded as occurring in California.

17. Clerus rosmarus Say. Pa.

18. Clerus lunatus (Spin) Klug. N. J.; Mo.

19. Clerus quadrisignatus Say var. *laticinctus* Lec. Tex.

Six specimens, all of which are referrable to the color variety *laticinctus.*

20. Clerus quadriguttatus Oliv. *(nigripes* Say) Wis.

Nigripes is placed by Sigm. Schenkling as a distinct species. but it does not differ from *quadriguttatus* Olivier.

20a. Clerus quadriguttatus Oliv. var. *rufiventris* Spin.

Some specimens in the collection from Wis.; Mich., and Kans., belong to this variety, but in all there is a faint indication of red at base of elytra.

21. Clerus nigrifrons Say. Pa.; Neb.

This is placed as a synonym of *quadriguttatus* Oliv., by Schenkling, but, as pointed out by Mr. Chas. Schaeffer (Bull. Brooklyn Ins., I, No. 7, p. 155), *nigrifrons* is a valid species, it being more slender, the sculpture of upper surface finer and more shining and the abdomen is black, the latter being red in *quadriguttatus.*

22. Clerus analis Lec. Tex.

23. Clerus thoracicus Oliv. Pa.; Tex.

One specimen from Texas has the entire pronotum pale yellow, the head and femora pale testaceous. This may be a slightly immature specimen.

24. Clerus moestus Klug. N. Mex.; Nev.

25. Clerus sphegeus Fabr. Oreg.; N. Mex.

26. Clerus abruptus Lec. Ariz.; Tex.

The Arizona specimen is of the typical form, having the head, thorax and legs red; the Texas specimens are of the variety in which the head and thorax are black.

27. Clerus ichneumoneus Fabr. Pa.; Ohio.

28. Clerus muttkowskii sp. nov.

Similar to *ichneumoneus* in both form and color but differing as follows: Head and thorax more finely and rather more densely punctate, the latter proportionately shorter, the anterior margin sinuate, sub-apical constriction stronger, the sides behind the middle strongly convergent, nearly straight, (strongly arcuate in *ichneumoneus);* elytra more deeply punctured, black, a broad median fascia yellow, broader at flanks than at suture, margins lunate, the anterior with its convexity toward base, posterior with convexity toward apex, suture before the fascia narrowly and very obscurely testaceous nearly to the scutellum, the latter black, apical fourth clothed with dense whitish pubescence, the anterior margin deeply sinuate at suture. Length 8—10 mm.

Two specimens. Labeled "Wis.," without other data. Type in collection of the museum; cotype in collection of the author. The type has the sixth ventral segment of abdomen black, in the cotype the entire abdomen is red.

In all specimens of *icheneumoneus* the writer has seen the median fascia is rather irregular in outline and slightly prolonged posteriorly at the suture, while in the present species the fascia curves toward base as it approaches the suture. The principal character, however, relied upon for the differentiation of this species is the great difference in form of the prothorax.

Named for my friend, Mr. Richard A. Muttkowski, as a token of appreciation of many favors received.

29. **Thaneroclerus sanguineus** Say. Wis.; Colo.

30. **Trichodes bibalteatus** Lec. Tex.

31. **Trichodes apivorus** Germ. var. *interruptus* Lec. N. J.; Pa.; Tex.

Six specimens, all of which belong to the variety *interruptus,* in which the dark elytral fascia are interrupted at the suture.

32. **Trichodes nuttalli** Kirby. Wis.

33. **Trichodes ornatus** Say. Colo.; Oreg.

In only one specimen out of a series of twelve are the basal markings of elytra complete; in the others the posterior prolongation of the basal fascia is broken, the broadened portion of apex remaining as an isolated maculation near suture, midway between base and the median fascia; the other fasciæ show but little variation.

Subfam. III. PHYLLOBAENINÆ.

34. **Phylobaenus dislocatus** Say. Pa.; Wis.; Ohio.

Subfam. IV. HYDNOCERINÆ.

35. **Hydnocera unifasciata** Say. Pa.; Tex.

36. **Hydnocera subfasciata** Lec. Mont.; Wyo.; Tex.; Ariz.; Cal.

37. **Hydnocera humeralis** Say. N. J.; Mass.

37a. **Hydnocera humeralis** Say. var. *difficilis* Lec. Mass.; Pa.

This color variety is scarcely deserving of a name, no doubt being possible as to its identity with the typical form, the two being connected by intermediate forms in which the humeral maculations are of all manner of size and degree. The elytral sculpture of *humeralis* and the two forms *cyanescens* and *difficilis* is extraordinarily variable and, like the form of the thorax, gives nothing of a stable nature to enable the forms to be differentiated.

38. **Hydnocera pubescens** Lec. Tex.

39. **Hydnocera tricolor** Schaef. Tex.

40. **Hydnocera cribripennis** Fall. Ariz.

41. **Hydnocera discoidea** Lec. Ariz.

42. **Hydnocera scabra** Lec. Cal.; Ariz.

43. **Hydnocera pedalis** Lec. Wis.; Mo.

44. **Hydnocera verticalis** Say. Pa.; Tex.

This is an exceedingly variable species in coloration, and especially so in regard to head and thorax; nevertheless, in over two hundred specimens the writer has examined, not an individual has been found in which the dark occipital marking of head was wanting.

45. **Hydnocera pallipennis** Say. Wis.; Pa.; N. Y.

Also quite variable in extent of color markings.

46. **Hydnocera tricondylæ** Lec. Nebr.

Since the publication of the original description of this species sixty years ago (Ann. Lyc. Nat. Hist. N. Y., V, 1849, p. 26), nothing has appeared in print concerning it with the exception of one record of its occurrence: Mr. H. Tyler Townsend (Canad. Entom., XXVII, 1895, p. 44) records taking a specimen July 6, 1892, in Arizona (Coconini Plateau).

This species is very appropriately named, having a *facies* strikingly like that of the Cicindelid genus *Tricondyla*, this appearance being produced by the large prominent eyes, the slender form, the elytra converging toward base and the long slender legs. These characters in combination make this a very distinct and easily recognized species. It is a neat and handsomely colored insect.

47. **Hydnocera longicollis** Ziegl. Wis.; N. Y.; Can.

48. **Hydnocera tabida** Lec. Wis.; Kans.

Subfam. V. ENOPLIINÆ.

49. **Chariessa texana** Wolc. Tex. Male. Female.

Both the typical form and color variety are represented: The specimens vary in length from 11— 16 mm. The color of the elytra in the typical form is dark blue, but in some specimens of the variety nearly black, having only a very slight tinge of blue.

50. **Chariessa pilosa** Forst. Wis.; Mo.

51. **Pelonium leucophæum** Klug. (*vetusta* Spin) Tex.

52. **Pelonium granulosum** sp. nov.

General form and size of *leucophæum*, which it somewhat resembles in color and from which it differs by having the eyes more nearly approximate in front, the thorax subopaque, proportionately longer and with elevated areas wanting, the sides of prothorax anterior to the dilation nearly straight, gradually convergent to near apex, the apical angles oblique, sides behind the dilation very suddenly and strongly constricted, the dilation more remote from base, disk with a feeble longitudinal impression at middle, remote from base and not attaining the apex, surface more densely and deeply umbilicately punctate; elytra more shining, punctures coarse and deep but less sharply defined, not smaller nor wanting in a subsutural space behind the middle, apices conjointly rounded, the sutural angle rectangular, the entire insect clothed with denser, longer, coarser yellowish hairs, most conspicuous on head and thorax, color and markings nearly as in *leucophæum* but the whitish median fascia is wanting and is replaced by an irregular whitish area situate almost entirely before the middle. Length 6.4—9.7 mm.

Texas, three specimens. Type in collection of the Museum; cotype in collection of the author.

The writer was at first inclined to believe this to be merely a variety of *leucophæum*, but closer examination reveals too many points of structural difference to permit of its assignment to that species.

The coloration is practically the same as in *leucophæum*, but, as noted above, the pale fascia is wanting and is replaced by an indeterminate whitish space which is marked with several large blackish spots, the markings are otherwise similar, but more suffused in the present species; in both the type and the cotype the head has the vertex and the anterior margin of prothorax dull testaceous, in the third specimen the entire head and prothorax is dull testaceous, the peculiar sculpture gives to the elytra a granulose appearance. The elytra in this species are divergent from the humeri, while the *leucophæum* the sides at basal fourth are parallel and the elytra are equal to more than three times the length of thorax, while in *granulosum* they are but slightly more than twice as long as the thorax.

53. **Pelonium fasciatum** Lec. Cal.

54. **Pelonium mixtum** Lec. Ohio.; Tex.

55. **Pelonium oculatum** Say. Pa.

56. **Orthopleura damicornis** Fabr. Mo.

One of the specimens shows quite plainly the testaceous postmedian fascia of the color variety *pennsylvanica* Chevr., another has but a slight trace of this fascia near the flanks.

57. **Orthopleura texana** Brand. Tex.

One specimen much larger than *O. damicornis*, being 12 mm. in length, the apical margin of thorax obscurely testaceous, the antennal funicle, femora, coxæ and posterior margin of ventral abdominal segments 1—4 broadly yellowish testaceous.

58. **Enoplium quadrinotatum** Hald. Tex.

The two specimens in the collection, both males, vary slightly in markings. In one the dark occipital maculation of head is confluent with one at apex of thorax and has the rounded elytral spots very large, the posterior pair extending very nearly from the flanks to near the suture; in the other specimen the elytra markings are of normal size and the apical maculation of thorax is wanting.

Subfam. VI. CORYNETINÆ.

59. **Laricobius erichsoni** Rosenh. Mass.

The markings in this species appear to be remarkably constant, the specimens in collection varying not at all.

60. **Nebrobia ruficollis** Fabr. N. J.; Wis.

61. **Necrobia violacea** Linn. Wis.; Tex.

62. **Necrobia rufipes** De Geer. Tex.

Field Museum of Natural History.
Chicago, Illinois, Oct. 8, 1909.

SOME FURTHER REMARKS ON THE SYSTEMATIC AFFINITIES OF THE PHORIDÆ, WITH DESCRIPTIONS OF TWO NEW NORTH AMERICAN SPECIES.*

By Charles T. Brues.

In a recent paper published in the Transactions of the Entomological Society of London[1], Mr. W. Wesché has dealt with this interesting question, and as his paper is in part a criticism of my last contribution along this line[2], I think it desirable to add a few brief remarks.

Wesché has unfortunately completely misunderstood the position which I have taken in regard to the Phoridæ and Hippoboscidæ. In the paper above referred to (pp. 354 and 357) I

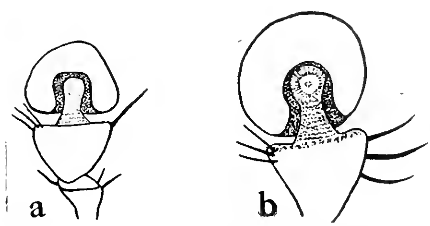

Fig. 1. a. antenna of *Borborus equinus* Fall.
b. antenna of *Lonchoptera lutea* Panz.

have called attention to many striking *resemblances* between these two families, but it is expressly stated that "these resemblances are undoubtedly the result of parallel development." It was not my intention to imply that they indicate genetic relationship, for I most emphatically believe that they do not. The undoubted recent geological development of the Hippoboscidæ and their evident adaptation to a peculiar habitat must preclude any idea that they are closely connected with the evolution of such comparatively generalized Diptera as Phoridæ. As can be seen from my

* Contributions from the entomological laboratory of the Bussey Institution, Harvard University, No. 8.

[1] For September 29, 1908, pp. 283-296, with plate VII.

[2] The Systematic Affinities of the Dipterous Family Phoridae, Biol. Bull., Vol. XII, No. 6, pp. 349-359 (May, 1907).

remarks on page 355 of the same article, this comparison was introduced simply to show what Wesché has perhaps more clearly stated when he says: "It will thus be seen that the Phorid venation is but of small assistance to the systematist, as in spite of its being so simple, striking and peculiar, it has led to very divergent opinions." This fully supports my contention that the superficial résemblance between the venation of Phoridæ, *Aspistes, Mycetophila, Scatopse, Olfersia, et al.*, is of very questionable value in tracing Phorid relationships.

Both of us seem to be in full accord in associating the Lonchopteridæ and Phoridæ, which is also the position taken by most recent dipterists. Beyond this, however, we appear to be almost completely at variance, as Wesché would assume that the Phoridæ show a closer, or at least a very close, affinity with the Dolichopodidæ.

There are indeed many resemblances between the two families, but there are also a number of wide differences which I consider quite fundamental.

As to the venation, I think there is little more to be said, for it seems quite certain that it offers but few available data. There is one point, however, on which I cannot agree with Wesché; that is in calling the nebulous thickening near the costa beyond the tip of the third vein a vestige of the apical part of the third (which he calls the second) vein. It is evidently of adventitious origin, for among Diptera it is always the case, so far as I know, that the costal vein when not encircling the entire wing, ends sharply where it meets the tip of one of the longitudinal veins, usually the third or fourth. That is to say, the point where the costa and the longitudinal vein meet may vary in different forms, but their junction always marks sharply the end of both. This makes it almost certain that this thickening in the Phoridæ is of secondary origin.

I must confess that I was mistaken in assuming that the articulation of the third antennal joint of the Phoridæ is so unique among Diptera. Wesché shows in this paper that the Dolichopodidæ have a somewhat similar arrangement, which he regards as a strong mark of affinity between them. I have therefore been led to examine the antennæ of a species of Borborus (*B. equinus* Fall.) and find, contrary to my expectations, that this species shows a closely similar method of attachment to that exhibited by the Phoridæ (Fig. 1), a fact which still further confirms my opinion that the resemblances between these two families are not superficial. The second joint shows the same bulbous enlargement which appears to contain a type of spherical sense organ similar to that in the Phorid antenna.

I have also made preparations of several specimens of *Lonchoptera lutea* Panz. and find that this species is somewhat different from the figure given by Wesché for *L. flavicauda* Meig. Particularly in dorsal view the attachment is extremely like that of *Borborus* and much more like that of the Phoridæ than the figure given in Wesché's paper. (Fig. 1.)[3] The antennæ therefore shows less similarity to those of at least some of the Dolichopodidæ than to certain Borboridæ.

Another point not touched upon by Wesché is the general form of the head, the relations of the antennæ, face and front. This character has already been pointed out by Mik in discussing the relationships of certain aberrant Phoridæ; it is quite constant among Asilidæ, Empididæ and Dolichopodidæ, the face is long, not regularly excavated for the antennæ nor sharply differentiated from the front as is the case in the Cyclorrapha, particularly the Myodaria.[4] The Phoridæ are very different in this respect from these families with which Wesché would associate them, and while the character may at first sight appear to be vague, I think it is one which is clearly defined in the mind of anyone who has devoted much time the taxonomy of Diptera.

Perhaps the absence of a ptilinum is good evidence that the Phoridæ are not descended from Muscid-like forms, but it can not be considered at all unlikely that such a character might be easily lost, especially in such minute forms where its mechanical use is probably not so great.[5]

I do not feel competent to express an opinion on Wesché's data concerning the mouthparts and genitalia, but am assured

[3] The preparations figured were made by soaking the insects for several hours in a 25% aqueous solution of Potassium hydroxide, rinsing in water and bleaching in strong Hydrogen peroxide until sufficiently transparent, after which they can be dehydrated and mounted in balsam. The evolution of oxygen bubbles caused by immersion in the peroxide serves a very useful purpose in gently distending the body, thus extruding very nicely the mouthparts, genitalia, etc.

[4] It must be admitted that some Leptidæ, e. g. *Chrysopila*, depart widely from this and remind one strikingly of Phoridæ in the form of the head.

[5] As to the assumption that the Phoridæ are predaceous, I cannot believe that they are very generally so. Most of our species feed on decaying plant or animal matter as adults; even *Phora incisuralis* Lw., one of our species with unusually chitinized proboscis, feeds normally on decaying plant tissue, caterpillar excrement, and dead insect larvæ. Even so, I do not think that such a character is of much use in determining affinities between families.

from other characters that there are many, and at least fully as great, differences between these flies and the Dolichopodidæ as between them and the Borboridæ; nevertheless I feel, as when concluding my original paper, that my negative conclusions are more acceptable than any positive ones yet put forward in regard to their relationships.

Aphiochæta smithii sp. nov.

Male. Length 1.2 mm. Black; legs brownish testaceous; knob of halteres whitish; palpi clear yellow. Head rather flat, the front subopaque or slightly pollinose; about one-fourth broader than high; median frontal groove and ocellar tubercle present. Anterior margin of front with only two distinct median proclinate bristles. Lateral bristles of lower row close to the lateral angle and very near to the anterior margin of the front; following row above straight, its bristles equidistant, but the lateral ones very close to the eye. Ocellar row as usual. Third antennal joint oval, slightly more elongate than usual, with a long, almost entirely bare arista. Probiscis retracted. Palpi of moderate size, with numerous, but rather small bristles; conspicuous by their contrasting clear yellow color. Mesonotum subshining, very much more distinctly punctate than usual, thinly hairy. One pair of dorsocentral bristles and only two marginal scutellar bristles; mesopleura bare. Abdomen opaque, the segments gradually decreasing in length, the second not elongated and without lateral tufts of bristles. Entire abdomen with very sparse, short, bristly hairs. Wings hyaline, the costal vein reaching distinctly beyond the middle of the wing; first vein ending very close to the third, its tip being fully twice as far from the humeral cross-vein as from the tip of the third; tip of second vein slightly but distinctly nearer to the tip of the third than to the first. Costal cilia quite long and closely placed. Fourth vein slightly and evenly curved; fifth sinuate, sixth more distinctly so; seventh distinct. Knob of halteres whitish. Legs slender, brownish testaceous, the four posterior coxæ and the hind femora more or less infuscated. Tibiæ destitute of distinct bristles or setulæ; the hind ones with a raised line on the upper side extending to the apical third where it divides to enclose a peculiar oval, flattened or concave area which extends to the tip of the tibiæ. Tarsi simple.

Described from two specimens reared June 21 by Professor John B. Smith from an agaric mushroom collected at Stelton, N. J., which were sent to me by Dr. E. P. Felt for determination.

The species is very distinct from any known to me, the bare hind tibiæ, with the peculiar flattened pit-like structure at the tip serving at once to distinguish it from any other so far described.

Puliciphora sylvatica sp. nov.

Male. Length 1 mm. Black, with long piceous legs and very large quite strongly infuscated wings. Head rather small and considerably flattened. Four anterior frontal bristles proclinate, slender, but unusually long. Lower lateral angles of front with a pair of reclinate bristles as usual. Row above rather strongly curved downward medially. Ocellar row long, but rather slender. Ocellar tubercle present, but no median frontal groove. Eyes faintly pubescent; postocular cilia delicate; cheeks with a small patch of rather small macrochætæ. Proboscis small, retracted; palpi very much enlarged and flattened; leaf-like, nearly as long as the head height and as broad as the eye, strongly bristly along the inferior edge near and at the apex. Antennæ of moderate size, oval with a pubescent arista. Mesonotum subshining, with one pair of dorsocentral macrochætæ and four strong scutellar bristles. Abdomen smooth, faintly shining along the sutures, with a few sparse bristly hairs scattered over its surface. Second segment elongated, but scarcely longer than the third; following growing shorter. Hypopygium not prominent, the superior lamella more strongly hairy than usual. Legs long and slender, quite thickly clothed with short, velvety pubescence, but without any external macrochætæ or bristles. Tibial spurs obsolete on all the legs. Wings very large, strongly infuscated, especially in front and along the veins. Costal vein extending to or a little beyond the middle of the wing; its cilia very short and delicate, almost obsolete. Mediastinal vein present, very distinct. Tip of first vein slightly but very appreciably closer to the humeral cross-vein than to the tip of the third. Third vein simple, not furcate or swollen at the tip and connecting closely with the tip of the costal vein; fourth vein almost straight; fifth and sixth slightly sinuate; seventh vein nearly straight, very distinct and close to the margin. Halteres pure black.

Described from a single male specimen taken from sweepings collected along a mountain stream near the base of Mount Constitution (Humid transition area), Orcas Island, San Juan Co., Washington, during July, 1908.

No doubt the female is wingless like those of other species of the genus, and as the male is unusually large, it must be a very striking form.

This is a very extraordinary species, and I cannot be positive that it is correctly placed in the present genus. It is apparently closely related to some East Indian species of *Puliciphora* (*P. pulex* Dahl and *P. lucifera* Dahl), but unfortunately these are imperfectly known. The enlarged palpi are unique in the genus so far as I know, although similarly swollen palpi are of occasional occurrence in *Phora* and *Aphiochæta*. The venation and frontal chætotaxy, however, exclude it from either of these genera and from *Hypocera* as well. It is undoubtedly a very interesting addition to our fauna.

UEBER DAS ZIRPEN DER RAUPEN.

By William Reiff.

Es ist eine allgemein bekannte Tatsache, dass eine grosse Anzahl Insekten existiert, die bei verschiedenen Gelegenheiten Töne erzeugen können. In den meisten Fällen waren es Arten aus den Gruppen der Orthoptera, Coleoptera und Homoptera, welche durch ihr Zirpen, Zischen oder Pfeifen die Aufmerksamkeit der Menschen erregten. Alles was zu diesem interessanten Capitel je geschrieben worden ist, hat Dr. Oskar Prochnow, Wendisch-Buchholz (Deutschland) zu einem wertvollen Aufsatz über die "Lautapparate der Insekten" zusammengefasst und diese Arbeit als einen Beitrag zur Zoophysik und Descendenz-Theorie im Jahr 1907 in der "Internationalen Entomologischen Zeitschrift" Guben Vol. 1 veröffentlicht. Auf p. 229 gibt der Verfasser bekannt, was über zirpende Raupen bisher beobachtet worden ist. Nur wenige Einzelheiten sind aus diesem Gebiete im Verhältnis zu den andern Insekten in die Öffentlichkeit gelangt. Prochnow führt Raupen von acht Arten auf, welche fähig sind, Töne zu erzeugen. Am bekanntesten ist der Ton der *Acherontia atropos*-Raupe, die bei Berührung einen pfeifenden Laut hören lässt. Ausserdem sind Töne vernommen worden bei folgenden Raupen aus der Familie der Saturniidae: *Samia cecropia, Telea polyphemus, Saturnia pyri, Antheraea yamamai, Antheraea pernyi* und *Rhodia fugax*. Aus der grossen Familie der Sphingidae führt der Verfasser neben der *Acherontia atropos*-Raupe nur noch die Raupe der nordamerikanischen *Cressonia juglandis* Abb. & Sm. auf, welche gemäss einer kurzen Mitteilung in der "Insekten-Börse" 1897 (Vol. 14, No. 3, p. 16) im erwachsenen Zustande beim Berühren ein Zirpen hören lässt. Prochnow hält den von dieser Raupe erzeugten Ton identisch mit dem des zur Familie der Chrysomelidæ gehörigen Käfers *Lema trilineata* Oliv. Wie der Verfasser auf Grund verschiedener Untersuchungen mitteilt, erzeugen Raupen einen Ton dadurch, das sie den Kopf blitzschnell in das erste Thoracalsegment zurückziehen und dabei die Haut an dem stark chitinisierten Halsschild reiben.

Ich habe im September 1908 öfters Gelegenheit gehabt, *Cressonia juglandis*-Raupen zu beobachten. Den Ton, welchen diese

Raupen erzeugen, möchte ich eher mit einem kurz abgebrochenen scharfen Zirpen der gemeinen Grille (*Gryllus pennsylvanicus* Burm.) vergleichen, nur hat der Ton ungefähr ein Drittel der Stärke. Die Zeitdauer desselben beträgt circa drei viertel Secunden. Schon die ganz junge Raupe vermag diesen Ton hervorzubringen, der mit dem Weiterwachsen des Tieres nur ein Geringes an Kraft gewinnt, und bei der ausgewachsenen Raupe sich kaum nennenswert vertieft. Dieser Ton ist nur zu hören, wenn die Raupe irgendwie berührt wird; auch muss die Berührung so stark sein, dass durch dieselbe ein wenigstens geringer Druck erzeugt wird. Es ist mir nicht gelungen, die Raupe den Ton erzeugen zu hören, so lange sie sich in Bewegung befand. Immer konnte das Zirpen erst dann wahrgenommen werden, nachdem das Tier in seiner Wanderung inne gehalten hatte. Die Enstehung der Tones ist dieselbe, wie sie Prochnow gemäss seiner Untersuchungen angibt. Die Raupe zieht den Kopf blitzschnell in das erste Thoracalsegment zurück, infolge dessen die Haut sich scharf an dem stark chitinisierten Halsschild reibt und durch diese Reibung den Ton hervorbringt. Ausserdem krümmt die juglandis-Raupe noch dabei ein wenig ihren Rücken. Ferner bewegt diese Raupe auch die Fresswerkzeuge im Moment der Tonerzeuzung, doch dürfte dies wohl mit der Entstehung des Tones nichts zu tun haben, sondern vielmehr nur als eine Trutzstellungsmassregel zu betrachten sein. Entgegen der von Prochnow genau untersuchten Raupe von *Rhodia fugax,* welche nach Erzeugung des Tones den Kopf eingezogen behält und demgemäss einen zweiten Ton sobald nicht hervorzubringen vermag, bringt die juglandis-Raupe den Kopf gleich nach dem Verklingen des Tones in die normale Lage zurück. Sie ist daher im Stande, jeden beliebigen Augenblick das Zirpen zu erzeugen. Während ausserdem auch die fugax-Raupe nach vollzogener Stridulation—wenn man diesen Ausdruck gelten lassen darf—verkürzt erscheint, ist eine Verkürzung bei der Raupe von juglandis nicht wahrzunehmen.

Zweifellos könnte durch weitere Beobachtungen die Liste der "musikalischen Raupen" vergrössert werden. Es wären solche Feststellungen nicht nur vom entomologischen Standpunkt aus von Interesse, sondern es wäre auch—um Prochnow's Worte anzuführen—für die Wertung der Tierstimmen von hoher Bedeutung, zu wissen, dass es Raupen gibt, die bei bestimmten Bewegungen bestimmte Töne erzeugen.

Bussey Institution, Harvard University.
October 17, 1909.

A PRELIMINARY LIST OF THE PROCTOTRYPOID HYMENOPTERA OF WASHINGTON, WITH DESCRIPTIONS OF NEW SPECIES.*

By Charles T. Brues.

On account of its large extent and varied life conditions, the State of Washington supports an unusually interesting fauna. So far it has received but scant attention from entomologists in comparison to that which has been bestowed upon most other parts of the United States, and it offers an almost virgin field for the student of many groups of insects. During a part of the past summer I had the good fortune to enjoy the hospitality of the Puget Sound Marine Station, located among the islands of Puget Sound in the extreme northwestern part of the state. While there I had the opportunity, through the kindness of my friend, Professor A. L. Melander, to examine a collection of parasitic Hymenoptera, obtained principally in the country surrounding the site of the laboratory and on the slope of a nearby mountain about 2,500 feet in height.

I have worked over only the material representing the superfamily Proctotrypoidea, and although it contains but a small number of species from a very restricted region, it nevertheless more than trebles the number of recorded forms of this group known from the state. I have therefore included for mere convenience such other records as I have been able to gather from published and other sources relating to Washington.

The Proctotrypoidea will undoubtedly be found to be well represented in the state when carefully collected, especially in the Humid Transition Area, where the present material was obtained. One genus, *Proctotrypes*, seems indeed to reach its highest development there, to judge from the extensive series of species which are contained in the collection.

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* Contributions from the entomological laboratory of the Bussey Institution, Harvard University, No. 9.

Family PROCTOTRYPIDÆ.

Proctotrypes Latreille.

The seven species which are so far known from the state may be separated by the aid of the following key:

1. Head quadrate or longer than broad........................ **2**
   Head strongly transverse.................................. **3**
2. Head quadrate when seen from above..........**femoratus Ashm.**
   Head considerably longer than wide..........**angusticeps sp. nov.**
3. Antennae of male with simple joints, not dentate or toothed.. **6**
   Antennae of male with some of the basal flagellar joints toothed or dentate above.............................. **4**
4. First five, six or seven joints of male flagellum dentate...... **5**
   First joint of male flagellum simple; cylindrical; joints 2-8 dentate ....**placidus** sp nov.
5. Legs ferruginous; tooth on first flagellar joint conspicuous. **serricornis** sp. nov.
   Legs much infuscated; tooth on first flagellar joint not prominent, but nevertheless present..............**obscuripes** sp. nov.
6. Body entirely black..........................**simplicior** sp. nov.
   Second abdominal segment almost entirely red. **terminalis** Ashm.

Proctotrypes femoratus Ashm.

Ashmead, Bull. U. S. Nat. Mus., No. 45, p. 344 (1893).

I have seen two specimens, both from Orcas Island, San Juan Co., one collected on the slope of Mount Constitution. The species was originally described from Wyoming.

Proctotrypes terminalis Ashm.

Ashmead, Bull. U. S. Nat. Mus., No. 45, p. 377 (1893).

Kieffer, Berliner Entom. Zeitschr., Vol. 50, p. 276 (1905).

Several years ago I received a specimen of this species from Mr. H. L. Viereck bearing the label "Washington Territory, A. E. S. Collection."

Proctotrypes angusticeps sp. nov.

Female. Length 2.5 mm. Shining black, the legs and base of antennæ pale yellowish brown. Head very long antero-posteriorly, over one-third longer then wide when viewed from above. When seen from the side it is nearly triangular, with the face very strongly reflexed. Vertex and front above antennæ smooth and highly polished. Face long, gradually narrowed below, its surface faintly punctulate. Eyes small, round, bare; separated from the posterior margin of the head by more than their own diameter. Ocelli in a triangle, the median one farther anterior to the lateral ones than the distance separating these from each other. Mandibles and palpi ferruginous. Antennæ 13-jointed, as long as the head and thorax, and much thickened. Scape stout, about two and one-half times as long as thick; pedicel minute; first and second flagellar joints of equal length, about twice as long as thick, and each three-fourths as long as the scape; following joints growing shorter, after the sixth quadrate, the last longer, acute at the tip; in color they are ferruginous at the base, shading into black near the middle of the flagellum. Thorax unusually narrow, metanotum and scutellum smooth, polished; the latter with a depression across the base, and more strongly elevated medially than is usual. Metanotum slightly longer than high, rather abruptly declivous behind; its surface finely rugose, above with a faint median carina, not extending on to the posterior slope, surrounded by a more nearly smooth area. Pro- and mesopleuræ polished, smooth; tegulæ testaceous. Abdomen shining black; petiole rugose, broader then long; second segment striate only at the extreme base. Cauda short, scarcely longer than the hind metatarsus, with an unusually slender, acute tip. Legs yellowish brown; hind coxæ black; inner spur of hind tibia one-third the length of the metatarsus. Wings hyaline, with no indications of discoidal veins; stigma piceous; marginal cell one-half as long as the stigma; radial vein fuscous.

Described from one female specimen collected on the slope of Mount Constitution on Orcas Island, San Juan Co., Wash.

The head is more elongate in this species than in any other member of the genus which I know. It approaches most closely to two Canadian species described by Ashmead, *longiceps* and *canadensis*, but can be readily recognized by the shorter antennal joints, longer head, and different metathoracic characters.

Proctotrypes placidus sp. nov.

Male. Length 6 mm. Smooth, black, highly polished; legs except base of coxæ ferruginous. Wings slightly infuscated. Head transverse, twice as broad as long. Vertex and front shining, impunctate; between the antennæ with a median raised line which extends almost to the clypeus. Face faintly punctulate with a longitudinal depression on each side of the median elevation. Eyes oval, bare, broader than the temples. Ocelli in a triangle which is much broader than high. Mandibles and palpi fuscous. Cheeks impunctate. Antennæ 13-jointed, considerably longer than the head and thorax together; stout, entirely black, joints 2-8 of flagellum each with a tooth-like projection at the middle of the upper side. Scape stout, twice as long as thick, pedicel minute; first flagellar joint about four times as long as thick, not dentate or toothed; second and each following joint somewhat shorter, but very slightly so, and gradually more slender; last joint very little longer than the penultimate. very slender with acute apex. Mesonotum shining slightly fuscous pubescent like the head. Scutellum broad, evenly convex, with a transverse depression at the base. Metathorax nearly twice as long as high; angulate, not curved at the upper edge of the posterior slope when seen in profile; its surface entirely coarsely rugose-reticulate, except above where a large shield-shaped much smoother area is formed by two lateral carinæ which meet behind. This area is divided by the usual median carina which however does not continue on the posterior slope. Pro and mesopleuræ smooth; polished; tegulæ ferruginous. Abdomen as long as the head and thorax; petiole as long as broad, coarsely fluted; second segment with a few coarse deep striæ at the base; apical spines black. Legs bright ferruginous except the bases of the coxæ which are black, especially on the posterior pair. Femora slender, inner spur of posterior tibia not quite one-half as long as the metatarsus; all tarsal claws simple. Wings quite distinctly infuscated, with the discoidal veins very distinctly indicated by brownish streaks; stigma, except upper half, and radial vein very dark fuscous; marginal cell petiolated, less than one half as long as the stigma.

Described from a male collected on Mount Constitution, Orcas Island, San Juan Co., Wash., July 31, 1908 (A. L. Melander).

Allied to *californicus* Holm, but separable from this and other species with dentate flagellar joints by the large divided shield-shaped area on the metathorax.

Proctotrypes obscuripes sp. nov.

Male. Length 4 mm. Entirely black, with the base and tips of the femora and part of the tibiæ and tarsi honey-yellow. Head transverse, barely twice as wide as thick, its surface smooth and polished except for a faint punctulation on the face. Front between the antennæ with a short median carina which extends tor a slight distance down the front. Eyes oval, bare; ocelli in a broad, transverse triangle. Antennæ 13-jointed, entirely black; distinctly longer than the head and thorax. Scape twice as long as thick, shorter than the first flagellar joint; second a little shorter than the first; following subequal but very gradually shortening; apical joint longer. First five flagellar joints dentate above, also sometimes less distinctly so to the sixth and seventh. Mandibles piceous, palpi fuscous. Mesonotum shining, with sparse pale grayish pubescence. Scutellum sharply convex, with a transverse depression at its base. Metathorax finely rugose reticulate, with a median carina extending entirely to the tip; above with a smoother space, but without any lateral carinæ. Metathorax, viewed from the side, about one-half longer than high and evenly arcuate above. Pro and mesopleuræ smooth and shining. Tegulæ ferruginous. Abdomen shining black; petiole a little broader than long, longitudinally fluted; second segment with a few coarse striæ at the base, longer medially. Spines at tip of abdomen black. Legs, including coxæ, black or piceous; bases and tips of femora and tibiæ, except darkened spot medially, honey-yellow. Wings hyaline, without trace of any discoidal veins; stigma and nervures piceous, marginal cell petiolated, one-third the length of the stigma.

Described from two males collected on the islands in Puget Sound, Wash., one on the slope of Mount Constitution on Orcas Island.

This species is most closely related to the following species, from which it may be most easily separated by the different color of the legs.

Proctotrypes serricornis sp. nov.

Male. Length 4.5 mm. Entirely black; legs, except coxæ, ferruginous. Head transverse, not quite twice as broad as thick, quite strongly narrowed on the temples behind the eyes. Front with a slight median carina between the antennæ. Surface of the head smooth, except the face which is punctulate and furnished with a median longitudinally convex central elevation, on each side of which at the base of clypeus are two unusually well pronounced foveæ. Mandibles and palpi piceous. Eyes bare, oval, separated by less than their diameter from the posterior margin of the head; ocelli in a small, transverse triangle. Antennæ three-fourths the length of the body rather thickened basally, 13-jointed; basal eight joints of the flagellum each with a sharp tooth above, and the ninth with a less distinct one. Scape scarcely twice as long as broad and quite distinctly shorter than the first flagellar joint; following flagellar joints very slightly decreasing in length more distinctly so near the base; apical joint nearly one-half longer than the penultimate; the first joint about three times as long as thick at the apex and the second about the same. Thorax rather slender, especially in front: mesonotum shining, very slightly pilose; scutellum strongly convex, the transverse depression at its base broad and deep. Metathorax nearly twice as long as high, sharply rounded behind; its surface coarsely rugose reticulate; with a smoother space above near the base; median carina very short, a lateral one on each side indicated at the extreme base. Pleuræ smooth and shining; mesopleura behind with a crenate margin. Tegulæ dark ferruginous. Abdomen as long as the head and thorax; petiole coarsely longitudinally striated; second segment with a row of very short striæ or pits at the base; apical abdominal spines large, black. Legs slender, ferruginous, the four posterior coxæ, and the base of the anterior ones black. Inner spur of posterior tibia one-half the length of the slender metatarsus. All tarsal claws simple. Wings subhyaline, slightly brownish, with faint traces of discoidal veins. Stigma and veins piceous, the marginal cell scarcely one-fourth the length of the stigma.

Three specimens, two from the slope of Mount Constitution on Orcas Island, San Juan Co., Wash., and the other from one of the islands in Puget Sound without further data. All were collected during July.

This species is distinguishable by its dentate first flagellar joint and by metathoracic characters.

Proctotrypes simplicior sp. nov.

Male. Length 2.5—3.5 mm. Black, legs except coxæ reddish yellow or dull ferruginous. Head transverse, two and one-fourth times as wide as thick; smooth and shining black, but quite noticeably pubescent. Front with a very slight short carina between the antennæ; face evenly and but little convex. Mandibles and palpi piceous. Eyes bare; oval, separated by their own width from the posterior margin of the head. Antennæ 13-jointed, about four-fifths as long as the body; filiform, none of the flagellar joints toothed or dentate; scape much narrowed basally, twice as long as thick at apex; flagellar joints long cylindrical and gradually decreasing in length to the penultimate, all of the joints between four and five times as long as thick; last joint one-third longer than the penultimate. Mesonotum elongate, very strongly narrowed anteriorly. Scutellum very highly convex, with a deep broad depression at its base. Metathorax one-half longer than high; finely rugose-reticulate; above smoother centrally near the base, with a median carina which extends nearly to the insertion of the abdominal petiole. In profile the metathorax is arcuate above, more sharply bent at the upper part of the posterior slope. Pleuræ shining black; tegulæ brown. Abdomen nearly as long as the head and thorax; petiole as broad as long, finely rugose; base of second segment with a series of extremely short, more or less irregular longitudinal grooves or pits; remainder of abdomen shining black; the apical spines prominent, black. Legs reddish yellow or dull ferruginous; the coxæ black, except the tips of the four anterior ones; femora slender; claws simple; inner spur of hind tibia not quite half as long as the metatarsus. Wings hyaline, without trace or with scarcely distinguishable discoidal veins; stigma piceous, three times as long as the petiolate marginal cell.

Six specimens, all from the Puget Sound region; three collected on the slope of Mount Constitution on Orcas Island, San Juan Co., Wash.

This species approaches most closely the common eastern *P. abruptus* Say., differing by its longer antennæ, composed of much more elongate joints, and its entirely different metathoracic sculpture.

Family BELYTIDÆ.

Scorpioteleia mirabilis Ashm.

Ashmead, Canad. Entom., Vol. 29, p. 53 (1897).

Orcas Island, San Juan, Co., Wash. This most extraordinary genus was first described from Ottawa, Canada, and I have collected it also at Milwaukee, Wisconsin.

Ismarus nevadensis Kieff.

Kieffer, Berliner Entom. Zeitschr., Vol. 50, p. 276 (1905).

There is a single specimen of this species recently described by Kieffer from Nevada. It was collected on one of the islands in Puget Sound during July, 1908. The genus occurs also in Europe, but so far has not been detected in the Eastern United States.

Belyta rostrata Harr.

Harrington, Trans. Royal Soc. Canada, Section 4, p. 196 (1899).

There is a male from Mount Constitution, Orcas Island, which I think, without doubt, is cospecific with the male described by Harrington from Quebec as *Belyta rostrata.*

There are at least six other species of Belytidæ from the Puget Sound region, but owing to the almost chaotic condition of many of the genera of this family I have not been able to identify them satisfactorily.

Family DIAPRIIDÆ.

Trichopria sp.

There is a male, probably representing an undescribed species in this genus, collected on the slope of Mount Constitution on Orcas Island, in Puget Sound.

Family CERAPHRONIDÆ.

Ceraphron glabricornis Kieff.

Kieffer, Berliner Entom. Zeitschr., Vol., 50, p. 260 (1905).

This species was originally described from specimens taken at Ormsby, Nevada. There is one specimen from Mount Constitution, on Orcas Island, San Juan Co., Wash.

Megaspilus ottawensis Ashm.

Ashmead, Canadian Entom., Vol. 20, p. 149 (1888).

Ashmead, Bull. U. S. N. M., No. 45, p. 117 (1893).

Harrington, Trans. Royal Soc. Canada, Sec. 4, p. 178 (1889).

I have seen two female specimens which appear identical with others that I have taken, at Woods Hole, Mass., on the Atlantic Coast. The species thus evidently extends entirely across the continent.

Megaspilus orcasensis sp. nov.

Male. Length 2 mm. Entirely black, except the legs including the coxæ, which are brownish yellow. Head nearly twice as broad as thick, its surface shagreened and semi-opaque except for a small rounded polished median spot just above the base of the antennæ; above the ocelli with a short median impressed line. Eyes oval, nearly circular in outline, pubescent. Ocelli in a triangle, the lateral ones slightly nearer to the eye margin than to the median ocellus. Mandibles and palpi pale brownish. Antennæ 11-jointed, as long as the body and gradually becoming more slender toward the apex. Scape three times as long as thick at the apex, slightly curved; pedicel minute, obovate; first flagellar joint four times as long as thick, all the following joints including the last more slender and very slightly shorter. Mesonotum elongate, slightly narrowed anteriorly, its surface shagreened and subopaque; with three furrows which converge posteriorly and meet an impressed line at the posterior margin; axillæ barely meeting medially. Scutellum nearly as long as the mesonotum, narrow, convex; its surface shagreened. Metathorax very short, rugose. Pleuræ nearly smooth; the mesopleura anteriorly with a row of large punctures. Abdomen somewhat longer than tne thorax; slightly convex above, but strongly so below when seen in profile. First segment rugose, extremely short; second twice as long as the remaining ones together; with a raised basal rim or margin and a series of short basal longitudinal striæ; following all very short; apical projecting appendage yellow. Legs brownish-yellow; the coxæ and the anterior legs lighter than the four posterior legs which are more nearly rufous. Wings infuscated, stigma piceous; two-thirds as long as the radial vein.

One specimen from one of the islands in Puget Sound, Wash., collected during July, 1908.

The species is distinguished from others in our fauna by the subopaque body, nearly equal flagellar joints and the color of the legs with lighter coxæ.

Lygocerus constrictus sp. nov.

Male. Length 1.2—1.4. mm. Black, the legs except the basal part of the coxæ brownish yellow; wings slightly infuscated. Head strongly transverse, nearly three times as wide as thick; front subshining, faintly punctate. Eyes nearly circular in outline, faintly pubescent. Ocelli in a broad triangle, the lateral ones equally distant from the eye-margin and the median ocellus. Face strongly convex centrally. Mandibles piceous, palpi pale brown. Antennæ 11-jointed, entirely black except the extreme base of the scape which is pale. Scape elongate, slender, about four times as long as thick; pedicel small; first seven flagellar joints with long sparse black hairs and dentate at the outer apical angle; the base of each constricted to a very thin pedicel which is as long as the joints near the base, but gradually grows shorter to the seventh joint after which it is not present. First flagellar joint scarcely twice as long as thick; second to fourth about quadrate; fifth one-half longer than thick; sixth twice as long as thick; following becoming more elongated. Mesonotum about as broad as long and scarcely narrowed in front; its surface subopaque and faintly punctulate: with three furrows which converge toward the posterior margin where they meet the narrow impressed line at the base of the axillæ. Axillæ meeting narrowly on the median line. Scutellum broad, not very strongly convex. Metathorax very short rugose. Pleuræ smooth, polished; mesopleura with a curved series of punctures at its upper anterior angle. Abdomen as long as the thorax, more strongly convex below than above; petiole very short; second segment occupying nearly two-thirds of the surface of the abdomen, basally with a raised rim or margin and an extremely short series of basal pits or striæ. Apical segments all very short; tip of abdomen piceous. Legs brownish yellow, the posterior coxæ infuscated except at their tips. Wings nearly hyaline, stigma fuscous, oval; two thirds as long as the radial vein.

Three specimens, two from the slope of Mount Constitution and the other from one of the islands in Puget Sound, without more definite data.

The present species appears to be most closely related to *L. picipes,* but differs decidedly from a male of this species which I have from the East, by its much more strongly dentate antennæ.

The following table will aid in separating the North American species of *Lygocerus.*

KEY TO THE SPECIES OF LYGOCERUS.

1.	Males	2
	Females	9
2.	Antennæ with the first seven joints ramose; legs entirely reddish yellow ....**floridanus** Ashm.	
	Antennæ serrate or toothed on the basal joints..............	3
3.	Flagellar joints, 1-5 or 6 dentate..............................	4
	Flagellar joints, 1-7 dentate..................................	8

4. Legs, including coxæ yellow................**pallipes,** Harrington.
   Legs, black or brown in great part......................... 5
5. First flagellar joint twice as long as thick........**stigmatus** Say.
5. First flagellar joint scarcely as long as thick................ 6
6. Stigmal vein distinctly longer than the stigma.............. 7
   Stigmal vein not longer than the stigma........**californicus** Ashm.
7. Sixth flagellar joint dentate..................**6-dentatus** Ashm.
   Sixth flagellar joint not dentate..................**picipes** Ashm.
8. First flagellar joint 2½ times as long as thick.....**niger** Howard.
   First flagellar joint scarcely twice as long as thick.
   constrictus Brues.
9. Legs, including all coxæ, reddish yellow........**floridanus** Ashm.
   Legs in part, or at least the hind coxæ black............... 10
10. Pedicel as long or longer than the first flagellar joint........ 11
    Pedicel distinctly shorter than the first flagellar joint...... 13
11. Antennæ entirely black or brown........................... 12
    Antennæ black, scape brownish yellow below; legs pale brownish ....**picipes** Ashm.
12. Legs black, lighter on the knees, anterior tibiæ and all tarsi.
    stigmatus Say.
    Legs brownish yellow........................**6-dentatus** Ashm.
13. Legs including coxæ, yellow................**pallipes** Harrington.
    At least the coxæ black.................................. 14
14. Legs except coxæ, brownish yellow..............**pacificus** Ashm.
    Legs of prevailing black color............................ 15
15. Scape of antennæ as long as the three following joints taken together ....**alaskensis** Ashm.
    Scape longer than the three following joints.......**niger** Howard.

Family SCELIONIDÆ.

Telenomus heracleicola Brues.

Brues, Bull. Wisconsin Nat. Hist. Soc., Vol. 4, p. 148 (1906).

Pullman, Wash. This is the type locality.

Hoplogryon tenuicornis Kieff.

Kieffer, Berliner Entom. Zeitschr, Vol. 50, p. 263 (1905).

There are two specimens, one from Mount Constitution on Orcas Island, and the other from one of the other islands in Puget

Sound, which apparently belong to this species, originally described from Nevada.

Sparaison nigrum Ashm.

Ashmead, Bull. U. S. N. M., No. 45, p. 238 (1893).

"Washington." Ashmead cites Nevada and Washington as type localities, without further data.

EPIDEMIC OF SILVER MAPLE LEAF-MITE.
PHYLLOCOPTES (ERIOPHYES) QUADRIPES SHIMER.

By Alfred C. Burrill.

The silver maple *(Acer saccharinum)* shade trees along the streets of Whitefish Bay, Wis., a suburb north of Milwaukee, were plagued this summer with an unusual abundance of the Bladder Maple Gall. It is made by the invisible mite known in literature as *Eriophyes (Phytoptus) quadripes* Shimer, the material having been identified for me through the kindness of Wm. Beutenmüller, Entomologist of the American Museum, New York City.

In answer to the queries of residents along Day Avenue, Whitefish Bay, I looked up the literature for remedies, relying on Dr. E. P. Felt's "Insects Affecting Park and Woodland Trees," which gives a very good description, Vol. 2, pp. 630-1. The colored plate I. fig. 11, however, shows galls of a slightly different form from those common at the Bay. As this account gave no literature or remedial measures, I wrote Dr. Felt, who most kindly furnished me with eleven references, to six of which I had access, and these mostly very meagre accounts.

GREAT DISFIGUREMENT BUT SLIGHT DAMAGE.

Prof. H. Garman also kindly wrote me, "The mite is common in the Mississippi Valley, and is sometimes very abundant on the leaves of the soft maple, though I have never known it to occasion very serious harm to the trees. Like other insects, I suppose it may do some local mischief, though commonly not to be feared." Dr. Felt's 1906 account states, p. 630: "This trouble is sometimes exceedingly prevalent in the vicinity of Albany, the galls being so numerous on certain trees as to disfigure a very considerable proportion of the foliage."

The descriptions of the galls by the various writers show a variation from discoidal to spherical, with slightly constricted neck approaching to top-shaped forms, beginning as a green swelling on the dorsal surface of the leaf, and changing through varying shades of pink and purple but chiefly red or green, to black or seldom dark brown when they are greatly shrivelled, hardened and distorted,—with which my observations agree. The young gall has a smooth interior, but fills with granular or smoothly bulging excrescences until, with the shrivelling of the old gall, the cavity is nearly filled. There may be from one to over a hundred galls per leaf, but I unfortunately did not see several hundred as reported by Banks (1905), Garman (1882), or several thousand as stated by Shimer (1869).

The best redescription of the mite is given by Parrott (1908), with which my microscopic examination agrees except that I had only September-October material to examine. Parrott here changes the generic name to *Phyllocoptes* and enters into their life history.

As is so usual with gall insects, I noticed a very wide difference in gall distribution on the trees. One or two healthy trees near the Chicago & Northwestern R. R. track were almost free from galls, as I found but one or two leaves with a gall or two apiece. Others, especially the smaller trees, were infested from top to bottom of the crown, a few small leaves being so thoroughly covered as to be crumpled all out of shape. As these trees probably represent only two separate plantings when Day Avenue was first laid out, the smaller trees of each planting undoubtedly represent the less thrifty, perhaps unhealthy specimens, these being worst affected with galls. Again, of two trees of equal and thrifty proportions, one would have a few branches, usually the lower, slightly infested with a few galls on some leaves, and the other have a whole branch or all the lower branches, especially on the sunny side of the tree, thoroughly infested with one to mostly many galls per leaf, and seldom a leaf on the whole branch uninfested. On the better trees, no shrivelling or dwarfing of the leaf appears; so that the chief disfigurement of the tree seems to be the dirty variegated speckling of the leaves by the galls.

HABITS VS. REMEDIAL MEASURES.

Parrott (1908) says that the winter quarters of this common and widely distributed species "seems not to have been determined. While occasionally a specimen may be found in hiding under a bud scale, the buds generally harbor only a very few, which represents but an exceedingly small fraction of the mites that have been produced for that season on the tree." I examined several buds, in fact whole leaf sprays, all over under the microscope to see if any were crawling about in early October, but found none. Then I tested gall-covered leaves fallen to the ground within a few days,—some of the galled leaves ripening among the first and others hanging on with the last perfect leaves, in fairly equal proportions; also kept fresh leaves two or three days on my desk till they were quite dry and shrivelled up. No mites were thus forced out. On opening the galls, I found their occupants quite alive. Is this not the key to preventive measures? If the mites of the last generations of the season prove quite generally to stay in the galls, burning the leaves from time to time as they fall in October will certainly reduce the numbers.

There are two series of observations which throw doubt on the complete efficacy of this measure,—the observations of Parrott (1908) on their migration, and the other, the possibility of natural parasites, as indicated by my observations. If there are parasites to destroy them sufficiently, no further measure may be needed.

Quoting Parrott first: "Shimer, 1869, suggested that it is probable that they pass the winter, perhaps in the egg stage, on the ground around the tree, and in early spring ascend the trunk. Our observations on the hibernating habits of these mites *(P. quadripes* and *P. aceris-crumena)* show that they seek protection just under the loose edges of the bark, about the stubbed ends of broken twigs and limbs, and about scars of wounds caused by hail and other agencies. For the past two years, the beginning of the migration of these mites from the leaves to hibernating quarters occurred on July 12 and 10, respectively. On badly infested trees, the mites have been seen assembled in such large numbers on portions of the tree as to give a very distinct reddish tinge to the bark. The mites are only to be found in scattering numbers on the trunks of the trees near the ground. If it should become desirable to spray for these mites, protection could unquestionably be obtained, by the thorough treatment of the trees with an efficient contact insecticide when the mites are migrating in their largest numbers on the bark, or when they are established in their winter quarters."

Though not having seen such a migration myself, I have no doubt that their traveling powers are great and for a creature so tiny, .008 of an inch long, very fast, one traveling so fast from end to end of the glass slide on my microscope that two of us frequently lost track of her. But they show no such speed until they have had a little time to get over their sluggishness, as found in newly opened galls. Perhaps daylight awakens their migratory speed. Lintner (1888) recommends burning infested leaves in June, but in trees so badly infested, this would be more serious for the tree than for the mites; for the leaves seldom falling in June, would have to be completely burned off many trees. This migration is peculiar, as the mites are quite generally in their galls in October, unless this migration be of a distinct, earlier generation. In that case, the final whereabouts of the July migration complicates any remedial measure short of the expensive spraying for that migration, as suggested by Parrott. Although I discovered the mite infested region July 6, it was not until middle August when I moved into the region and had a little time to study them, so cannot say if there were a July migration here.

NATURAL ENEMIES.

As to natural enemies, Dr. Felt wrote me, Oct. 11, "I fear there are comparatively few records dealing with its natural enemies." None are mentioned in the authors available to me.

In August, I thought I saw a tiny worm within an opened gall I was examining, violently jerking himself as if disturbed by my intrusion. I carefully preserved this till I could show it to C. T. Brues next day. He examined with his microscope without finding anything. We opened about fifty fresh galls on different occasions without result. In October, however, I found two worms in galls on the same leaf. They had mite exuviæ sticking to them here and there on all parts, but no hostile attitude towards living mites could be proved. They were of a light almost transparent amber color with brownish central interior mass about midway the length, and while shiny were slightly papillate. On removal to a tiny vial with cotton plug, with fresh galls cut open and living mites, they showed no ability to crawl,—merely squirmed and dried up in a day. This probably happened to the first specimen lost. Further evidence showed that although in contact with the galls, they stuck to the glass and kept their shape, though slightly contracted.

Despite the gall has been described as smooth in the interior, in most of the galls turned black and dry there was evidence of loose trichomes, but in some, fungus filaments. In many of them, living salmon-colored mites existed, but most had dead bodies still salmon-colored and amidst the fungus; and, in two cases, the filaments of fungus had apparently borne the dead mite out into the cavity, whether wrapped about it I could not tell. All the fungus was shrivelled. This may prove a chief parasite of the mite both in the trees and perhaps in the leaves on the ground. A tuft of hairs closes the gall opening on the ventral surface of the leaf and it would be easy to mistake, in sections, the shrivelled trichomes for old fungus, were it not for the webbed character of the fungus. On this point Cook (1902, p. 265) says: "Trichomes are always found extending from the walls of the cavity (figs. 8-11) of young galls, but disappear as the galls approach maturity." Describing the histology of these galls in 1904, he speaks of the growing of "convolutions of the parts as in the case of—*Phytoptus quadripes* (figs. 10, 43)—" which "result in the formation of a more or less well defined cavity, and trichomes are developed in great abundance in the younger stages." The frequent interruption of regular lecture work prevented completion of this study before I moved away from this region, and before I could save material for submission to others for identification of fungus. As shown, the worm was not common, but the fungus was sufficiently so to suggest its possible value as a parasite. However, the restatement of the facts about this species should point out to others the gaps in our knowledge, the filling in of which may yet lead to an inexpensive treatment of the beautiful and ornamental silver maple.

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October 22, 1909.

BRIEFER ARTICLES.

PINE-CONE WILLOW GALL ABUNDANT.

BY ALFRED C. BURRILL.

There is marked abundance of the Pine-Cone Willow Gall (*Cecidomyia strobiloides* O. S.) in the region west of Milwaukee. On a 236-mile ride on horseback through the counties of Milwaukee, Waukesha, Dodge, Green Lake, as far as Marquette, it seemed as if no considerable group of roadside willows had escaped the work of this Cecidomyid, especially in brook valleys where the willows most occur. Several times I noted that nearly every other twig bore a gall, equalling the remarkable picture of these willow galls published by Dr. M. T. Cook in his "Insect Galls of Indiana" (Ind. Dept. Geol. & Nat. Res. 29th Ann. Rep. 1904, p. 84, fig. 33), and surpassing any occurrence I have noted in tramps about New York or points in Maine, Massachusetts or Pennsylvania.

GRAPE-VINE FILBERT GALL.

BY ALFRED C. BURRILL.

On the Frost or Chicken Grape (*Vitis cordifolia* Michx.) vines on the south shore of Lake Puckaway, Marquette Co., Wis., the only point on the above route at which it was observed among the hundreds of grape vines passed, I was pleased to find several clusters of the Grape-Vine Filbert Gall (*Cecidomyia coryloides* Walsh) together with a beautiful scarlet spot gall. The latter arrived in such poor condition from the ride that it was unidentifiable when submitted to Mr. Wm. Beutenmüller of the American Museum. At the time of finding this gall, Sept. 3, 1909, these clusters, the individual members of which are shaped more or less like crowded Grape-Vine Apple Galls (*C. vitis-pomum* Walsh and Riley), were still so like the green of the leaves, in contrast to the bright-hued grape clusters, that the galls easily pass unnoticed. It is quite possible, therefore, that a few other occurrences may have escaped my notice among the many roadside grapes passed. I judge it is of uncommon occurrence, as I find no account of it in the eastern lists of *Cecidomyidae* nor in

Dr. M. T. Cook's list for Indiana. It has so far been mentioned in J. M. Aldrich's Catalog of North American Diptera as from Illinois, where it was described, and the gall and larva figured by Walsh (Amer. Ent. 1:107; repeated by Riley in his 5th Mo. Rept., p. 116; and the figure repeated with note by A. S. Packard in his Guide to the Study of Insects, p. 377, fig. 284) and in J. Williams' account "On Grape-Vine Galls. Ann. Rept. Ent. Soc. Ontario for 1877, 1877, p. 48-51, fig. 37-41.

SWALLOW MIGRATION, 1909.

BY ALFRED C. BURRILL.

Passing through the region of Fox Lake, Dodge Co., Wis., the first week of September, 1909, was made memorable by the great flocks of blackbirds and other myriads of swallows gathering for their autumn migration. I should say over three miles throughout the lowlands of Fox Lake, and again in lowland pasture plateaus west of there, the swallows were present in thousands. No need to go to the classic points of swallow assemblage, the New Jersey or Potomac marshes, in order to have unrivaled opportunity to study variation in the budding instincts in birds of the year. Though not able to stop on horseback (under military discipline), the birds flew so close to the heads of the horsemen that there was no trouble in identifying the barn swallow *(Chelidon erythrogaster)*, tree swallow *(Tachycineta bicolor)*, and bank swallow *(Riparia riparia)*. With all the bird lists published and all the bird students in Wisconsin, is there not someone not only competent but also instantly able to give us an annotated list of the chief flocking points of those bird species which come together annually in this way, for at least southern Wisconsin? It is known in the East and on the Mississippi River that old flocking places have been abandoned with the advent of man, and it is a comment on bird psychology too important to be so markedly neglected in ornithology. Even if some bird statistics that our nation's bird life has decreased 46% be true, it will still be interesting to see where else the remaining masses of birds gather. The reasons for changing a flocking point should make a good comparative study of bird psychology and a contribution to the study of migration in general. But most students do not even know where the chief points of assemblage are. I think I am right in stating that the study of bird migration has thus far been limited to chronicles of arrival and departure up and down our country, to weather conditions, or scarcity of food supply.

BANK SWALLOW NESTING SITES.

BY ALFRED C. BURRILL.

Although bank swallows *(Riparia riparia)* about Milwaukee and Madison make their homes in very high cliff banks, it is interesting to note the variation of the instinct of this cosmopolitan little bird in choosing nest-sites even in this hilly state, indicating an adaptability to very low unprotected banks, as has been reported of them in railroad banks crossing the western prairie (E. Ingersoll, 1902, "Wild Life of Orchard and Field," p. 287). About three or four miles south of Markesan, Green Lake Co., Wis., there was a colony of some hundred or so holes in a little creek bank facing mostly east, though a very tortuous meander, in some places hardly 4 feet to the water and in others not over 10 feet high. This tributary is, I believe, from Lake Maria to Lake Puckaway.

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MILWAUKEE, WISCONSIN

1910

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OFFICERS AND DIRECTORS.

PUBLICATION.

The "Bulletin of the Wisconsin Natural History Society."

Matter intended for publication should be sent to the editor of the Bulletin, who will transmit it to the associate editor of the proper department for consideration.

EDITORS.

MEETINGS.

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room at the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

MEMBERSHIP DUES.

Active Members, $3.00 per annum; Junior Members, $1.00 per annum; Corresponding Members, $2.00 per annum; Life Members, one payment of fifty dollars.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 8. JANUARY, 1910. No. 1

PROCEEDINGS.

Milwaukee, October 14, 1909.

Meeting of the combined sections. President Barth in the chair. Thirty people present. Minutes of the last meeting read and approved.

The subject for discussion was "The Physical Nature of Death."

Dr. Robert C. Washburn opened by speaking on The Question of Natural Death Among One-celled Organisms. Dr. Washburn discussed briefly Weissmann's theory, "that death among unicellular organisms is ompossible, and that reproduction by fission or spores insures immortality." In disputing this theory Dr. Washburn declared that Weissmann had built on an unsound basis and quoted Maupas' experiments with Infusoria, which the latter had bred for many generations; these organisms soon showed signs of decay, changes leading to death, unless opportunity for conjugation was given. Hertwig states that "part of every cell dies during fission—the macronucleus."

Dr. P. H. Dernehl then took up the subject What Science Has Taught Us Concerning Animal Death And Its Causes. He called attention to various cases of apparenth death, such as of hibernating animals, and drying or freezing of invertebrates, the last named as exhibited by the well known vinegar leech being kin to immortality. Alluding to Weissmann, Dr. Dernehl said that the immortality of lower forms is not applicable to higher forms of life. Death may result from three varieties of causes; namely through violence, pathological death, and natural death—the last being death resulting from old age. While the question of pathological death was not pertinent to the subject under discussion, the speaker, quoting from Notnagel, explained that in every pathological instance death is due to stoppage of the heart-beat, arising from the effects of the sickness, which is to be ranked only as a secondary cause.

As to the question of natural—or physiological death—this form of death is impossible, if Weissmann and Loeb are to be believed. Such forms of death do occur, said Dr. Dernehl, though they are very rare. For example among invertebrates, we have the instance of natural death in the may-fly; Metchnikoff studied this insect very carefully for pathological causes, but was unable to discover any disease. Among vertebrates old age occurs more frequently in birds than in mammals, the latter showing senility much more early than birds.

Dr. Dernehl then took up the theories of death which he said are exceedingly numerous, but of which only three need be considered. The first was that of Weissmann, as explained by the foregoing speaker, that the individual cell does not die. The second, widely accepted theory is that of Metchnikoff; that death is due to general intoxication of the animal body, arising from the toxins of the bacteriæ infesting the intestinal canal. A third theory is Ribard's, which in many respects is the same as that of Metchnikoff: namely, death begins as life sets in; fine granules of pigment appear in the cells, increasing in number with age, at length becoming so numerous as to interfere with flowing bodies in the cells. Since the cerebral cells are the first and most strongly affected, the brain functions are accordingly first interfered with, as instanced in the childishness of old age.

Mr. Charles B. Whitnall followed, speaking on the Interdependence of Animal and Vegetable in Avoiding Death. Beginning with a brief definition of a living being he showed the interdependence of the various cell groups of each being, saying that if one group of cells would cease their functions this would interfere with the other groups, thereby causing death. Mr. Whitnall then pointed out various phases in the economy of nature such as the purification of the soil and atmosphere, the absorption of the excreta of animals and the regulation of moisture by trees; and the reciprocal scavenging of the micro-organisms, that reduce the sewage to its chemical components.

The members of the society then entered into a discussion of the papers read and related subjects, as follows. Mr. Colles spoke on the length of life in seeds, Mr. Whitnall on the biennial death of trees, Dr. Barth called attention to the experiments on the life of eggs, star-fishes, etc., now being carried on in California. Messrs. Burrill, Ward, Whitnall, Barth. Graenicher, discussed what Mr. Whitnall termed the biennial death of trees. Mr. Burrill mentioned the senile decay of queen ants as an instance natural old age.

Dr. Dernehl pointed out the failure of experiments with sterilized animals fed with sterilized food based on Metchnikoff's theory. Dr. P. H. McGovern supported Metchnikoff, and explained his theory of the life of multicellular organisms as contrasted to that of unicellular.

Upon motion the meeting then adjourned.

Milwaukee, October 28, 1909.

Regular meeting of the society. President Barth in the chair.

Thirty people present. Minutes of the last meeting read and approved. The emergency appointment of Dr. P. H. Dernehl as treasurer by the chair owing to the resignation of Mr. Wm. McLaren was ratified by the members. Mr. Charles T. Brues of Harvard University was continued in the office of editor of the bulletin by the chair. The application of Miss Mary C. Lunney, 930 Cedar St. for membership was read; Mr. H. L. Ward nominated Dr. S. A. Barrett, Public Museum, and Mr. Henry Amos Betts, 895 Hackett Ave., for membership; the names being referred to the board of directors for action, who subsequently elected them active members.

The following resolution was introduced by Mr. Geo. W. Colles:

Resolved, That in future at all meetings which are open to the public the first four rows of seats, or such other number as the committee in charge shall deem proper, shall be reserved for members; and

That such seats shall be set off by suitable signs in the aisles at the points of demarkation.

This resolution was referred to the board of directors for consideration.

Miss M. L. Shorey, Professor of Biology at the Milwaukee Downer College, then gave the evening's lecture on The Development of The Nervous System. Miss Shorey stated that the object of her experiments was to ascertain whether the neuroblasts are entirely self-differentiating, or if they are wholly, or in part, dependent on some stimulus arising from the presence of their end organs. The first observations were made on the chick embryo, but these were afterward confirmed by experiments on the frog, toad and salamander.

EXPERIMENTS ON THE CHICK.

I. The wind bud was removed, usually by electrolysis, after three days of incubation, the egg again closed and allowed to develop from 24 hours to five days. At the time of this operation the nerve roots are already established, and extend largely to the inner margin of the wing, but have not penetrated it. There is, therefore, no direct injury to the nervous system. Varying amounts of muscle tissue developed from the three somites from which the wing arises are left by this operation, but in every case it was found that:

1. The complete destruction of the primordium of any muscle before its innervation results in the complete suppression of the branch of the peripheral nerve leading to it.

2. The nerve leading to a defective muscle, resulting from the destruction of a portion of its primordium before innervation is always decreased in size, but is usually larger in proportion to the size of the normal muscle than the normal nerve is in proportion to the size of the normal muscle.

3. The ventral roots and ventral horn are always decreased in size.

4. Destruction of sensory areas always results in a decrease in the size of the nerve trunk, ganglion, dorsal root and dorsal horn.

5. All of these defects are due to lack of development and not to degeneration.

II. One, two or three wing somites were removed from one side when the embryo was about two days old. At this time there is no apparent differentiation of the motor cells in the spinal cord, and no outgrowth of peripheral nerves. Some motor nerve fibers develop in each somite even if all the musculature of that somite is destroyed, but instead of forming a compact nerve root, they at first run freely in the mesenchyme, and later become connected with muscles in an adjacent somite. There is no degeneration.

Miss Shorey said that from these experiments she concluded that the neuroblasts of the chick are not self-differentiating but that they are wholly dependent for differentiation on the presence of end organs. These end organs are not necessarily those which they normally innervate, but may be others of the same character, developed from somites above or below. As there is no contact between the neuroblasts and their end organ before differentiation, and as the number which differentiates is always decreased by the destruction of the peripheral areas; moreover, as other investigations have shown that neuroblasts separated from the organism may develop nerve fibers in a drop of lymph,—hence the expressed belief that the stimulus must come from the presence of the metabolic products of the end organs.

EXPERIMENTS ON AMPHIBIANS.

Both somites and limb buds were again removed in the amphibians, but the situation is complicated by the fact that regeneration, and redifferentiation always occur. As a consequence no specimen in which all of the end organs of a given nerve were missing was obtained, but by repeated removals the size of the end organs is much reduced and there is always a corresponding decrease in the size of the nerves. Again there is no degeneration, and the obvious conclusion is that the neuroblasts are dependent on the presence of end organs, or the products of the metabolism of end organs for their differentiation.

The lecture was illustrated with slides made from original photographs. After a spirited discussion participated in by Miss Shorey, Dr. P. H. McGovern, and Dr. P. H. Dernehl, the meeting adjourned.

Milwaukee, Wis., Nov. 11, 1909.

Regular meeting of the society.

President Barth in the chair. 18 members present. Minutes of the last section meeting read and approved.

The nomination of Mrs. Auguste Reichel, southeast corner Fifth and Sherman Sts., was read and referred to the board of directors for action; at the subsequent meeting of the board she was elected an active member. A communication from Prof. I. N. Mitchell was read, in which he excused his absence, as the new Normal School was to be eddicated that evening.

The subject of the evening's discussion was "Nonsexual Schemes of Reproduction."

Dr. P. H. McGovern opened the discussion by speaking on Cytogenesis and Reproduction among the Protista. Dr. McGovern outlined briefly what a cell is, the life history of a cell, and the mechanical relationship of cytoplasm and the cell nucleus in the differentiation of the cell. Reproduction by fission, budding, etc., was explained. As to theories of cell reproduction the speaker mentioned two: Weissmann's theory of preformation—that the biophores actually contain all powers and functions of the later cell, and the more recent theory of epigenesis—that the biophores contain these powers potentially. Dr. McGovern accompanied his talk with numerous black-board diagrams.

Dr. G. W. Peckham spoke on the subject of Parthenogenesis in Animals; this phenomenon being an adaptation to environment (usually abundant nutritive conditions), the process of sexual reproduction being in abeyance till condition rose necessitating the animal to reproduce again sexually. Plant lice, ants, wasps, and many other insects were cited as instances.

Mr. A. C. Burrill then took up the subject of the Development of Fertile Individuals from Neuters in Hymenoptera. Parthenogenesis among insects is perpetual, seasonal, or alternative in generation, the phases of which can be classed as follows: Thelyotoky—when females only are produced, Arrhenotoky—males only, and Deuterotoky—either males or females.

Mr. Howland Russel followed by speaking on the Asexually Propagating Phenogams of Wisconsin, by means of rhizomes, bulbs, roots, stolons, tubers, runners, bulblets, and leaf-growers.

The papers presented were then informally discussed by the following members: Dr. Dernehl, Dr. Graenicher, Dr. Peckham, Dr. M.Govern, and Messrs. Burrill and Russel.

Upon motion the meeting then adjourned.

Milwaukee, Wis., Nov. 18, 1909.

Regular meeting of the society.

President Barth in the chair. 50 people present.

Minutes of the last regular meeting read and approved.

Mr. Howland Russel moved that hereafter abstracts of lectures and papers presented before the meeting and spread on the minutes be read to the meeting by title only. Motion seconded and passed.

President Barth announced that Mrs. Auguste Reichel, southeast corner Fifth and Sherman Sts. whose nomination had been presented at the last section meeting, had been elected an active member by the board of directors.

Mr. H. Ward then read the following report: Your committee to consider further action on the resolutions looking to increased protection for bank swallows and to the establishment of a state experimental farm for learning ways of fostering all useful wild life, reports that after mature consideration, it seems inexpedient to go further with proposals. Signed, Alfred C. Burrill, Chairman; Sigmund Graenicher, Henry L. Ward.

Dr. George P. Barth reported that the resolutions submitted to the last meeting by Mr. Colles, treating of the reservation of seats for the members of the society in public meetings of the society, had been indefinitely postponed by the board of directors. Both reports were accepted by the members by regular vote.

Dr. S. Graenicher then gave the lecture of the evening on "The Vegetation of the Pine Barrens of Northern Wisconsin." The lecture was illustrated by about fifty colored lantern slides.

After the lecture President Barth expressed the thanks of the society to the speaker. Upon motion the meeting then adjourned.

Milwaukee, Wis., Dec. 9, 1909.

Meeting of the combined sections.

President Barth in the chair. 24 people present.

Minutes of the last section meeting read and approved.

The name of Mr. Fred W. Werner, 991 Sixteenth St., nominated by Mr. Henry L. Ward, was read and referred to the board of directors for action.

The subject of the evening's discussion was "Migration of Animals." Mr. Henry L. Ward opened the discussion by speaking on the Migration of Mammals and Birds; he was followed by Mr. Charles L. Mann on Migration of Deer.

Dr. Sigmund Graenicher spoke on the Migration of Marine Animals.

R. A. Muttkowski spoke on the Migration of Insects in general, while Mr. A. C. Burrill particularized on Ants.

Mr. George W. Colles closed the discussion by speaking on the Migrations of Man.

Upon motion the meeting then adjourned.

Milwaukee, Wis., Dec. 30, 1909.

Regular monthly meeting of the society.

President Barth in the chair. 25 people present.

Minutes of the last meeting read and approved.

President Barth announced the election of Mr. Fred W. Werner, 991 Sixteenth St., whose name had been presented at the December section meeting. The following nominations were read: Miss Florence Olcott, 686 National Ave., nominated by Mr. H. L. Ward, and Mr. Herman B. Beckmann, 668 Buffum St., nominated by Dr. P. H. Dernehl. Both nominations were referred to the board of directors for action.

Motion made by Dr. Sherman that the committee on publication be discontinued and that the bulletin be placed in charge of an editor and three associate editors chosen by the board of directors and who shall have charge respectively of a Zoological, Botanical and a Geological and Palaeontological section. Seconded by Miss Wlora Elmer. Carried.

Miss Helen Sherman then gave an interesting talk on "The Puget Sound Biological Laboratory and Its Various Interests." Her lecture was illustrated with many colored lantern slides and various specimens.

President Barth expressed the appreciation and thanks of the society to Miss Sherman for her lecture.

Upon motion the meeting then adjourned.

NOTES ON VARIATION IN DURATION OF SIMILAR PERIODS OF EMBRYONIC DEVELOPMENT: ITS BEARING ON THE THEORY OF EFFECTIVE TEMPERATURES.

By A. A. Girault.

Perhaps attention should be called to the fact, which, however, is obvious, that in determining the relations of periods of development to effective temperatures one of the factors involved is often obtained approximately only; or in other words is measured without any reference to its variation. This factor, of course, is the period of development. Very little has been written concerning certain phenomona exhibited by these periods. For instance, in determining the periods of embryonic development — the egg stage—is it necessary, for the purpose in view, for any single record to be made with eggs deposited by a single parent? Would several parents of these eggs affect the results, providing the eggs were all deposited at the same time and kept together? Do two eggs deposited simultaneously (i. e. in quick succession) by the same parent and kept in the same environment hatch at the same time? If not, how is the period recorded? If not, how would the period be recorded for 50 eggs deposited in the same manner by a single parent? If the period of embryonic development is variable in the case of two eggs deposited simultaneously by the same or different parents or for any number of eggs deposited in rapid succession, how is it to be measured? Does not this mean that the probable error will have to be determined first from a large number of simultaneous observations? Or is the case such that this factor may be ignored entirely? The latter is most probably true—since the duration of the period of hatching for eggs of the same or different parentage deposited simultaneously and kept in similar environments are limited to short periods of time—as far as we know—and therefore the effective temperature recorded for either limit would vary not at all or very imperceptibly; perhaps it would always be within the probable error for observations, either in regard to the temperature or in regard to the time. Moreover, the variation is chanced.

But it is indicated that the egg-stage shows less variation than other stages. Thus, the larva's development may be greatly retarded or hastened in the case of numerous individuals in a large lot of similar origin because of varying supplies of food to the individual, less or more favorable external environmental factors liable to the individual, inherent variability, and so on, which would tend to increase the limits of the period of pupation even to several or more days. In such a case, there would be a perceptible difference in the effective temperatures for the limits of the period though it is doubtful, even here, if this difference in temperature would really mean anything, the general tendency not being affected. The pupae are probably not so variable, that is, as far as actual development is concerned, but the final ecdysis may be indefinitely prolonged for a number of individuals in a lot of similar or simultaneous origin by the action of various external factors other than temperature. In any case, it is obvious that periods of time less than a minute are of no consequence and it is indicated that periods of time even as long as 12 hours may be ignored always, at least in most cases, without affecting the realness of the results. How can we prove that this variation in the duration of similar developmental periods is eliminated as a factor by the determined probable error of observation? Are the two equal or so nearly so as to eliminate one of them? As both are as liable to occur one way as another, in a large series of observations, undoubtedly they could be ignored on the basis of the law of chances?

The following observations which bear directly upon some of the stated questions are submitted for examination. They are of the simplest kind, but I believe, unique in their way. They are not intended to prove anything more than the fact of marked variation in the duration of similar periods of embryonic development.

A female moth of *Sanninoidea*[1] *exitiosa* (Say) was allowed to mate with a male, both recently emerged, and as soon as the male left her she was confined in a glass vial of convenient size

[1] Or *Sannina.*

and a record made of the eggs deposited by her. Oviposition began immediately and at timed intervals the female was removed to other, clean vials and a record thus made of the actual time of deposition of several lots of eggs all of the same origin and deposited at successive short intervals of time varying from 4 to 68 minutes. The period of hatching was then recorded for each lot, showing marked variation both in the cases of the individuals of any single lot and between the lots themselves. The observations are not detailed enough to give the actual frequency of hatching but the curves of distribution shown later represent approximately what took place in each lot. The whole period of time for deposition was 6.03 hours; that for hatching, 43 hours.

The following lots were obtained and observed; they were all kept together under optimum conditions, there being no violent

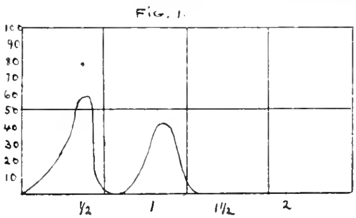

Figure 1.—54 observations.

The tendency of hatching here is roughly expressed by the 2 modes.

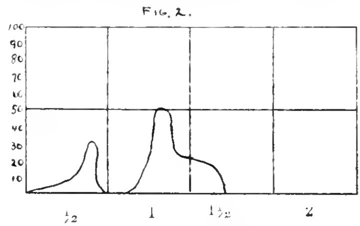

Figure 2.—45 observations.

The tendency is practically the same as in Lot No. I.

changes in temperature. The variation described therefore is apparently usual or normal.

Lot. No. I. Fifty-four eggs deposited in rapid succession during a period of 30 minutes (10:38 to 11:08 A. M.) began to hatch at 11 P. M., August 31st; after 9½ hours (8:30 A. M.) but 24 (44%) had hatched; after 12 hours (11 A. M.) but 32 (59%) had hatched and none hatched during the next 7 hours (to 6 P. M.); however, the remaining 22 eggs (41%) hatched during the next 13 hours. The period of hatching extended to 31 hours or 30½ hours over the period of deposition. The curve of distribution would be something like that shown in figure 1.

Lot No. II. Forty-five eggs deposited similarly in the same period of time (11:10 to 11:40 A. M.) began to hatch at about the same time as in the preceding lot. After 9½ hours but 6 (13.3%) had hatched;

after 12 hours, 14 (31.1%) had hatched, but none did so in the succeeding 7 hours; during the next 13 hours 23 more (51.1%) hatched and the total was completed by the hatching of the 8 (17.7%) remaining eggs during the next 6 hours. Here, the period of hatching extended to 37 hours or 36½ hours over the period of deposition. The curve of distribution shows about the same facts as shown for lot No. 1. (See figs. 1 and 2.)

Lot No. III. Sixty-seven eggs deposited in a similar manner during a period of 20 minutes (11:40 A. M. to noon) began to hatch at 11 P. M., August 31st, or at the same time as the previous lots; after 9½ hours, 20 (29.7%) of them had hatched; after 12 hours, 28 (41.8%) had hatched; then followed a period of 9 hours during which none hatched; then during the next 11 hours 30 (44.7%) more had hatched and hatching (13.4%) was completed during the next 10 hours. The period

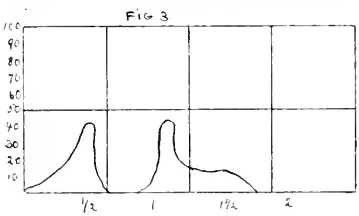

Figure 3.—67 observations.

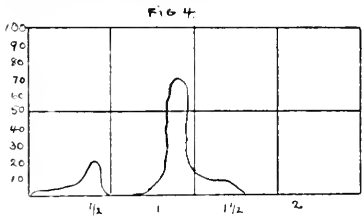

Figure 4.—97 observations.

of hatching here extended over 41 hours, 40½ hours longer than the period of deposition. The curve of distribution is shown approximately in figure 3.

Lot No. IV. Ninety-seven eggs deposited similarly in a period of 45 minutes (noon to 12:45 P. M.) began to hatch at about the same time as the previous lots and after 9½ hours but 9 (9.27%) of them had hatched; after 12 hours, 20 (20.61%) had hatched; then followed a lapse of 10 hours; during the following 10 hours 68 (70.1%) more of the eggs hatched and hatching (9 eggs or 9.27%) was completed in 8 more hours, making a period of hatching of 40 hours, over 39 hours longer than the period of deposition. The curve of distribution is shown in figure 4.

Lot No. V. Two hundred and fifteen eggs deposited similarly during a period of 90 minutes (12:45 to 2:15 P. M.) began to hatch at approximately the same time as those in the previous lots and after 9½ hours 10 (4.65%) had hatched; after 15 hours 25 (11.62%) of them had hatched: then followed a lapse of 6 or 7 hours; by the passing of the next 10 hours, 145 (67.44%) more had hatched and hatching (45 eggs or 20.93%) was completed during the next 12 hours. Here the period of hatching extended to from 42 to 44 hours, at least 40 hours longer than the period of deposition. The distribution shown in figure 5 lies between that of the previous lots and those to follow, approaching the single mode. (Cf. figs. 4, 5 and 6.)

Lot No. VI. Thirty-seven eggs similarly deposited during a period of 15 minutes (2:15 to 2:30 P. M.) did not begin to hatch until 11 P. M., September 1st, 24 hours after those of the previous lots and then after 9½ hours 32 (86.48%) had hatched; the remaining (13.51%) hatched after 4 hours more. Here hatching was continuous, there being no lapse and the curve of distribution (Fig. 6) shows but one mode;

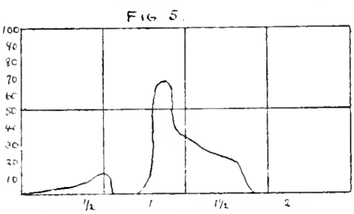

Figure 5.—215 observations.

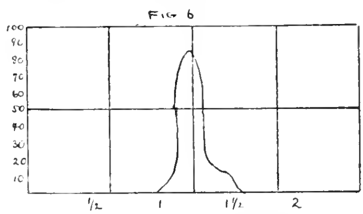

Figure 6.—37 observations. Here the tendency approximates that of normal frequency.

the period of hatching was but 13½ hours long, yet the period of development was about 24 hours longer than in the previous lots.

Lot No. VII. Eight eggs deposited in rapid succession during a period of 5 minutes (2:31 to 2:36 P. M.) hatched almost simultaneously at about 5 A. M., September 2d. Here the curve of distribution is almost straight up and down and the period of development averages longer than in most previous lots.

Lot No. VIII. Two eggs deposited during a period of 15 seconds (2:37 to 2:37:15 P. M.) hatched at 10:30 A. M. and at 11 P. M., September 1st, hatching extending over a period of 12½ hours. Here, the curve is indicated as bimodal, but actually it would probably take the form approximately of the curve of normal frequency, so-called. The period of hatching greatly exceeds the period of deposition and the period of development is shorter than in the preceding lot.

Lot No. IX. One hundred and fifty-eight eggs deposited in rapid succession during a period of 120 minutes (2:40 to 4:40 P. M.) began to hatch at 11 P. M., September 1st, as in Lot No. 6 and after the first 9½ hours 137 (or 87%) of them had hatched; the remaining 21 eggs (13%) hatched during the next 9½ hours, making a period of hatching of 19 hours, 9 times the period of deposition. The curve of distribution is a normal frequency curve skewed. (Fig. 7.)

The following discussion is to be taken for what it is worth, which is no more than the actual value of the data. A large part of it is unwarranted if based on the data alone. However, it may be useful. Attention is directed to the fact that but a single species is referred to.

What has actually happened? First, in each separate lot of eggs, we find an inherent[2] variation in the duration of embryonic

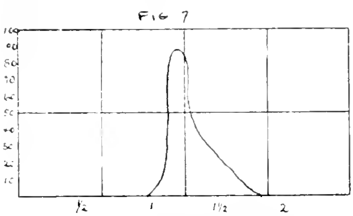

Figure 7.—158 observations.

The curve is similar to that of Lot No. VI.

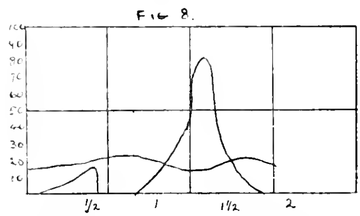

Figure 8.—683 observations.

Frequency of hatching in the lots combined, expressed roughly in percentages. The added line is the curve of temperature in centigrade degrees.

development causing a variable period of hatching; hatching occurs in such a manner as to become distributed over a curve of frequency having one or two modes. Secondly, periods of deposit short in regard to time, are apparently unrelated to the duration of the period of hatching. Thirdly, the duration of the period of hatching—and similarly, the duration o the period of deposit—is measurable, not by its frequency distribution which has to do with relations, but by that time which is a mean of the times of its beginning and ending; and the duration of the period of embryonic development is to be taken as the period of time included between the mean times of the period of deposit and the period of hatching.

[2] Apparently inherent; the lots were all in the same environment for the same period of time, the first lot not being separated from the last by more than 6 hours, during which there were no abnormal fluctuations in temperature.

As regards the first and second. Two eggs of the same parentage deposited simultaneously (within 15 seconds of each other) hatched 12½ hours apart; 8 eggs from the same parent deposited in 5 minutes, hatched within an hour of each other; the 2 eggs of the first lot deposited 4 minutes later than the 8 eggs of the second lot, hatched 12 hours earlier (mean time); that is, the period of embryonic development was a half day shorter. Again, 54 eggs deposited in 30 minutes hatched during a period of 31 hours; 158 eggs deposited in 120 minutes hatched during a period of 19 hours; the 158 eggs of the second lot deposited 4½ hours later than the 54 eggs of the first, hatched 14 hours later, hatching commencing, however, 24 hours later than the commencement of hatching in the first lot.

The comparative durations of the period of embryonic development, with related data, are shown in Table I.

Table I. Comparative Durations of the Egg Stage in Similar Lots of Eggs Deposited in Rapid Succession, *Sannina exitiosa* Say.

No. Lot	Time deposited, Aug. 24th, mean.	Duration of the Period of Deposit, Minutes.	No. of Eggs.	Time Elapsing Since Previous Deposit, Minutes, Taken from Means.	Duration of the Period of Hatching, Hours.	Duration of the Stage, Days.	Range of Variation in the Period of Hatching, Days.
I.	10:53 A. M.	30	54	0	31	8.13	1.29
II.	11:25 A. M.	30	45	32	37	8.25	1.50
III.	11:50 A. M.	20	67	25	41	8.33	1.72
IV.	12:22 P. M.	45	97	32	40	8.25	1.66
V.	1:30 P. M.	90	215	68	43	8.29	1.80
VI.	2:22 P. M.	15	37	52	13.5	8.62	0.57
VII.	2:33 P. M.	5	8	11	1	8.60	0.
VIII.	2:37 P. M.	0.25	2	4	12.5	8.09	0.52
IX.	3:40 P. M.	120	158	63	19	8.71	0.79
Sums		(362[3])	683	287	238.0	75.27	9.85
Averages	1:39 P. M.[4]	39.5	75.8	31.8	36.4	8.36	1.09

[3] Deposition of first and last egg. The combined lots were deposited in 362 minutes and hatched during a period of 43 hours with an egg stage of 8.29 days. [4] Mean.

The frequency of hatching for the combined lots is approximately shown in figure 8. Although more of the eggs were deposited during the first three hours (first half) of the period of deposition, the majority (82%) hatched during the last half of the period of hatching.

As stated, the length of the period of deposit when relatively short appears to be unrelated to the duration of the period of hatching or to the duration of the period of embryonic development either. The data probably, are insufficient to show the general tendency, yet the period of hatching was as long for some of the lots as for the lots combined. It may be noted further in regard to the latter, that the eggs of the first five lots deposited during the first half—approximately—of the whole time, began to hatch 24 hours earlier than those eggs of the remaining lots which were deposited during the last half of the whole period of deposition. And this was "correlated" with bimodal and "normal" frequencies of hatching for the two groups; yet the relations of these "correlations" are not apparent. Just why the random, chanced or accidental groups of eggs obtained in succession at short intervals of time over a relatively short period (.25 day) should show grouping into halves (in regard to the period of deposit) in relation to frequency, first hatching and distribution of frequency is obscure from the data. Moreover, the table brings out a substantial increase in the duration of the period of embryonic development and noticeable decreases in the range of variation for the period of hatching. These are pointed out, not explained.

It was found therefore, that many eggs of similar parentage deposited in rapid succession for short periods of time, as in the cases cited, hatch at random after a certain period of time, and that any single one of them is as likely to hatch at one time as another within the limits of the whole period; that two (or more) lots of eggs deposited in short successive periods of time vary in regard to the beginning of hatching in all of the lots, yet without affecting the actual duration of the period of embryonic development,—that is, the duration of the period of hatching is variable under such conditions; and that lots of eggs deposited continuously (in succession) for 362 minutes during periods varying from .25 to 120 minutes, required for hatching a period no longer for the whole deposit than for the maximum period of the lots taken separately. Fourthly, the period of hatching is much greater than the period of deposition, when the former is relatively short at least.

Coming to the period of embryonic development. First in regard to what was found in the cases cited. Referring again to table I, it is found that variation occurs under conditions where it is ordinarily unlooked for, namely in depositions of nearly simultaneous occurrence kept in similar environments; but in the nine cases did not exceed a half day by very many hours; it did not differ from the average by more than slightly over a third of a day nor the mean by more than 9.6 hours. Moreover, it was found that the variation within six hours as between the limits of that period was nearly equal to the variation as between two of the lots deposited slightly over an hour apart (lots VIII and IX); whereas in two lots deposited nearly an hour apart, there was no variation (lots II and IV); in two lots deposited 11 minutes apart there was practically none (lots VI and VII), but in two lots deposited 4 minutes apart there was a half-day's variation (lots VII and VIII).

How should the period of embryonic development be measured? Obviously, but in one way and that very simple. It is evident that if measured with but a single case, the period has not been obtained as accurately as if measurement was based on many cases in the same lot because of the random variation of the period of hatching. It is also evident, because of the latter, that the more cases upon which the measurement of any single period of hatching is based, the more accurate will be the determination of the period of development. The question is, then, simply one of determining the best measure of the time involved. The time at which the modes of hatching occur in cases such as this are not very precise, because the true mode will be seldom obtained, and because the modal time does not take into consideration extreme or even intermediate hatchings. Under the circumstances, the mean time is better and more easily obtained and will be precise enough for all purposes; the average time could be obtained very difficultly only.

In order to determine accurately the period of embryonic development it is merely necessary to know the limits of the periods of deposition and hatching, calculating the result from the mean times of the two periods. Hence the variation described in foregoing apparently has little or no effect on the present methods of measuring periods of embryonic development; but it is also apparent that as yet we do not know any too much concerning it. We have, in fact, neglected to observe it at all.

Its bearing on the theory of effective temperatures is no more than this: If it proves to be very large and is left out of consideration it is obvious that true relations will not be obtained; it is also obvious that true relations may not be obtained if it proves to be very small and is neglected. It is best therefore, to determine it in all cases, if for no other purpose than to know to what extent it occurs. It is important also from the standpoint of physiological variation, for is not that kind of variation as important as morphological variation which we hear so much about?

Urbana, Ill., 1909.

A CHECK-LIST OF WISCONSIN MAMMALS.

By N. Hollister.

This paper is the result of an attempt to place the names applied to mammals, in all the lists dealing exclusively with Wisconsin, in their proper places in synonomy. The results are interesting and, it is hoped, will be of value to future workers on the fauna of the state. A bibliography of the principal papers on the mammals of Wisconsin is given below, and throughout the list which follows only the authors' names and dates of publication are used.

1853. LAPHAM, I. A. A Systematic Catalogue of the Animals of Wisconsin. Mammalia. Trans. Wis. State Agric. Soc., II (1852), pp. 337-340, 1853.

Sixty-two mammals in the list, many included on extra-limital records and faulty identifications. One, the *Canis familiaris,* is here ignored.

1882. HOY, P. R. The Larger Wild Animals That Have Become Extinct in Wisconsin. Trans. Wis. Acad. Sciences, Arts, and Letters, V (1877-81), pp. 255-257, 1882.

Ten mammals extinct or nearly so.

1883. STRONG, MOSES. List of the Mammals of Wisconsin. Geology of Wisconsin. Survey of 1873-1879. Vol. I, pp. 436-440, 1883.

Sixty-nine species in list. Many duplications by the frequent use of synonyms as different species.

1902. SNYDER, W. E. A List, With Brief Notes, of the Mammals of Dodge County, Wisconsin. Bull. Wis. Nat. Hist. Soc., II, pp. 113-126, 1902.

Thirty-six species in list proper.

1907. WARD, HENRY L. A Weasel New to Wisconsin's Fauna. Bull. Wis. Nat. Hist. Soc., V, pp. 63-64, 1907.

First record of *Putorius r. allegheniensis* in Wisconsin.

1908. JACKSON, HARTLEY H. T. A Preliminary List of Wisconsin Mammals. Bull. Wis. Nat. Hist. Soc., VI, pp. 13-34, 1908.

Fifty-five species in list. Five species mentioned as without doubt having occurred, but of which there are no actual records.

1909. HOLLISTER, N. Notes on Wisconsin Mammals. Bull. Wis. Nat. Hist. Soc., VI, pp. 137-142, Oct., 1908. (Actual date of publication April, 1909).

Notes on twenty-one species.

1909. WARD, HENRY L. Additional Records of the Alleghenian Least Weasel in Wisconsin. Bull. Wis. Nat. Hist. Soc., VII, pp. 11-12, April, 1909.

Further notes on *P. r. allegheniensis* in Wisconsin.

In the following list I have included sixty-three species and subspecies, all that I consider at present entitled to a place in a work on Wisconsin mammals. Nine additional species, recorded in former lists by various authors, but apparently on insufficient evidence, are included in the customary "Hypothetical List" at the end of the paper. Probably some of these have occurred within the borders of the state, but no specific record has been found for any of them.

MARSUPIALIA.

DIDELPHIIDÆ.

Didelphis virginiana Kerr. Opossum.

Didelphus virginiana Lapham, 1853.

Didelphis virginiana Hoy, 1882.—Jackson, 1908.—Hollister, 1909.

Didelphys virginiana Strong, 1883.

UNGULATA.

CERVIDÆ.

Odocoileus virginianus borealis Miller. Northern Deer.

Cervus virginianus Lapham, 1853.—Strong, 1883.

Odocoileus virginianus Snyder, 1902.

Odocoileus americanus borealis Jackson, 1908.

Cervus canadensis Erxleben. Canadian Wapiti.

Elaphus canadensis Lapham, 1853.

Cervus canadensis Hoy, 1882. — Strong, 1883. — Jackson, 1908. — Hollister, 1909.

Alce americanus (Clinton). Eastern Moose.

Cervus alces Lapham, 1853.—Strong, 1883.

Alce americanus Hoy, 1882.—Hollister, 1909.

BOVIDÆ.

Bison bison (Linnæus). American Buffalo.

Bison americanus Lapham, 1853.

Bos americana Hoy, 1882.

Bison bison Hollister, 1909.

GLIRES.

SCIURIDÆ.

Sciurus carolinensis leucotis Gapper. Northern Gray Squirrel.

Sciurus leucotis Lapham, 1853.—Snyder, 1902.

Sciurus niger Lapham, 1853[1].—Strong, 1883.

Sciurus migratorius Strong, 1883.

Sciurus carolinensis leucotis, Jackson, 1908.

Sciurus carolinensis hypophæus Merriam. Minnesota Gray Squirrel.

Sciurus hypophæus Snyder, 1902.

Sciurus carolinensis hypophæus, Jackson, 1908.

Sciurus hudsonicus minnesota Allen. Minnesota Red Squirrel.

Sciurus hudsonicus Lapham, 1853.

Sciurus hudsonius Strong, 1883.

Sciurus hudsonius loquax Snyder, 1902.

Sciurus hudsonicus loquax Jackson, 1908.

Sciurus hudsonicus minnesota Hollister, 1909.

Sciurus niger rufiventer Geoffroy. Fox Squirrel.

Sciurus vulpinus Lapham, 1853.

Sciurus sayi Strong, 1883.

Sciurus ludovicianus Snyder, 1902.

Sciurus niger rufiventer Jackson, 1908.

[1] I do not hesitate to place Lapham's "Black Squirrel" under *S. c. leucotis.* All the totally black squirrels from Wisconsin that I have examined were *leucotis*, though partly black *rufiventer* are not especially rare. Black gray squirrels used to be abundant in southeastern Wisconsin but are now seldom found.

Tamias striatus griseus Mearns. Gray Striped Chipmunk.
Sciurus striatus Lapham, 1853.
Tamias striatus Strong, 1883.
Tamias striatus griseus Snyder, 1902.—Jackson, 1908.

Eutamias borealis neglectus (Allen). Lake Superior Chipmunk.
Tamias quadrivittatus Strong, 1883.
Eutamias quadrivittatus neglectus Jackson, 1908.
Eutamias borealis neglectus Hollister, 1909.

Citellus franklini (Sabine). Franklin's Spermophile.
Spermophilus grammurus Lapham, 1853.
Spermophilus parryi Lapham, 1853.
Spermophilus franklini Strong, 1883.—Snyder, 1902.
Citellus franklini Jackson, 1908.—Hollister, 1909.

Citellus tridecemlineatus (Mitchill). Striped Spermophile.
Spermophilus tridecimlineatus Lapham, 1853.
Spermophilus tridecemlineatus Strong, 1883.—Snyder, 1902.
Citellus tridecemlineatus Jackson, 1908.

Marmota monax (Linnaeus). Woodchuck.
Arctomys monax Lapham, 1853.
Arctomys monax Strong, 1883.—Snyder, 1902.
Marmota monax Jackson, 1908.

Sciuropterus sabrinus (Shaw). Northern Flying Squirrel.
Pteromys sabrinus Lapham, 1853.
Pteromys hudsonius Strong, 1883.
Sciuropterus sabrinus Jackson, 1908.

Sciuropterus volans (Linnæus). Flying Squirrel.
Pteromys volucella Lapham, 1853.—Strong, 1883.
Sciuropterus volans Snyder, 1902.—Jackson, 1908.

CASTORIDÆ.

Castor canadensis Kuhl. Beaver.
Castor fiber Lapham, 1853.—Strong, 1883.—Snyder, 1902.
Castor canadensis Hoy, 1882.—Jackson, 1908.—Hollister, 1909.

MURIDÆ.

Mus musculus Linnæus. House Mouse.
Mus musculus Lapham, 1853.—Strong, 1883.—Snyder, 1902.—Jackson, 1908.

Epimys norvegicus (Erxleben). Norway Rat.[1]

Mus decumanus Lapham, 1853.—Strong, 1883.—Snyder, 1902.

Mus norvegicus Jackson, 1908.

Peromyscus maniculatus gracilis (Le Conte). Canada White-footed Mouse.

Peromyscus canadensis Jackson, 1908.

Peromyscus maniculatus bairdi (Hoy & Kennicott). Michigan White-footed Mouse.

Hesperomys bairdii Strong, 1883.

Hesperomys michiganensis Strong, 1883.[2]

Peromyscus bairdi Snyder, 1902.—Hollister, 1909.

Peromyscus michiganensis Jackson, 1908.

Peromyscus leucopus noveboracensis (Fischer). Deer Mouse.

Mus leucopus Lapham, 1853.

Hesperomys leucopus Strong, 1883.

Peromyscus leucopus Snyder, 1902.

Peromyscus leucopus noveboracensis Jackson, 1908.

Evotomys gapperi (Vigors). Red-backed Vole.

Arvicola gapperi Strong, 1883.

Evotomys gapperi Snyder, 1902.—Jackson, 1908.

Microtus pennsylvanicus (Ord). Meadow Mouse.

Arvicola riparius Lapham, 1853.—Strong, 1883.

Microtus pennsylvanicus Snyder, 1902.—Jackson, 1908.

Microtus ochrogaster (Wagner). Prairie Meadow Mouse.

Arvicola hirsutus Lapham, 1853.[3]

Arvicola austerus Strong, 1883.

Microtus austerus Snyder, 1902.

Microtus ochrogaster Jackson, 1908.

Fiber zibethicus (Linnæus). Muskrat.

Fiber zibethicus Lapham, 1853.—Strong, 1883.—Snyder, 1902.—Jackson, 1908.

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[1] For use of name *Epimys* for the rats, see Miller, Proc. Biol. Soc. Wash., XXIII, p. 58, Apr. 19, 1910.

[2] Though the *Mus michiganensis* of Audubon and Bachman is a true synonym of *Peromyscus leucopus noveboracensis,* as shown by Osgood in his recent revision of the genus (N. Am. Fauna, No. 28, p. 81, 1909), this reference belongs under *bairdi.*

[3] *Arvicola hirsutus* Emmons is a synonym of *Microtus pennsylvanicus,* but the name is here used by Lapham for Hoy's "Beaver Field Mouse", which is undoubtedly *ochrogaster,* as he also includes *Arvicola riparius,* the "Marsh Meadow Mouse", in his list.

GEOMYIDÆ.

Geomys bursarius (Shaw). Pocket Gopher.
Geomys bursarius Lapham, 1853.—Strong, 1883.—Jackson, 1908.

ZAPODIDÆ.

Zapus hudsonius (Zimmermann). Jumping Mouse.
Meriones americanus Lapham, 1853.
Jaculus hudsonius Strong, 1883.
Zapus hudsonius Snyder, 1902.—Jackson, 1908.—Hollister, 1909.

ERETHIZONTIDÆ.

Erethizon dorsatum (Linnæus). Canada Porcupine.
Hystrix hudsonius Lapham, 1853.
Hystrix dorsata Strong, 1883.
Erethizon dorsatum Jackson, 1908.

LEPORIDÆ.

Lepus americanus phæonotus Allen. Minnesota Varying Hare.
Lepus americanus Lapham, 1853.—Strong, 1883.
Lepus americanus phæonotus Jackson, 1908.

Sylvilagus floridanus mearnsi (Allen). Mearns Cottontail.
Lepus nanus Lapham, 1853.
Lepus sylvaticus Strong, 1883.
Lepus floridanus mearnsi Snyder, 1902.
Sylvilagus floridanus mearnsi Jackson, 1908.

CARNIVORA.

FELIDÆ.

Felis couguar Kerr. Panther.
Felis concolor Lapham, 1853.—Hoy, 1882.—Strong, 1883.
Felis couguar, Hollister, 1909.

Lynx canadensis Kerr. Canada Lynx.
Lyncus borealis Lapham, 1853.
Lynx canadensis Strong, 1883.—Jackson, 1908.

Lynx ruffus (Güldenstaedt). Wild Cat.
Lyncus rufus Lapham, 1853.
Lynx rufus Strong, 1883.—Snyder, 1902.
Lynx ruffus Jackson, 1908.

CANIDÆ.

Urocyon cinereoargenteus ocythous Bangs. Wisconsin Gray Fox.
Vulpes virginianus Lapham, 1853.—Strong, 1883.
Uroeyon cinereoargenteus ocythous Jackson, 1908.—Hollister, 1909.

Vulpes fulvus (Desmarest). Red Fox.
Vulpes fulvus Lapham, 1853.—Strong, 1883.—Snyder, 1902.—Jackson, 1908.—Hollister, 1909.
Vulpes fulvus argentatus Snyder, 1902.[1]

Canis occidentalis Richardson. Timber Wolf.
Lupus occidentalis Lapham, 1853.
Canis lupus Strong, 1883.
Canis griseus Jackson, 1908.

Canis latrans Say. Coyote.
Lupus latrans Lapham, 1853.
Canis latrans Strong, 1883.—Jackson, 1908.—Hollister, 1909.

MUSTELIDÆ.

Lutra canadensis (Schreber). Otter.
Lutra canadensis Lapham, 1853.—Strong, 1883.—Snyder, 1902.—Jackson, 1908.

Mephitis mesomelas avia Bangs. Illinois Skunk.
Mephitis mesomelas avia Hollister, 1909.

Mephitis hudsonica Richardson. Northern Skunk.
Mephitis americana Lapham, 1853.
Mephitis mephitica Strong, 1883.
Mephitis sp. Snyder, 1902.
Mephitis hudsonica Jackson, 1908.

Taxidea taxus (Schreber). Badger.
Meles labradoria Lapham, 1853.
Taxidea americana Hoy 1882.—Strong, 1883.—Snyder, 1902.
Taxidea taxus Jackson, 1908.—Hollister, 1909.

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[1] This reference may possibly belong under *Urocyon c. ocythous*, a species which should occur at the place mentioned, and is not included in Snyder's list. The fact that the skin sold for thirty-five dollars, however, makes it probable that the animal was a silver fox, a color phase of *Vulpes fulus.*

Gulo luscus (Linnæus). Wolverine.

Gulo luscus Lapham, 1853[1]—Hoy, 1882.—Strong, 1883.—Hollister, 1909.

Lutreola vison (Schreber). Mink.

Putorius vison Lapham, 1853.—Strong, 1883.—Jackson, 1908.

Lutreola vison Snyder, 1902.

Putorius cicognanii (Bonaparte). Bonaparte's Weasel.

Mustela pusilla Lapham, 1853.[2]

Putorius noveboracensis Lapham, 1853.[3]

Putorius vulgaris Strong, 1883.[4]

Putorius cicognanii Strong, 1883.—Jackson, 1908.

Putorius cicognani Snyder, 1902.

Putorius rixosus allegheniensis Rhoads. Alleghany Weasel.

Putorius rixosus allegheniensis Ward, 1907; 1909.—Jackson, 1908.

Putorius noveboracensis Emmons. New York Weasel.

Putorius richardsonii Strong, 1883.

Putorius noveboracensis Strong, 1883[5]—Snyder, 1902.—Jackson, 1908.

Mustela americana Turton. Marten.

Mustela martes Lapham, 1853.

Mustela americana Strong, 1853.—Jackson, 1908.

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[1] Extralimital record. Following the narrative of Long's second expedition, on which the record is based, I find that the only wolverine mentioned was killed in what is now Alberta. During the time spent by the explorers in what is now Wisconsin, enroute from Chicago to Fort Crawford (Prairie du Chien), but three quadrupeds were seen, one deer, one wolf, and a badger.

[2] It is difficult to fix some of the names used for weasels in early lists to any species. *Mustela pusilla* De Kay (not of Baird) is a synonym of *Putorius cicognanii*, and is probably the species meant in the present case, though the locality mentioned, Racine, makes it possible that the reference should be placed under *P. noveboracensis*, the common species at that place.

[3] I believe Lapham's reference to *P. noveboracensis* also belongs under *cicognanii*. The record is extralimital at any rate and of very little consequence. *P. noveboracensis* does not occur in the region referred to, while *P. cicognanii* is generally distributed and abundant throughout the district.

[4] Strong evidently included all the names in use for the weasels of eastern North America without much of an idea of the species. Some of the duplications may be attributed to Strong's having accepted and published names furnished by Hoy without knowing that they referred to species which he had already included under other names. The same complications exist in other groups in Strong's list, especially among the bats.

[5] The great sexual difference in weasels, not well understood at the time, may have misled Strong into listing four weasel names where he probably had but two species.

PROCYONIDÆ.

Procyon lotor (Linnæus). Raccoon.

Procyon lotor Lapham, 1853.—Strong, 1883.—Snyder, 1902.—Jackson, 1908.

URSIDÆ.

Ursus americanus Pallas. Black Bear.

Ursus cinnamomum Strong, 1883.

Ursus americanus Lapham, 1853.—Strong, 1883.—Jackson, 1908.

SORICIDÆ.

Sorex personatus I. Geoffroy. Masked Shrew.

Sorex cooperi Lapham, 1853.—Strong, 1883.

Sorex forsteri Lapham, 1853.

Sorex platyrhinus Strong, 1883.

Sorex personatus Snyder, 1902.—Jackson, 1908.

Sorex richardsoni Bachman. Richardson's Shrew.

Sorex richardsoni Lapham, 1853.—Snyder, 1902.—Jackson, 1908.

Sorex fumeus Miller. Smoky Shrew.

Sorex richardsonii Strong, 1883.[1]

Sorex fumeus Hollister, 1909.

Microsorex hoyi (Baird). Hoy's Shrew.

Sorex hoyi Strong, 1883.—Jackson, 1908.

Neosorex palustris (Richardson). Marsh Shrew.

Neosorex palustris Jackson, 1908.

Blarina brevicauda (Say). Short-tailed Shrew.

Sorex dekayi Lapham, 1853.

Sorex brevicaudus Lapham, 1853.[2]

Blarina talpoides Strong, 1883.

Blarina brevicauda Strong, 1883.—Snyder, 1902.—Jackson, 1908.

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[1] It seems almost certain that Strong's record of *Sorex richardsoni* in Wisconsin is based on Baird's identification of a specimen of *fumeus* from Racine as *richardsoni*. See Miller, N. Am. Fauna, No. 10, p. 38, 1895. It is doubtful if he had true *richardsoni* from the state at that time. Lapham's 1853 record of *richardsoni* is extralimital.

[2] As in other instances, the two names for the same species, included in Lapham's list, is explained by the fact that Hoy furnished him notes on mammals from Racine, using different names from those used by Lapham, and he apparently allowed them a place in his list without realizing that they were synonyms.

TALPIDÆ.

Scalopus aquaticus machrinus (Rafinesque). Large-nosed Mole.
Scalops aquaticus Lapham, 1853.
Scalops argentatus Strong, 1883.
Scalopus aquaticus machrinus Hollister, 1909.

Condylura cristata (Linnaeus). Star-nosed Mole.
Condylura cristata Lapham, 1853.—Strong, 1883.—Jackson, 1908.

VESPERTILIONIDÆ.

Myotis lucifugus (Le Conte). Little Brown Bat.
Vespertilio lucifugus Strong, 1883.
Myotis lucifugus Snyder, 1902.—Jackson, 1908.

Myotis subulatus (Say). Say's Bat.
Vespertilio subulatus Lapham, 1853.—Strong, 1883.
Myotis subulatus Hollister, 1909.

Lasionycteris noctivagans (Le Conte). Silvery-black Bat.
Vespertilio noctivagans Lapham, 1853.
Scotophilus noctivagans Strong, 1883.
Lasionycteris noctivagans Snyder, 1902.—Jackson, 1908.

Nycteris borealis (Müller). Red Bat.
Vespertilio noveboracensis Lapham, 1853.
Lasiurus noveboracensis Strong, 1883.
Lasiurus borealis Snyder, 1902.—Jackson, 1908.

Nycteris cinereus (Beauvois). Hoary Bat.
Vespertilio pruinosus Lapham, 1853.
Lasiurus pruinosus Strong, 1883.
Lasiurus cinerea Snyder, 1902.
Lasiurus cinereus Jackson, 1908.—Hollister, 1909.

HYPOTHETICAL LIST.

Rangifer caribou (Gmelin). Caribou.
Rangifer tarandus Lapham, 1853[1].
Rangifer caribou Hoy, 1882.[2]

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[1] Extralimital record.

[2] Evidence too meager to accept as record, though it is possible the caribou formerly occurred on the south shore of Lake Superior.

Antilocapra americana (Ord). Prong-horn Antelope.
Antilope americana Lapham, 1853.
Antilocapra americana Hoy, 1882.[1]

Epimys rattus (Linnæus). Black Rat.
Mus rattus Lapham, 1853.—Strong, 1883.[2]

Microtus xanthognathus (Leach). Yellow-nosed Vole.
Arvicola xanthognathus Lapham, 1853.[3]

Microtus pinetorum scalopsoides (Audubon & Bachman). Pine Mouse.
Arvicola pinetorum Strong, 1883.[4]

Spilogale interrupta (Rafinesque). Spotted Skunk.
Mephitis putorius Jordon, 1894.
Spilogale interrupta Jordon, 1899.[5]

Mustela pennanti Erxleben. Fisher.
Mustela canadensis Lapham, 1853.
Mustela pennantii Strong, 1883.[6]

Pipistellus subflavus (F. Cuvier). Yellowish-brown Bat.
Scotophilus georgianus Strong, 1883.[7]

Eptesicus fuscus (Beauvois). Brown Bat.
Scotophilus carolinensis Strong, 1883.[8]
Scotophilus fuscus Strong, 1883.

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[1] It seems probable that Hennepin's "wild goats" were white-tail deer, and not antelope, as Hoy surmised. Joliet also mentions "wild goats", wild oxen, and stags, referring, no doubt, to deer, buffalo, and elk. Lapham's record is extralimital.

[2] There are no recent records of *rattus* from anywhere near Wisconsin. Melanistic specimens of *E. norvegicus*, of which I have seen skins, are perhaps responsible for these records.

[3] This record, based on Hoy's notes, is unquestionably an error.

[4] Probably included all the species of *Arvicola* known from eastern North America without evidence of occurrence in the state.

[5] Included in the various editions of Jordon's Manual of the Vertebrates, and range given as extending to Wisconsin, on Hoy's authority.

[6] Unfortunately there are no specific records for the fisher, though it doubtless occurred within the boundaries of the state in early days.

[7] Strong listed all the bats known from eastern and northern states, without having local records, and this one is not entitled to a place in a Wisconsin list.

[8] Perhaps meant to include *Nycticeius*, and thus list all the bats known from eastern North America.

A PRELIMINARY LIST OF THE FLIES OF WISCONSIN BELONGING TO THE FAMILIES BOMBYLIIDÆ, SYRPHIDÆ AND CONOPIDÆ.

By S. Graenicher.

Our acquaintance with the insect fauna of this State is still so unsatisfactory that a list of this kind can not be considered more than a simple registration of the facts in our possession at the present time, from a few sources only. Owing to the ardor of some of our local entolomologists the immediate surroundings of Milwaukee have been pretty thoroughly canvassed for some groups of insects, and as a result records have been obtained that form a nucleus for comparison with the records from other parts of the State. Nearly 10 years ago the writer published a list of the *Syrphidæ* of Milwaukee County (Bull. Wis. Nat. Hist. Soc., July 1900; pp. 167-177), in which 64 species were enumerated. Since that time, partly through the efforts of Dr. G. P. Barth of Milwaukee, partly through my own observations the following 17 species have been added to the Milwaukee list for this family:

Chrysogaster nigripes, *Chilosia prima*, *Eupeodes volucris*, *Xanthogramma emarginata*, *X. tenuis*, *X. divisa*, *Volucella evecta* *V. vesiculosa*, *Sericomyia chrysotoxoides*, *Eristalis saxorum*, *Helophilus bilinearis*, *Teuchocnemis lituratus*, *Criorhina intersistens*, *Xylota angustiventris*, *Spilomyia hamifera*, *Temnostoma bombylans*, and *Ceria abbreviata*.

I am also indebted to Dr. Barth for a number of records from other points in the State, mainly from Wausau, Marathon County, Wis.

The collection of the Public Museum of Milwaukee contains a large number of species of the three families under consideration, among them some interesting material collected by Mr. C. T. Brues on two collecting expeditions of the Public Museum to northern parts of the State, one in 1905 to the Door Co. peninsula, the other 1907 to Vilas Co. and the Lake Superior region around Ashland. In this latter lot I have come across a new species of

Helophilus, a description of which *(H. bruesi)* is given in this paper. Last year's collecting expedition of the Publ. Museum down the St. Croix River in the northwestern corner of the State furnished 64 species for the three families, 2 of which, *Anthrax nemakagonensis* and *Zodion lativentre* proved to be new, and were described in the Canadian Entomologist, January 1910, pp. 26-29.

In the St. Croix region a number of species not occurring in the Milwaukee region were encountered, several of these, mainly from the upper St. Croix, being decidedly boreal, while others show a more southern or western range of distribution. Boreal species not known from the southeastern part of the State (Racine, Milwaukee or Washington Cos.) are especially the following:

Syrphidæ.	*Pyrophæna granditarsus.*
	Pyrophæna rosarum.
	Syrphus disjectus.
	Helophilus porcus.
	Temnostoma æqualis.
Conopidæ.	*Physocephala furcillata.*

Syrphus disjectus and *Physocephala furcillata* are both characteristic species of the St. Croix region, having been met with in comparatively large numbers, especially in Douglas and Burnett Cos. Judging from the fact that specimens of *P. furcillata* have been found also in Marathon and Door Cos., it is probable that this species occurs throughout the northern part of the State.

Of the three Bombylids *Anthrax tegminipennis, Lepidophora ægeriiformis* and *Systropus macer* we have no other records for the State except those from the St. Croix region. These species have a rather extended range of distribution, and will in all probability be found to inhabit the greater portion of the central and western areas of the State, but they seem to be absent from the eastern area bordering on Lake Michigan.

BOMBYLIIDÆ.

Spogostylum.

S. albofasciatum Macquart. Specimens from Milwaukee and Burnett Counties.

S. anale Say. Specimens from Milwaukee Co.

S. œdipus Fabricius. Milwaukee and Douglas Cos.

S. pauper Loew. Specimens from Milwaukee Co.

S. pluto Wiedemann. 1 specimen from Ellison Bay, Door Co., about 13 mm. long, and 1 from Jacksonport, Door Co., 10 mm. long. In the latter specimen there is a third, very small spot on the anterior branch of the third vein close to the margin of the wing, which is distinctly developed in the right wing, hardly perceptible in the left. This species shows a great deal of variation in the number and arrangement of the spots of the wings, a point to which attention has been called by Osten Sacken (Western Diptera, p. 244).

Aldrichia.

A. ehrmanni Coquillett. A single specimen taken in Milwaukee Co. June 30, 1907. This rare fly was described in 1894 from a specimen collected in Pennsylvania, and has not been reported since.

Exoprosopa.

E. capucina Fabricius. Milwaukee, Waukesha and Washington Cos.

E. decora Loew. Milwaukee and Douglas Cos.

E. fascipennis Say. Milwaukee, Waukesha, Washington and Burnett Counties.

E. fasciata Macquart. Milwaukee, Racine, Burnett and St. Croix Cos.

Anthrax.

A. alternata Say. Milwaukee, Washington, Portage, Douglas and Burnett Cos.

A. fulviana Say. Milwaukee and Burnett Cos.

A. fulvohirta Wiedemann. Rare. One specimen only from Milwaukee County.

A. halcyon Say. Not uncommon in Milwaukee Co.

A. lateralis Say. Milwaukee and Burnett Cos. I have before me 11 specimens, all of which belong to the form with yellow tomentum and pile for which Johnson (Psyche XV, p. 15) has proposed the varietal name *gracilis*.

A. morio Linné. Specimens from Door, Ashland, Douglas and Burnett Cos.

A. nemakagonensis Graenicher. Described from 16 cotypes in the Milw. Public Museum taken at different points along the St. Croix

River in Burnett Co., from the Nemakagon River on down to Randall. Since the publication appeared (Can. Entomologist Jan. 1910, pp. 26-29) I have selected the specimen with Cat. No. 29055 —a female—as the type (lectotype).

A. parvicornis Loew. Specimens from Milwaukee and Racine Cos.

A. sinuosa Wiedemann. Milwaukee, Douglas and Burnett Cos.

A. tegminipennis Say. Found in Douglas and Burnett Cos.

Bombylius.

B. fulvibasis Macquart. Milwaukee and Douglas Cos.

B. major Linné. Milwaukee and Washington Cos. This circumpolar species is distributed throughout Europe, northern Asia to Japan.

B. pulchellus Loew. 3 specimens from Milwaukee Co. Rarer than the two preceeding species.

Systœchus.

S. vulgaris Loew. Milwaukee, Washington, Douglas, Burnett and Polk Counties.

Phthiria.

P. aldrichi Johnson. Washington Co., 2 specimens. This species was described from material collected at Caldwell, Idaho. Not reported from any other State.

P. punctipennis Walker. Taken repeatedly in Milwaukee and Washington Cos.

Lepidophora.

L. ægeriiformis Westwood. Burnett Co. at several points.

Sparnopolius.

S. fulvus Wiedemann. Milwaukee and Waukesha Cos.

Eclimus.

E. harrisii Osten-Sacken. 2 specimens from Elkhart Lake in Sheboygan County.

Systropus.

S. macer Loew. 3 specimens from North Hudson, St. Croix Co. This species, an exceedingly close mimic of some wasps of the genus *Ammophila* occurs from N. J. and Pa., west to Kans.

Geron.

G. calvus Loew. Milwaukee, Washington and Waukesha Cos.

G. subauratus Loew. 1 specimen taken at Randall, Burnett Co.

SYRPHIDÆ.

Microdon.

M. tristis Loew. Taken in Milwaukee Co., flying around the nests of ants belonging to the genus *Formica*.

Chrysogaster.

G. nigripes Loew. Milwaukee and Washington Cos.

C. nitida Wiedemann. Milwaukee and Marathon Cos.

C. pictipennis Loew. Milwaukee and Marathon Cos.

C. pulchella Williston. Milwaukee, Racine, Washington and Douglas Counties.

Pipiza.

P. femoralis Loew. Milwaukee Co. A study of numerous specimens from the Atlantic States has led Johnson to consider *femoralis* and *albipilosa* different forms of one and the same species (Psyche XIV, p. 75). A consideration of the 4 specimens taken at Milwaukee points in the same direction. 1 male and 2 females have the wings hyaline, slightly infuscated on the outer half. In the remaining female the wings are conspicuously clouded *(albipilosa)*, and the insect is altogether darker than the typical *femoralis*, having black antennæ and darker legs. In one of the females the interrupted yellow fascia across the 2nd abdominal segment is about twice as broad as in the others.

P. pistica Williston. Milwaukee and Burnett Cos. The distribution of the yellow color on tibiæ and tarsi is very variable.

Paragus.

P. bicolor Fabricius. Milwaukee, Washington and Burnett Cos.

P. tibialis Fallén. Milwaukee, Washington, Marathon and Burnett Cos. A female from the latter county (Yellow River, July 28, 1909) has the face entirely dark.

Chilosia.

C. cyanescens Loew. Milwaukee Co.

C. hoodiana Bigot. 2 females from Solon Springs, Douglas Co. agree well with the description.

C. prima Hunter. 4 males and 1 female taken in Milwaukee Co. probably belong to this species, although none of them exceed 8 mm. in length. The type was from Pennsylvania.

C. sororcula Williston. Burnett and Sheboygan Cos. This was described from Mexico, and reported by Snow from the Magdalena Mts. in New Mexico. Our 6 specimens agree with 2 specimens in the Milw. Publ. Museum from the Magdalena Mts. (received from Prof. Snow). Front varying considerably in width in the females.

Baccha.

B. clavata Fabricius. Milwaukee Co., 3 males and 3 females. All have a yellow spot on each side of the first abdominal segment as observed by Hunter in a female from Nebraska (Can. Ent. XXIX, 30).

B. fascipennis Wiedemann. Milwaukee, Washington and Polk Cos.

Ocyptamus.

O. fuscipennis Say. Milwaukee Co.

Pyrophæna.

P. granditarsus Forster. Burnett Co.

P. rosarum Fabricius. Sheboygan Co. The occurrence of these circumpolar species of Pyrophæna in Wisconsin has been reported by the writer in the Can. Ent., Jan. 1910, pp. 28-29.

Platychirus.

P. hyperboreus Staeger. Milwaukee, Washington and Burnett Cos.

P. peltatus Meigen. Milwaukee, Sheboygan and Washington Cos.

P. quadratus Say. Milwaukee and Washington Cos.

Melanostoma.

M. mellinum Linné. Milwaukee, Washington, Douglas, Burnett and Polk Cos.

M. obscurum Say. Milwaukee and Washington Cos.

Eupeodes.

E. volucris Osten-Sacken. Milwaukee, Marathon and Burnett Cos.

Didea.

D. fasciata Marcquart. Milwaukee Co.

Syrphus.

S. americanus Wiedemann. Milwaukee, Washington, Douglass and Burnett Cos.

S. arcuatus Fallén. A specimen of this fly, var. *lapponicus* was taken by Dr. G. P. Barth at Milwaukee, April 26, 1908.

S. disjectus Williston. Douglas and Burnett Cos.

S. grossulariæ Meigen. Milwaukee Co.

S. ribesii Linné. Milwaukee, Washington, Marathon, Douglas and Burnett Cos.

S. torvus Osten-Sacken. Milwaukee Co.

S. umbellatarum Osten Sacken. Milwaukee, Marathon and Burnett Cos.

S. xanthostoma Williston. Milwaukee Co.

Allograpta.

A. obliqua Say. Milwaukee, Washington and Douglas Cos.

Xanthogramma.

X. æqualis Loew. 1 female specimen, Door Co., July 6, 1905. Frontal stripe to base of antennæ broad, covering a greater part of the surface than the yellow. On posterior margin of thorax 2 widely separated yellow spots. Length 12 mm.

X. divisa Williston. Milwaukee, Racine and Burnett Cos.

X. emarginata Say. Milwaukee, Douglas, Burnett and Polk Cos. Extremely variable as the following specimens from Milwaukee show. Male, Sept. 5, 1908: Typical, spots of 2nd abdominal segment attenuated near the lateral margins, and touching the latter. Female, Aug. 11, 1906: Bands of segments 2, 3 and 4 reaching the lateral margins. Band on segment 2 hardly interrupted, little attenuated laterally. Bands on segments 3 and 4 more attenuated, on 3 emarginate, on 4 narrowly interrupted. Female, Sept, 5, 1908: Similar to the last, but bands on segments 3 and 4 more attenuated, that on 4 touching the lateral margin very slightly. Male, June 22, 1898: Band on segment 2 not interruped, hardly touching the lateral margin. Bands on segments 3 and 4 not reaching the margin, the one on 3 emarginate, that on 4 narrowly interrupted. Material from the St. Croix region (5 specimens from Douglas, Burnett and Polk Cos.): not so variable, band on segment 2 only reaching the lateral margin.

X. flavipes Loew. 1 specimen taken at Milwaukee, May 27, 1898.

X. tenuis Osburn. (Can. Ent. XL, p. 8). A female specimen taken at Milwaukee, July 4, 1907, agrees with the description, but it has a broad band on femur and tibia of hind legs only. In size and form it is like *emarginata*.

Mesogramma.

M. geminata Say. Milwaukee, Washington, Door, Burnett and Polk Counties.

M. marginata Say. Milwaukee, Washington and Door Cos.

M. polita Say. Milwaukee Co.

Sphærophoria.

S. cylindrica Say. Milwaukee, Racine, Washington, Marathon, Douglas, Burnett and Polk Cos.

Neoascia.

N. distincta Williston. Milwaukee Co., 1 specimen taken May 13, 1898.

N. globosa Walker. 3 specimens from Milwaukee, 3 from Racine and 1 from Sheboygan Co. All have 2 interrupted reddish-yellow abdominal bands and a black ring on front and middle femora and tibiæ; they therefore represent Prof. Williston's "third variety" (Synopsis N. Am. Syrphidæ. p. 112). There is an additional variety in our region (4 specimens from Milwaukee Co.), in which the body is smaller and more slender, with bands on segments 2 and 3, which are not interrupted.

Rhingia.

R. nasica Say. Milwaukee, Washington, Marathon and Polk Cos.

Volucella.

V. evecta Walker. Milwaukee and Marathon Cos. 1 specimen (Milwaukee, June 22, 1908) represents var. *sanguinea* Will. In this the abdomen from the 4th segment on is covered with yellow pile; it shows in general a lighter coloration than the typical *erecta* from this locality, having lighter antennæ, and the yellow pile of thorax and 2nd abdominal segment, as also the reddish parts of the legs being of a lighter hue.

V. vesiculosa Fabricius. Milwaukee Co. Several specimens were taken by Dr. G. P. Barth from the nest of a wasp, a species of *Crabro*.

Sericomyia.

S. chrysotoxoides Macquart. Milwaukee Co.

S. militaris Walker. Milwaukee and Washington Cos.

Eristalis.

E. æneus Scopoli. Milwaukee Co.

E. bastardi Macquart. Milwaukee, Washington, Door and Douglas Cos.

E. dimidiatus Wiedemann. Milwaukee, Washington, Marathon, Ashland, Douglas and Burnett Cos.

E. flavipes Walker. Milwaukee, Washington and Burnett Cos.

E. meigenii Wiedemann. Milwaukee, Washington, Marathon and Douglas Cos.

E. saxorum Wiedemann. A specimen from Milwaukee in Dr. G. P. Barth's collection agrees fairly well with the description, but it has the posterior half of the scutellum yellow, and the posterior half of the 5th abdominal segment velvety black.

E. tenax Linné. Milwaukee, Washington and Douglas Cos.

E. transversus Wiedemann. Milwaukee, Racine, Washington, Door, Douglas and Polk Cos.

E. vinetorum Fabricius. 2 specimens from Milwaukee Co.

Tropidia.

T. quadrata Say. Milwaukee and Washington Cos.

Helophilus.

H. bilinearis Williston. Milwaukee Co.

H. bruesi n. sp.

Female.—Close to *latifrons* and *similis*. Length about 13 mm. Face black, the shining median stripe is black, broad, slightly narrowed above, and reaches the antennæ. Profile of the face beneath the antennæ is only slightly concave. Pile of scutellum yellow, without any mixture of black. First and second segments of abdomen as in *latifrons*. Third segment black, with a yellow spot on each side in the anterior corner. The black portion is shining except along the posterior margin, where there is an opaque band, produced in the middle into a round spot. Fourth segment entirely black, shining, with an opaque posterior band and an opaque spot, both of which are smaller than those on the third segment. Fifth segment black, shining, without pollen. Legs mainly black, the yellow markings confined to the tips of all the femora, the basal halves of the front tibi e, the basal two-thirds of the middle tibiæ and nearly the basal halves of the hind tibiæ. Claws yellow with black tips, pulvilli yellow. The 3 black dorsal stripes of the thorax are very broad, leaving 2 slender yellow stripes between them. Pleuræ black, not pollinose.

Type: Divide, Vilas Co., Wis., taken between June 24 and 30, 1907 (Cat. No. 25147), in the coll. of the Milw. Public Museum. I have named it in honor of my friend Mr. C. T. Brues, who, as a member of the Milw. Public Museum collecting expedition of 1907 collected the specimen.

As stated above this species resembles *H. latifrons* and *H. similis*, but it may be readily separated from either of these on account of its black face with the conspicuous black shining median stripe, the broader black stripes on the thorax above, the prevalence of black on the legs, and above all by the darker abdomen which has only one transverse interrupted yellow band, that on the second segment.

H. chrysostoma Wiedemann. Milwaukee and Washington Cos.

H. conostoma Williston. Milwaukee Co.

H. distinctus Williston. Milwaukee Co.

H. lætus Loew. Milwaukee and Washington Cos.

H. latifrons Loew. Milwaukee, Washington and Door Cos.

H. porcus Walker. 1 specimen taken between July 17 and 22, 1909, at the St. Croix dam in Douglas Co. answers Walker's description in most points, but the hairs of the body are dirty brown, not black, and the front and middle legs only have the knees light colored. Besides, this color is a light yellow and not ferruginous as in Walker's description.

H. similis Macquart. Milwaukee, Washington and Door Cos.

Mallota.

M. cimbiformis Fallén. Milwaukee and Washington Cos.
M. posticata Fabricius. Milwaukee and Washington Cos.

Triodonta.

T. curvipes Wiedemann. Milwaukee Co.

Teuchocnemis.

T. lituratus Loew. 2 specimens from Milwaukee Co.

Syritta.

S. pipiens Linné. Milwaukee. Washington, Marathon and Douglas Cos.

Xylota.

X. angustiventris Loew. Milwaukee Co.
X. anthreas Walker. 1 specimen, Douglas Co.
X. chalybea Wiedemann. Milwaukee Co.
X. ejuncida Say. Milwaukee, Marathon, Douglas, Burnett and Polk Counties.
X. fraudulosa Loew. Milwaukee, Washington and Douglas Cos.
X. obscura Loew. Sheboygan Co.

Crioprora.

C. cyanogaster Loew. Milwaukee Co.

Criorhina.

C. analis Macquart. Milwaukee Co.
C. decora Macquart. Milwaukee Co.
C. intersistens Walker. Milwaukee Co.

Milesia.

M. virginiensis Drury. Milwaukee Co.

Spilomyia.

S. fusca Loew. Milwaukee, Ozaukee, Washington and Burnett Cos.
S. hamifera Loew. Milwaukee Co. 1 specimen in Dr. Barth's collection.
S. longicornis Loew. Milwaukee and Washington Cos.
S. quadrifasciata Say. Milwaukee and Washington Cos.

Temnostoma.

T. æqualis Loew. Douglas Co.

T. bombylans Fabricius. Milwaukee, Washington and Douglas Cos. This species varies considerably in size, 3 specimens from Douglas Co. ranging between 6 and 14 mm. in length.

Ceria.

C. abbreviata Loew. Milwaukee and Washington Cos.

CONOPIDÆ.

Conops.

C. brachyrhynchus Macquart. Milwaukee and Burnett Cos. In our specimens the facial grooves are slightly darkened, otherwise as in the description.

C. sylvosus Williston. 1 specimen from Burnett Co. The red on the side of the second segment is hardly noticeable. Length only 6 mm. (9-11 mm. according to the description). The long hairs on vertex, thoracic dorsum and sides of first abdominal segment to which Prof. Williston has called attention are very distinct.

C. xanthopareus Williston. Milwaukee, and St. Croix Cos. The abdomen is red with very little black, while in the description the black is referred to as the prevailing color.

Physocephala.

P. affinis Williston. Milwaukee, Washington, Douglas and Burnett Cos.

P. furcillata Williston. Door, Marathon, Douglas, Burnett, Polk and St. Croix Counties.

P. marginata Say. Milwaukee Co.

P. tibialis Say. Milwaukee and Washington Cos.

Zodion.

Z. bicolor Adams. 1 specimen from Burnett Co. (Yellow River, July 31, 1909). This is smaller than the type, only 4 mm. long, but in a general way it agrees with the description.

Z. fulvifrons Say. Milwaukee, Washington, Douglas, Burnett and Polk Cos.

Z. lativentre Graenicher. Described from a specimen collected at the mouth of the Yellow River in Burnett Co., July 13, 1909. Type: Cat. No. 29257 Milwaukee Public Museum.

Z. pygmæum Williston. Milwaukee and Douglas Cos.

Eccemyia.

E. abbreviata Loew. Milwaukee, Washington, Racine and St. Croix Counties.

E. loraria Loew. Milwaukee, Washington and Douglas Cos.

Myopa.

M. clausa Loew. Milwaukee Co.

M. pilosa Williston. Milwaukee and Washington Cos.

M. plebeia Williston. Burnett Co., 1 specimen July 29, 1909. Somewhat differing from the description. Front black, red on sides and below only. The red on lateral margins and posterior segments of abdomen very dark, not at all distinct. Bases of femora, knees and tarsi yellowish, otherwise legs black, with a reddish tinge.

Public Museum, Milwaukee, Wis.
February 12, 1910.

NOTES AND DESCRIPTIONS OF NORTH AMERICAN PARASITIC HYMENOPTERA. VIII.

By Charles T. Brues.

FAMILY BETHYLIDÆ.

Lælius fumipennis sp. nov.

Female. Length 2.5 mm. Black; legs, except coxæ, and base of antennæ honey-yellow. Head as wide as long, semicircularly narrowed behind the eyes. Antennæ 13-jointed, about twice as long as the head; black, the first two joints honey yellow and the third brownish at the base. Pedicel about one-half longer than the first flagellar joint; second flagellar joint longer than the first, following growing slightly shorter, nearly quadrate; apical joint acute. Head above shagreened, with a few coarse punctures intermixed. Ocelli in a small equilateral triangle on the vertex. Eyes oval, removed by two-thirds of their length from the base of the mandibles. Mandibles apparently 4-toothed. Maxillary palpi 5-jointed; labials 3-jointed. Underside of head shining, punctulate. Thorax shining, faintly punctulate; pronotum very slightly longer than the mesonotum and scutellum together; these of about equal length, the scutellum with a transverse, slightly arcuate impressed line across the base; mesonotum without furrows. Superior face of metanotum as long as the pronotum and mesonotum combined, with three complete longitudinal discal carinæ, the median one of which continues down the posterior slope; between these carinæ and the lateral raised margin is another carina which extends only to the middle of the superior face. Entire metathorax finely transversely rugulose between the carinæ. Propleura with a round foveate depression just above the coxa; mesopleura punctulate, with a similar small fovea centrally and with a slightly impressed oblique line along its posterior edge; metapleura with a similar, more nearly vertical impressed line near the base, its surface punctulate. Abdomen as long as the thorax, smooth and shining; second segment as long as the following taken together. Legs stout, the femora thickened; the tibiæ fringed with hairs, but not spinose. Wings hyaline basally, strongly infuscated on their apical half; nervures pale brown. Median and submedian cells completely closed, of equal length on the externo-median nervure. Stigma very minute, about twice as long as thick; marginal vein as long as the linear stigma, straight. Body sparsely set with conspicuous black hairs.

Described from a female specimen collected by Professor W. M. Wheeler at Forest Hills, Mass.

This is the fifth species to be discovered and may be distinguished by the aid of the following key:

Lælius Ashmead.

1. Wings conspicuously bicolored; basal half hyaline, apical half fuscous .... **fumipennis** Brues.
   Wings hyaline or evenly somewhat grayish 2
2. Legs entirely yellow or rufous 3
   Legs with all coxæ and femora except tips of the latter, black. **trogodermatis** Ashmead.
3. Superior face of metathorax with four discal carinæ. **rufipes** Ashmead.
   Superior face of metathorax with three discal carinæ. **tricarinatus** Ashmead.
   Superior face of metathorax with one discal carina. **nigripilosus** Ashmead.

FAMILY SCELIONIDÆ.

Hadronotus robustus Brues.

Bull. Wisconsin Natural History Society, Vol. 5, p. 156, (1907).

This species occurs also at Fayetteville, Arkansas, from whence Dr. C. F. Adams has sent me a male specimen. The male is very similar to the female first described, differing mainly in the conformation of the antennæ. These are quite distinctly thickened from the base of the flagellum and the pedicel is scarcely over half the length of the first flagellar joint, while the second and following joints are quadrate or slightly moniliform.

The following dichotomy will serve to distinguish the species of *Hadronotus* at present known to occur in North America.

Hadronotus Förster (females)

1. Head and thorax smooth, punctulate or shagreened........... 2
   Head and thorax coarsely punctate or rugose................. 5
2. Head shagreened 3
   Head distinctly punctate or opaque......................... 4
3. Pedicel longer than the first flagellar joint; scape honey-yellow ....**largi** Ashmead.
   Pedicel shorter then the first flagellar joint; scape dark rufous ....**mesillæ** Cockerell.
4. Abdomen beyond the second segment punctate.
   leptocorisæ Howard.
   Abdomen beyond the second segment smooth, shining.
   myrmecophilus Ashmead.
5. Female with abbreviated wings..........**brevipennis** Harrington.
   Female fully winged.. 6
6. Head with two facets on the vertex between the ocelli; scape and legs honey-yellow..................**carinatifrons** Ashmead.
   Head with the vertex simple................................ 7
7. Coxæ brownish yellow 8
   Coxæ black 9
8. Abdomen with coarse longitudinal cribrate rugosites on all the segments; smooth and polished along the sutures.
   rugosus Howard.
   Abdomen cribrate rugose, the first segment with deep coarse striæ; the following smoother; segments not smooth along the sutures ....**floridanus** Ashmead.
   Abdomen finely evenly rugose; the first segment striate at the base ....**anasæ** Ashmead.
9. Legs brownish yellow; wings subfuscous; marginal vein in wing nearly as long as the stigmal..........**rugiceps** Ashmead.
   Legs black, except knees, tibiæ and tarsi; wings hyaline; marginal vein about one-half the length of the stigmal.
   robustus Brues.

FAMILY PLATYGASTERIDÆ.

Eritrissomerus Ashmead.

Table of Species.

1. Body rufo-piceous; antennæ, except apex, yellow..**pallipes** Harrg.
   Body black; antennæ black or piceous; brownish-yellow in the male 2

2. Vertex rugulose; legs more or less black........**cecidomyiæ** Ashm.
Vertex transversely aciculate; legs yellow, rarely somewhat infuscated.......... ....**noveboracensis** sp. nov.

Eritrissomerus noveboracensis sp. nov.

Male. Length 2mm. Black; legs yellow, sometimes infuscated on the hind femora; antennæ piceous brown, scape lighter brown. Head slightly wider than the thorax, very much contracted behind the eyes; about twice as wide as thick. Vertex and occiput finely transversely aciculated. Lateral ocelli more than their diameter removed from the eye-margin, about as close as to the median ocellus. Front punctate or slightly transversely aciculate, with a smooth, median, slightly impressed line below the anterior ocellus. Face transversely striate. Cheeks sparsely punctate. Mandibles ferruginous. Antennæ 10-jointed; scape reaching to the median ocellus; pedicel obovate, twice as long as the first flagellar joint which is half as long and only about one-third as wide as the greatly swollen second joint; two following joints narrow, each about one-half longer than wide; following growing shorter except the last which is longer, narrower and acuminate. Mesonotum elongate, with two very distinct, complete parapsidal furrows which are closely approximated; its surface shining, faintly punctulate. Scutellum very convex, rounded, with a very distinct carinate margin. Pleuræ smooth, shining; the mesopleura with a large impression below and with a few coarse striæ just beneath the tegulæ. Collar below on the sides closely punctulate. Metapleura thinly hairy, not striated, with a short basal carina above, which forms a triangular area with a second oblique carina lower down on the metapleura. Abdomen elongate, pointed, about one-third longer then the head and thorax united. Petiole and basal third of second segment finely striated, the striæ on the sides of the second segment shorter; second segment nearly as long as the following united. Legs bright or honey yellow; coxæ black and the four posterior tibiæ sometimes infuscated. Wings hyaline, with a slight yellowish tinge.

Described from two specimens (a1360) bred by Dr. E. P. Felt at Albany, New York, April 5th, 1907 from a Cecidomyid gall. A third specimen (a1339) was reared May 7, 1907.

The species looks very much like certain species of *Polygnotus*, but the peculiar swollen condition of the second flagellar joint, characteristic of males of the present genus will readily serve to distinguish from that very extensive genus.

Aneuron gen. nov.

Similar to *Polygnotus*, but differing in the structure of the antennæ which have the pedicel and the first and second flagellar joints elongated, slender and of equal length in the female. In the male they are also lengthened, and the second flagellar joint is scarcely at all thickened. Otherwise the type species might be readily mistaken for a true *Polygnotus*.

Aneuron anormis, sp. nov.

Female. Length 2.2 mm. Black; antennæ, except club, and legs, except coxæ, reddish yellow; the thickened parts of the femora very slightly infuscated. Head broad, slightly wider than the thorax; two and one-half times as wide as thick. Ocelli in a triangle, the lateral ones well removed from the eye-margin, but closer to it than to the median ocellus. Eyes oval, slightly, but distinctly pubescent. Vertex quite sharp above, but not distinctly carinated, except indistinctly so on the sides close to the eyes; transversely striate; on the occiput with vertical striæ. Cheeks punctulate, as long as the eye-height. Front finely punctulate; face coarsely transversely striate. Antennæ 10-jointed; slender, scape reaching to the ocelli, straight and slender; pedicel, first and second flagellar joints elongate, slender, of approximately equal length and together over three-fourths as long as the scape; following joints moniliform; one-half as long as the second flagellar; apical five joints forming a slender club, but of equal length; last slightly longer, more slender. Thorax more elongate than in species *Polygnotus*. Pronotum visible above as a line. Mesonotum nearly smooth; subshining, without traces of parapsidal furrows except near the base of the scutellum where they are very close together, defining a narrow truncate lobe which projects slightly over the depression across the base of the scutellum. Scutellum transverse, very convex, separated from the mesonotum by a very deep depression; sharply declivous behind and with a thin reflexed margin especially noticeable on the sides. Metathorax very short. Propleuræ punctulate above, smooth below; mesopleura polished, with a curved or slightly angulate depression below the middle. Metapleuræ thinly pubescent, with a carina defining their upper edge, and with a second one above the middle which forms a triangular area with the marginal carina and the mesopleural suture. Abdomen as long as the head and thorax together, pointed apically. First segment of abdomen subpetiolate, half as long as the second, its median third elevated and bounded laterally by two longitudinal carinæ which are united across the middle of the segment by a transverse carina. Second segment with a fovea on each side half way to the margin; between, and from each of the foveæ with a fan-shaped series of extremely delicate aciculations which reach nearly to the middle of the segment; third, fourth and fifth segments equal, short; sixth triangular, but rounded at the tip, twice as long as the preceding. Legs as in *Polygnotus;* yellow with the coxæ black, and the posterior femora and tibiæ somewhat infuscated. Wings hyaline, veinless.

Male. Differs from the female mainly in the form of the antennæ. The first flagellar joint is shorter, only about two-thirds as long as the pedicel which is equal to the second flagellar joint. The latter is somewhat thickened and arcuate, stouter at the tip. The antennæ are entirely yellow.

Described from nine specimens bred by Dr. E. P. Felt from Cecidomyid galls collected at Albany, New York, and Beverly, Massachusetts.

FAMILY BRACONIDÆ.

SUBFAMILY BLACINÆ.

Brachistes magdali sp. nov.

Female. Length 5.5 mm. Ovipositor 2. mm. Shining black, the plapi, base of antennæ, tegulæ and legs, including the coxæ, honey-yellow. Head full behind the eyes, transverse, twice as wide as thick. Eyes oval, bare, removed from the hind margin of the head by their own width and from the base of the mandibles by one-half their width; inner margins parallel. Vertex and head behind polished, with scattered delicate punctulate sculpture; the posterior margin very distinct. Ocelli in a small, nearly equilateral triangle. Antennæ 33-34-jointed, filiform, about as long as the body. Scape oval, pedicel globose; first flagellar joint three times as long as thick, slightly longer than the scape; second as long as the first, the following gradually growing shorter until those near the apex which are but one-half longer than thick. Maxillary palpi five-jointed, as long as the head-height; labials three-jointed, the first joint very short. Face sparsely punctulate, griseous pubescent. Clypeus strongly elevated, its anterior margin almost straight. Mandibles rufous. Thorax elongate, shining. Mesonotum with punctate parapsidal furrows, which converge before reaching the scutellar fovea; scutellum strongly convex at the base, with a large depression which is rugulose and indistinctly divided by a raised median line. Metanotum rugose, indistinctly areolate; medially at the base with a short carina which bifurcates to form two carinæ extending to the posterior angles; several other irregular and indistinct carinæ present. Pro- and mesopleuræ smooth, the former with a longitudinal depression which has a series of small foveæ along its base, and with a few short grooved lines posteriorly. Mesopleura behind with a row of large punctures and a small fovea in the middle near the posterior margin. Abdomen nearly as long as the thorax, first segment with a strongly elevated carina arising at each anterior angle, converging and becoming less prominent behind; irregularly longitudinally striated but less conspicuously so along the median concavity between the discal cariæ, following segments polished, smooth; second and third segments equal, together one-half longer than the first; fourth, fifth and sixth growing shorter, others still shorter. Ovipositor as long as the abdomen, its sheaths black, hairy. Legs rather stout, honey yellow or pale fulvous, including the coxæ; the hind tibiæ with a piceous stripe above, wings hyaline; veins and stigma piceous; the latter broad, as wide as the transverse cubitus; radial cell pointed, one-third longer than the stigma; first section of radius one-half as long as the transverse cubitus; discoidal cell sessile above, the recurrent nervure received at a distance before the tip of the first cubital cell equal to the length of the first section of the cubitus; submedian cell slightly longer than the median; second discoidal cell closed at its lower apical angle; anal cell with two short stumps of veins above.

Male. Length 4½ mm. Otherwise like the female.

Described from two females and one male bred by Mr. C. W. Johnson at Wellesley, Mass., May 25th, from *Magdalis olyra* Hbst. Type in the Museum of the Boston Society of Natural History.

SUBFAMILY HECABOLINÆ.

Monolexis lycti Cress.

This species was originally described by Cresson (Am. Entom. III, p. 24) as an *Anisopelma* and later placed by him in *Hecabolus* in his classification of North American Hymenoptera. I have seen specimens bred by Mr. C. W. Johnson from the same host, *Lyctus striatus* Say, at Framingham, Mass., which agree perfectly with Cresson's description, but belong in the genus *Monolexis* Förster.

Bussey Institution, Harvard University.
February 5, 1910.

NEW RECORDS OF WISCONSIN DRAGONFLIES.

By Richard A. Muttkowski.

The interesting material secured by the St. Croix Expedition of the Milwaukee Public Museum, together with a number of records obtained by the museum through purchase of a collection of Lepidoptera, which included a few Odonata, form a series of records for students of distribution. While neither collection was very thorough owing to the different bent of the collectors, some conclusion as to the general faunal aspects of the region is possible. Thus, the St. Croix material, at least that which was collected in the first lap, shows decided boreal leanings, which suggests a continuation of the Lake Superior strip of the boreal region down the St. Croix River. Farther south, below the St. Croix Dam, the material is more transitional in character.

The Howieson material—(I prefer to designate thus briefly the purchased material by the collector's name), as far as it is from Wisconsin, is wholly from Chippewa Falls, in the midst of the Transitional region. Although I have examined all the Wis. Odonata of this collection I cite only the more important records.

In addition, occasional reference is made to several minor lots, from various localities, chiefly Cedar Lake, Washington Co., collected by Dr. S. Graenicher, and Milwaukee and its surroundings.

The asterisk before a species signifies that the species is new to state lists.

Agrion maculatum Beauvais.

St. Croix Dam, Douglas Co., July 17-22, 1909; 8 males, 7 females.
Nemakagon River, Burnett Co., July 25-26, 1909; 4 males, 4 females.

As usual there is some variation in the size of the specimens. Abdomen: males 34-38 mm., females 34-36 mm.; hind wing: males 27-29 mm., females 30-34 mm.

Agrion æquabile Say.

St. Croix Dam, Douglas Co., July 17-22; 11 males, 7 females.

Nemakagon River, Burnett Co., July 25-26, 1909; 1 male, 2 females.

Yellow River, Burnett Co., July 28-31; 1 male.

The females of this material offer an interesting series, in which, besides the generally brown color of the wings, the apices of all wings are more or less infuscated. In two specimens this infuscation is so intense as to resemble that of the male. In a third specimen it is entirely absent in the fore wongs, while the hind wings are but faintly darkened in the apical region.

Lestes unguiculatus Hagen.

St. Croix Dam, Douglas Co., July 17-22, 1909; 1 male.

Cedar Lake, Washington Co., Aug. 21, 1909, 1 male; Aug. 29, 1 male, 1 female; Aug. 30, 4 males, 3 females.

Argia putrida Hagen.

St. Croix Dam, Douglas Co., July 17-22, 1909; 20 males, 11 females.

Cedar Lake, Washington Co., Aug. 21, 1909, 1 male, 2 females; Aug. 29, 1 male; Aug. 30, 1 male. 1 female; Aug. 31, 1 male, 2 females.

This species is common all over the state. It appeared in greater numbers last summer than ever before. On favorable days the grasses and bushes in sunny places along the Milwaukee River were fairly covered with the bluishly pruinose males and brownish females of this rapidly aging species.

Argia violacea Hagen.

Cedar Lake, Washington Co., Aug. 21, 1909, 4 males.

Enallagma hageni Walsh.

Solon Springs, Douglas Co., July 7-15, 1909; 3 males, 2 females.

St. Croix Dam, Douglas Co., July 17-22, 1909; 6 males, 4 females.

Cedar Lake, Washington Co., Aug. 29, 1909; 1 male.

Enallagma caruculatum Morse.

St. Croix Dam, Douglas Co., July 17-22, 1909; 2 males, 2 females.

Cedar Lake, Washington Co., Aug. 25, 1909; 5 males, 1 female.

Enallagma calverti Morse.

Johnson's Woods, Milwaukee Co., June 28, 1909; 1 male.

Soldiers' Home, Milwaukee, Wis., Aug. 28, 1909; 1 male, 2 females.

Enallagma signatum Hagen.

St. Croix Dam, Douglas Co., July 17-22, 1909; 1 male, 2 females.

This beautiful species, which because of its yellow and brown tints and the striking form of the appendages cannot be easily confused with another, has been taken in only one other locality in the state. Diligent search in the vicinity of Milwaukee has thus far not revealed the species, although it is regional. I have recently seen a pair of this species from Agricultural College, Mississippi.

* **Enallagma divagans** Selys.

St. Croix Dam, Douglas Co., July 17-22; 1 male, (?) 1 female.

This species has hitherto not been considered regional. It was therefore with considerable surprise that I discovered the single male in the St. Croix material. The specimen is in perfect condition, little, if at all, faded, prettily marked with blue, black, and green. It measures: abdomen 21 mm., hind wing 15 mm., which is slightly smaller than recorded by Williamson. A teneral female which appears to belong to none of the other species of *Enallagma* from St. Croix Dam, I have referred here temporarily.

Ischnura verticalis Say.

St. Croix Dam, Douglas Co., July 17-22, 1909; 4 males, 5 black females.

Cedar Lake, Washington Co., Aug. 29, 1909; 1 male; Aug. 39, 1 male; Aug. 31, 3 black females, 1 orange female.

* **Chromagrion conditum** Hegan.

Chippewa Falls, Chippewa Co., June 23, 1900; 1 male, 1 female; Coll. Howieson.

Another species not considered regional. Thus far known from the Atlantic States to Quebec and Indiana. The sinuous outline of the black dorso-thoracic stripe, and the equally long subparallel appendages of the male distinguish the species and genus from all other regional *Cœnagrionines*.

Ophiogomphus rupinsulensis Walsh.

Yellow River, Burnett Co., July 17-22, 1909; 1 male.

Chippewa Falls, Chippewa Co., May 26, 1900; 2 teneral females; June 22, 1 male; July 13, 1 female; Coll Howieson.

The single male from Yellow River is full grown and well preserved.

* **Ophiogomphus carolinus** Hagen.

Yellow River, Burnett Co., July 28-31, 1909; 1 female.

The specimen is not fully developed, though all the usual markings are clear. At first I took the specimen for *O. rupinsulensis*, as it is identical with representatives of that species in every respect, except the vulvar lamina. These agree closely with Needham's figure in the Canadian Entomologist, vol. 31, pp. 233-238, 1899; pl. 5, ff. 8, 17, 26, 35. Hagen's description refers to the nymph alone, although he had the adults; of the latter no description has been published. It is therefore impossible to verify this determination by comparison with a description. The possibility that the form of the vulvar scale was changed by compression I do not concede in this case, as the specimen is in perfect condition and shows no indication of pressure at any point of its anatomy. Further, the vulvars of four females of *O. rupinsulensis*, with which I have compared this specimen, exhibit no tendency towards variability.

This record is all the more surprising as the species has thus far been recorded from North Carolina alone.

Gomphus quadricolor Walsh.

Cement Mills, Milwaukee River, Milwaukee Co., July 15, 1909; 1 female.

Gomphus fraternus Say.

Chippewa Falls, Chippewa Co., May 26, 1900; 2 females; May 30, 1 male; June 30, 2 females.

* **Gomphus ventricosus** Walsh.

Yellow River, Burnett Co., July 28-31, 1909; 1 female.

The first specimen of this species taken in the state.

Gomphus spicatus Hagen.

Yellow River, Burnett Co., July 28-31, 1909; 6 males, 3 females.

* **Gomphus spiniceps** Walsh.

Yellow River, Burnett Co., July 28-31, 1909; 1 male.

Mr. Williamson of Bluffton, Ind., determined this and the following species, *notatus*.

* **Gomphus notatus** Rambur.

Yellow River, Burnett Co., July 28-31, 1909; 1 female.

* **Boyeria vinosa** Say.

St. Croix Dam, Douglas Co., July 17-22, 1909; 1male.

* **Aeshna eremita** Scudder.

St. Croix Dam, Douglas Co., July 17-22, 1909; 1 male.

Chippewa Falls, Chippewa Co., July 18, 1899; 1 male; Howieson Collection.

In the male from Chippewa Falls the thorax and abdomen have been opened, without injury to the genitalia, the contents removed, and the cavities filled with absorbent cotton. As a result all the natural colors of this species are preserved.

Aeshna canadensis Walker.

St. Croix Dam, Douglas Co., July 17-22, 1909; 1 male.

Chippewa Falls, Chippewa Co., (no date, probably 1900); 1 female.

Cedar Lake, Washington Co., Aug. 31, 1909; 1 female. Howieson Collection.

Aeshna umbrosa Walker.

Chippewa Falls, Chippewa Co., (no date), 1900; 2 males.

* **Dorocordulia lepida** Hagen.

Solon Springs, Douglas Co., July 7-15, 1909; 1 female.

I have not seen the female of *D. libera*. The females of *D. libera* and *lepida* are said to resemble each other in markings, with the difference that the abdomen of *D. libera* is spatulate apically. The present specimen has the apical segments of the abdomen but slightly enlarged.

Tetragoneuria spinigera Selys.

St. Croix Dam, Douglas Co., July 17-22, 1909; 1 male.

Tetragoneuria cynosura Say.

Solon Springs, Douglas Co., July 7-15, 1909; 1 male.

Tetragoneuria semiaquæa Burmeister.

Solon Springs, Douglas Co., July 7-15, 1909; 6 males.

St. Croix Dam, Douglas Co., July 17-22, 1909; 17 males.

Of this series six specimens have more than four antenodals in the hind wings; in three of these the fifth antenodal is entire; in the three others the additional antenodal shows a tendency to break up, so that there are from five to seven cross veins in the costal series and four in the subcostal series, or vice versa. As to the extent of the fuscous blotches of the hind wings, these are quite uniform, reaching to the level of the third antenodal and a little beyond the triangle; more and less each in one specimen.

Macromia illinoiensis Walsh.

Chippewa Falls, Chippewa Co., June 5, 1900, 2 males; June 16, 1 male, 2 females; July 1, 1901, 1 male.

These specimens show no differences from those listed by Williamson in his recent monograph of the genus *Macromia* (Proc. U. S. Nat. Mus., 37, pp. 369-398, 1909; pls. 35, 36; t. ff. 7).

Libellula quadrimaculata Linné.

St. Croix Dam, Douglas Co., July 17-22, 1909; 1 male, 1 female.

Ladona exusta Say.

Solon Springs, Douglas Co., July 7-15, 1909; 2 males.

St. Croix Dam, Douglas Co., July 17-22, 1909; 9 males, 3 females.

Both Calvert (Biologia Centralia Americana) and Ris (Catalogue Collections Selys) have rejected Needham's genus *Ladona*. Calvert finds a "variation of 20% toward *Libellula*", as the type of which he designates *L. quadrimaculata*. This is contrary to Kirby and Selys *(L. depressa,)* whom I have followed in my catalogue. Hence a comparison between a series of the type species of *Libellula* and *Ladona* must be the final criterion for the rejection or retention of the genus *Ladona*.

Libellula luctuosa Burmeister.

Cedar Lake, Waschington Co., Aug. 30, 1909; 1 male.

Perithemis domitia Drury.

Cedar Lake, Washington Co., Aug. 21, 1909; 1 male.

Sympetrum obtrusum Hagen.

St. Croix Dam, Douglas Co., July 17-22, 1909; 8 males.

Cedar Lake, Washington Co., Aug. 21, 1909; 2 males; Aug. 29, 1 male; Aug. 30, 2 males, 3 females.

Sympetrum vicinum Hagen.

North Hudson, St. Croix Co., Aug. 13-14, 1909; 2 males, 5 females.

Cedar Lake, Washington Co., Aug. 30, 1909; 1 male.

Sympetrum sp. Muttkowski.

North Hudson, St. Croix Co., Aug. 13-14, 1909; 1 male.

This is identical with the specimen from Fox Lake, Dodge Co., which I noted in the Bulletin of this Society (Vol. 6, p. 167, 1909). Like that specimen this male is also a teneral, and differs from normal forms of *S. costiferum* only in the number of denticles on the superior appendages and the entirely black tarsi. Both resemble teneral *S. costiferum* in that the costal area of all wings is flavescent.

Celithemis eponina Drury.

Cedar Lake, Washington Co., Aug. 30, 1909; 1 male, 1 female.

Leucorrhinia glacialis Hagen.

St. Croix Dam, Douglas Co., July 17-22, 1909; 15 males, 7 females.

It is well to call attention to E. B. Wilson's paper on Dragonflies of the Mississippi Valley (Proc. U. S. Nat. Mus.. 36. pp 653-671. 1909), in which several other species new to Wisconsin are listed. These are:

* **Gomphus vastus** Walsh from Prescott and La Crosse, Wis.

* **Didymops transversa** Say from Prescott, Wis.

* **Argia tibialis** Rambur from Prairie du Chien. Wis.

The following species which Mr. Wilson lists from surrounding localities probably occur in Wisconsin also:

Gomphus villosipes Selys from St. Paul, Minn.

Gomphus crassus Hagen from Red Wing, Minn.

Gomphus amnicola Walsh from Red Wing. Minn.

Enallagma geminatum Kellicott from Muscatine. Iowa.

Gomphus descriptus Banks from Burlington, Iowa.

These records increase the number of species taken in Wisconsin to 99, distributed as follows:

Subfamily	No. of genera	No. of species.
Agrioninæ	2	4
Lestinæ	1	7
Cœnagrioninæ	6	19
Cordulegasterinæ	1	2
Gomphinæ	4	18
Aeshninæ	5	10
Corduliinæ	6	11
Libellulinæ	11	28
Total. - - - - -	36 genera.	99 species.

Public Museum, Milwaukee, Wis.
January 11, 1910.

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Vol. 2, No. 2, "Spiders of the Marptusa Group of the Family Attidæ," G. W. & E. G. Peckham, Nov., 1894.

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.

"The Wisconsin Archeologist," Vol. I, No. 1, Oct., 1901; Vol. I, No. 2, Jan., 1902; Vol. I, No. 3, Apr., 1902; Vol. I, No. 4, July, 1902; Vol. II, No. 1, Oct., 1902, each .... 25 cents

This publication is now issued by the Wisconsin Archeological Society of Milwaukee, from whom the later volumes may be obtained.

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Vol. 8 APRIL, 1910 No. 2

BULLETIN

OF THE

Wisconsin Natural History Society

PUBLISHED WITH THE
COOPERATION OF THE

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The Wisconsin Natural History Society,

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ORGANIZED MAY 6. 1857.

OFFICERS AND DIRECTORS.

PUBLICATION.

The "Bulletin of the Wisconsin Natural History Society."

Matter intended for publication should be sent to the editor of the Bulletin, who will transmit it to the associate editor of the proper department for consideration.

EDITORS.

MEETINGS.

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room at the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

MEMBERSHIP DUES.

Active Members, $3.00 per annum; Junior Members, $1.00 per annum; Corresponding Members, $2.00 per annum; Life Members, one payment of fifty dollars.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 8. APRIL, 1910. No. 2

PROCEEDINGS.

Milwaukee, Wis., Jan. 13. 1910.

Meeting of the combined sections.

Vice-president Ward in the chair. Nine people present.

Minutes of the last meeting read and approved.

Mr. Ward announced that Miss Florence Olcott, 686 National Ave., and Mr. Hermann B. Beckmann, 668 Buffum St., had been elected to active membership in the society by the board of directors.

Mr. Ward then read two communications addressed to him by Mr. Beatty, the secretary of the Wisconsin Academy of Science, Arts and Letters, announcing the meeting of the Academy in Milwaukee on Feb. 17th and 18th and asking the society to co-operate by attendance at the meetings and by the presentation of papers. Dr. Graenicher moved that the society accept the invitation to co-operate and that Mr. Ward be requested to so inform the secretary of the Academy. Seconded by Mr. Colles and passed.

Mr. Ward then gave a resume of his December talk on migration of Mammals and Birds together with the chief theory of the migration of birds. He also cited some of the most interesting specific incidences of the migration of seals.

A spirited discussion was then held on the applicability of the theory that migration of birds originated in the glacial epoch. The following members participated in the discussion: Dr. Graenicher, Dr. Dernehl, Miss Elmer, Messrs. Colles, Ward, and Carpenter.

Upon motion the meeting then adjourned.

Milwaukee, Wis., Jan. 27, 1910.

Regular meeting of the society.

Vice-president Ward in the chair. At least 60 people present.

Minutes of the last regular meeting read and approved.

The order of business was reversed and Dr. S. Barrett, of the Public Museum, gave an interesting lecture on the Cayapa Indians of Ecuador. The lecture was illustrated with lantern slides.

After five minutes intermission at the close of the lecture the regular business was taken up.

The resignation of Mr. C. T. Brues as editor of the bulletin was read and accepted by the members. Two communications addressed to Mr. Ward by Mr. Beatty of the Wisconsin Academy of Science were read by the secretary; one expressing the pleasure of the Academy in the Society's agreement to co-operate in the joint meeting of the Wisconsin Scientific societies in February, the second letter announcing that the Academy had accepted an invitation to attend a dinner at Milwaukee Downer College on the evening of Feb. 17th. The latter point was brought to discussion and finally accepted by the members.

Mr. Ward then requested all members who intended to read any paper during the joint meeting to place the title in the hands of the secretary by Feb. 3rd, so that they could be transmitted to the Secretary of the Academy in time to be included in the printed program.

Upon motion the meeting then adjourned.

Milwaukee, Feb. 10, 1910.

Meeting of the combined sections.

President Barth in the chair. 37 people present.

Minutes of the last section meeting read and approved.

The nomination of Mr. Bernard Brah, Public Museum, for membership was presented; he was subsequently elected by the board of directors at their meeting.

President Barth announced that the February program of the Nature of Poisons had been postponed until March.

Mr. Charles C. Carpenter then spoke on the subject Laying Out The Home Grounds. He advocated a general parking system for the residence sections of the city; where lots are narrow he advised the removal of fences and the terracing of fronts, while for the larger plots landscape gardening would be permissable. The talk was illustrated with black-board diagrams.

Mr. I. N. Mitchell took up the subject of Plant Breeding; he outlined briefly the cellular process which takes place after grafting of plants, showing the various stages of cell development in black-board diagrams.

A rather lengthy discussion was held on the advisability of labeling plants and trees in public parks, in which the following members participated: Messrs. Carpenter, Ward, Burrill, Colles, Russel, Mitchell, and Dr. Dernehl.

Upon motion the meeting then adjourned.

Milwaukee, February 24, 1910.

Regular meeting of the society.

President Barth in the chair. 29 people present.

The secretary being absent, Mr. Burrill was appointed secretary pro tem. Minutes of the last meeting read and approved.

President Barth announced the election of Mr. B. Brah, Public Museum, to active membership. The following nominations were presented: Mr. Robert Almer Harper, 444 N. Charter, Madison, Wis., nominated by Mr. H. L. Ward for corresponding member, and Mr. Herbert F. Haessler, 828 Booth St., Milwaukee, nominated for Junior membership by Dr. P. H. Dernehl. Both nominations referred to the board of directors for action and were subsequently elected.

Mr. Ward then read the following resolutions, a petition on Bill H. R. 10276:

WHEREAS, one of the greatest if not the greatest obstacles toward the securing of adequate legislation in the separate states of these United States, and particularly in the State of Wisconsin, satisfactorily preserving the wild birds against extermination or a material lessening of their numbers, has been a lack of uniform or equivalent laws in the various states; and

WHEREAS, the suitable protection of such birds is a matter of very considerable economic importance as well as of scientific interest; and

WHEREAS, there has been introduced into Congress a bill looking toward the enactment and enforcement of uniform rules regulating the taking or destruction of such birds; therefore be it

Resolved, that the Wisconsin Natural History Society favors the passage of Bill H. R. 10276, by Mr. Weeks, providing for such regulation and requests the Wisconsin members of Congress to vote for this bill and to use their influence to secure its passage; and

Resolved, that the secretary of the Natural History Society be instructed to mail a copy of these resolutions to each Senator and Representative from Wisconsin to the United States Congress.

Mr. Ward moved that the resolutions be accepted. Seconded by Mr. Howland Russel. Carried.

Mr. Howland Russel read a resolution providing for the labeling of trees and schrubs in sections of public parks, as follows:

WHEREAS, some means of learning the names of the trees and shrubs in our public parks would greatly facilitate the study of botany by the students of our schools and colleges and would largely aid those citizens desirous of improving their home grounds; therefore be it

Resolved, that the Wisconsin Natural History Society hereby respectfully petitions the Board of Park Commissioners to set aside a portion of one or more parks in each section of the city where the trees and shrubs shall be identified by suitable labels; and be it further

Resolved, that a copy of this resolution be presented to the Board of Park Commissioners and that our schools and colleges be asked to join with us in this petition.

Seconded by Miss Helen Sherman. Carried.

A report on the assoeiate editorship for the bulletin was submitted by the directors, the staff to be composed as follows: R. A. Muttkowski, editor; Associate editors, Mr. I. N. Mitchell, for Dept. of Biology, Mr. Howland Russel, Botany, Mr. Edgar E. Teller, Geology, Dr. S. Graenicher, Zoology. Mr. Ward moved that the report be accepted. Seconded. The editorship of Zoology was declined by Dr. Graenicher. Mr. Russel moved an amendment that the Board of Directors choose another member in place of Dr. Graenicher. Seconded and Carried. The earlier motion was put to vote and carried, the report of the directors being adopted.

Miss Ellen Torelle spoke on the theme "An American Student at the Zoological Station at Naples.

The meeting then adjourned.

Milwaukee, March 10, 1910.

Meeting of the combined sections.

President Barth in the chair. 28 people present.

Minutes of the last section meeting read and approved.

Pres. Barth announced the election of Mr. A. Harper to corresponding membership, and of H. Haessler to junior membership. Mr. Ward presented the nomination of Mr. Albert G. Russell, Wabena, Wis. for corresponding member; Mr. Russell was subsequently elected by the board of directors. A communication was read from the City Park Commissioners reading that the petition of the Society to label trees and shrubs in public parks had been granted. A motion was passed instructing the secretary to convey the appreciation of the Society to the Park Commissioners for their ready compliance to the request of. the Society.

The name of Dr. P. H. Dernehl was presented by the directors for associate editor of zoology and accepted by regular vote.

The evening's theme "Poisons" was then taken up.

Dr. George P. Barth spoke on The Effects of Some Poisons on the Human System. Dr. Barth outlined two methods of classifying poisons; the chemical method of organic and inorganic poisons, and the physiological method of arranging poisons under the heads of Irritants and Neurotics. The maximum and minimum lethal doses of many of the commoner poisons were cited together with their chief effects. The curious action of several poisons, such as wood-alcohol, was outlined, briefly.

Mr. Howland Russel spoke on Poisonous Plants, confining himself to Milwaukee Co., from which he reported a list of over fifty poisonous plants.

Ivy poisoning, alcohol as preventive of infection, and the eradication of the plant formed the topic of a discussion participated by Messrs. Ward, Carpenter, Sherman, Graenicher, Burrill, Dernehl and Russel. Poisonous snakes and reptiles were discussed also.

Upon motion the meeting adjourned.

Milwaukee, March 31, 1910.

General meeting of the Society.

Vice-president Ward in the chair. 32 people present.

Minutes of the last general meeting read and approved.

Mr. Ward announced the election of Mr. Albert G. Russell, Wabeno, Forest Co., Wis., to corresponding member.

Mr. Alfred C. Burrill gave an illustrated lecture on the theme: The Development of Habits of Man Appears to Parallel Those of Lower Animals.

Upon motion the meeting adjourned.

NOTES AND DESCRIPTIONS OF NORTH AMERICAN PARASITIC HYMENOPTERA.—IX.*

By Charles T. Brues.

FAMILY ICHNEUMONIDÆ.

Subfamily Cryptinæ.

Pezomachus Gravenhorst.

The small wingless members of this genus of Cryptinæ are very abundant and have been described in great numbers by European entomologists. As early as 1851 Förster[1] enumerated over 200 species from Europe, and although many of these are of extremely doubtful specific value, a great many continental species exist. Very recently Morley[2] lists 58 from the British Isles, so evidently the thirty or forty known North American forms represent but a fraction of our fauna. In a previous paper I attempted to give a table for the separation of the then known forms[3] and following is another to aid in the identification of the ones added in the present paper.

Key to the new species of *Pezomachus* here described.

1. Metathorax with a complete transverse carina separating its dorsal and posterior surfaces..............................2.
   Metathorax without such transverse carina.......**P. cockerelli.**
2. Petiole of abdomen with more or less distinctly projecting angular tubercles or teeth at the spiracles...................3.
   Petiole of abdomen with no trace of spiracular tubercles......7.
3. Postpetiole longitudinally aciculated; antennae 20-21 jointed ....**P. foersteri.**
   Postpetiole shagreened or punctulate.......................4.
4. Males ....5.
   Females ....6.
5. Antennæ 24-jointed ....**P. urbanus.**
   Antennæ 29-jointed ....**P. fenestralis.**

1) Monographie der Gattung Pezomachus. Berlin, Verlag der Nicolai'schen Buchhandlung.
2) The Ichneumons of Great Britain, Vol. 2. Plymouth, 1907.
3) Trans. Amer. Ent. Soc., Vol. 29, pp. 119-121 1903.
* Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 26.

6. Abdomen entirely black, scutellum indicated as short and broad .... **P.obesus.**
Abdomen yellowish on the tips of the first and second segments; scutellum indicated as a small convex tubercle **P.habilis.**
7. Male, antennæ 21-jointed, abdominal hairs sparsely placed. .... **.P.foveatus.**
Females .... 8.
8. Hairs of abdomen sparsely placed; scutellum not at all indicated .... **P.insolens.**
Hairs of abdomen densely placed; scutellum indicated by a distinct grooved line basally .... **P.delumbis.**

Pezomachus cockerelli sp. nov.

Female. Length 4 mm. Piceous black; base of antennæ, anterior part of prothorax and tip of first abdominal segment brownish yellow. Legs very dark fuscous. Head above shining, very faintly shagreened; slightly less than half as thick as broad; the occiput feebly excavated. Ocelli in an equilateral triangle, closer to each other than to the eye margin. Front almost twice as wide as either eye, with a broad, shallow depression above the base of the antennæ. Seen from the side, the head is much produced into a ledge at the insertion of the antennæ. Malar line long, although but little more than half as long as the broad front. Upper edge of clypeus far below the lower corner of the eye which is equidistant from the vertex and lower corner of the cheek. Clypeus moderately convex with a fovea at each side. Thorax long, three and one-half times as long as broad. Meso- and metanotum shining and scarcely shagreened. Metathorax evenly convex, without any transverse carina although this is indicated on the sides by a slightly raised line. Petiole of abdomen rather long and broad at the tip which is nearly three times as broad as the base; its length equal to twice its greatest width; spiracular tubercles slightly projecting; spiracular carina obsolete before the spiracle, visible only behind it halfway to the apex of the petiole. Abdomen broad, fully twice as wide as the thorax; smooth and shining; its pale hairs densely placed. Second segment the longest; others gradually decreasing in length. Ovipositor only two thirds as long as the petiole. Pleuræ regularly shagreened and subshining. Legs stout, the longer spur of the hind tibia one-third as long as the metatarsus which is twice as long as the second tarsal joint.

Florissant, Colorado, July 8, 1906. Collected by Professor T. D. A. Cockerell.

Pezomachus foersteri sp. nov.

Female. Length 4 mm. Head twice as broad as thick, subopaque and densely shagreened or punctulate above, the lateral ocelli considerably closer to the eye-margin than to the median ocellus. Front fully twice as broad as either eye, scarcely narrowed above by the orbits. Malar space short, the malar line somewhat less than one-half as long as the width of the face. Clypeus short, deeply separated from the face, its lateral foveæ large. Cheeks smooth and polished. Antennæ 20-21 jointed; basal flagellar joint slightly longer than the second which is three times as long as broad; fifth twice as long as thick; those near the apical third of the antennæ quadrate; apical joint nearly twice as long as the penultimate. Thorax considerably less than three times as long as wide; pronotum (exclusive of the collar) visible from above only as a narrow band; mesonotum strongly convex; as long as broad, its surface coarsely shagreened and somewhat shining; scutellum not at all indicated although there is an elevated ridge behind the mesonotum which extends entirely across the thorax. Metathorax strongly gibbous anteriorly, but sharply declivous from before the middle; in front of the carina it shows a number of irregular longitudinal wrinkles, but is smooth on the posterior slope. Transverse carina complete, very sinuous medially and continuing to the posterior angles of the metathorax where it meets a short oblique carina, forming a triangular areola above each coxa. Petiole of abdomen long and evenly dilated toward the base; three times as long as broad at tip and one third as broad at base as at tip; spiracular tubercles moderately large, angular; postpetiole longitudinally aciculated. Body of abdomen broad, the second and third segments subequal in length, third more shining; abdominal hairs sparsely placed. Ovipositor half as long as the petiole. Legs rather slender; longer spur of hind tibia one third as long as the metatarsus which is twice as long as the second tarsal joint. Head, thorax, legs, first segment of abdomen, and antennæ except their darker tips, reddish ferruginous; abdomen black, the petiole and second segment, obscurely yellowish at their tips.

Austin, Texas; April and May.

Structurally this species is closely related to *P. obesus*, although it is much smaller and lighter colored. The sculpture of the head above and the mesonotum is finer; the scutellum is not distinctly separated by a transverse furrow as in the former species; and the petiole is less strongly dilated behind the spiracles.

Pezomachus urbanus sp. nov.

Male. Length 5 mm. Black, varied with paler markings. First five joints of antennæ brownish yellow, remainder fuscous or piceous; entire prothorax, sides of mesonotum and most of mesopleuræ honey yellow. Legs yellowish brown, the hind femora and the hind tibiæ near base and at apex infuscated. Abdomen with yellow bands at the apices of the first four segments. Head subopaque and shagreened above, twice as wide as thick. Ocelli in a nearly equilateral triangle, the lateral ones as far from the median one as from the eye margin. Occiput margined. Front above antennæ shagreened, one third wider than either eye. Upper edge of clypeus somewhat above a line drawn between the lower edges of the eyes; clypeus with a deep fovea at each side. Malar space with a carina, more distinct below, one-half as long as the first flagellar joint. Antennæ 24-jointed, as long as the body; first flagellar joint four times as long as thick and one fourth longer than the second; following very gradually growing shorter: those at the apical third of the antenna twice as long as broad. Thorax three times as long as wide, subopaque and shagreened throughout. Mesonotum one third longer than wide, behind the tegulæ with a sharply raised lateral margin and on each side opposite the tegulæ with a slight depression, anteriorly sharply narrowed. Scutellum strongly elevated, with a depressed line across its base. Metathorax with a complete sinuous carina limiting its posterior face which connects with a sharply defined quadrate areola on each side above the posterior coxa; also with an obsolete longitudinal carina outside the spiracles. Abdomen as long as the head and thorax, the petiole twice as wide at apex as at its narrowest basal portion, the spiracular tubercles only slightly projecting; on each side with a complete carina including the spiracles and another one along the lower edge of its lateral face. Petiole and base of second segment somewhat opaque; remainder of abdomen shining; its hairs sparsely placed. Legs rather stout, at least the femora; longer spur of hind tibia one-third as long as the metatarsus which is twice as long as the second tarsal joint. Pleuræ rather shining, shagreened, the mesopleuræ with a few wrinkles along their anterior and posterior margins.

New York City, collected by Mr. J. R. de la Torre Bueno.

This species is very similar to *P. foveatus*, but the greater number of joints in the antennæ and the more complete areolation of the metathorax serve to distinguish them easily in addition to several other characters included in the description.

Pezomachus fenestralis sp. nov.

Male. Length 5 mm. Dark fuscous or nearly piceous, varied with dull brownish yellow as follows; first two joints of antennæ, head except on the vertex, prothorax, mesonotum, all of legs including coxæ, tip of abdominal petiole, and a lateral and apical broad stripe on the second abdominal segment. Head twice as broad as thick; lateral ocelli as far from the median one as from the eye-margin; occiput sharply margined behind. Narrowest part of front above antennæ as wide as either eye. Antennæ long and slender, 29-jointed; scape short, oval; first flagellar joint about six times as long as thick, one third longer than the second; following decreasing in length until those at the apical third of the antennæ are twice as long as thick. Head above shagreened, subshining; below more shining and almost smooth; malar space with an opaque slightly depressed line from the eye to the base of the mandible. Maxillary palpi slender, four-jointed. Thorax long and slender, less than one-third as broad as long and only half as broad as the head. Vestiges of anterior wings pearly white, as large as the tegulæ. Mesonotum over twice as long as broad and much narrowed in front and with a faint median longitudinal depression. Scutellum very small, convex and with a deep fovea at its base. Entire thorax shagreened, the metathorax more strongly so. Metanotum with one distinct complete sinuous transverse carina. Petiole of abdomen only one-half wider at the apex than at its narrowest part near the base; spiracular tubercles distinct, but very small. Abdomen widest at the fourth segment, its hairs fine and very closely placed; its surface shining beyond the second segment, which like the petiole is roughly shagreened. Legs very slender; longer spur of hind tibiæ less than one-third as long as the metatarsus which is twice as long as the second tarsal joint.

New Brunswick, New Jersey, collected by Mr. John A. Grossbeck. The species was found upon a window in a house.

Pezomachus obesus sp. nov.

Female. Length 5 mm. Piceous black, mesonotum and prothorax more or less tinged with fuscous. Antennæ fuscous, with a piceous band near the middle; legs fuscous, piceous on the coxæ and slightly so on the femora and tips of tibiæ. Head large, slightly over twice as wide as thick, thickly punctulate and with sparse white hairs above. Occiput sharply margined. Front below the median ocellus one-half wider than either eye; smooth and shining between and just above the bases of the antennae. Head below punctulate except on a very finely roughened malar line from the lower corner of the eye to the base of the mandible. Clypeus at each side with a small deep fovea, its surface with scattered coarser punctures. Palpi short and stout, strongly hairy. Eyes oval, one-half longer than the malar space. Thorax about two and one-half times longer than broad. Pronotum visible in front, rather broad on each side at the humeri, rugulose or punctulate like the head. Mesonotum narrowed, nearly wedge-shaped in front, one-fourth longer than wide; more roughly sculptured than the head. Scutellar suture indicated by a short transverse grooved line which does not attain the margin of the mesonotum, scutellar space convex. Mesonotum with a raised marginal line behind the tegulæ and also behind on each side for one third of its width. Metanotum finely rugulose on its anterior half which bears a median depression that divides it into two quite distinct lobes. Behind this portion and in front of the transverse carina it is faintly and finely reticulate. Transverse carina very strongly sinuous; posterior slope smooth except for a number of irregular, mainly longitudinal wrinkles. Abdomen stout, twice as wide as the thorax, its surface behind the shagreened second segment shining and smooth; its hairs sparsely placed. Petiole scabrous, three times as broad at tip as at its narrowest part near the base; spiracular tubercles strongly projecting. Second and third segments subequal; fourth two thirds as long as the fifth; following growing rapidly shorter. Ovipositor as long as the second segment. Pleuræ rugose-reticulate. Legs stout, longer spur of hind tibia one-third the length of the metatarsus.

Forest Hills, Boston, Mass., April 10, 1909, reared from the egg capsule of a spider.

Pezomachus habilis sp. nov.

Female. Length 3 mm. Body shining throughout, black; antennæ yellowish at the base, darker medially and fuscous toward the tips; mesonotum brownish at the sides; metathorax above rufo-piceous; band at tip of first and second abdominal segments yellowish; trochanters, four anterior femora below and all tibiæ and tarsi yellowish brown. Head above shagreened and subopaque, fully twice as broad as thick and deeply excavated on the occiput. Ocelli in a rather small triangle, the lateral ones closer to the median ocellus than to the eye margin. Front slightly narrowed above, one-half wider than the eye. Malar line half as long as the width of the face; clypeus unusually transverse, with the usual fovea at each lateral angle. Cheeks shining, but faintly shagreened. Antennæ 20-jointed, slender, the joints all distinctly wider than long. First flagellar joint one-fourth longer than the second, following gradually decreasing to the tip, those at the apical third one-fourth longer than thick. Thorax above shagreened or punctulate; slightly shining, more distinctly so on the posterior half of the metanotum. Mesonotum scarcely longer than wide, the scutellum represented by a very small convex tubercle; marginal carina at posterior angles of mesonotum poorly developed. Metanotum strongly convex on its anterior half, the transverse carina not sinuate medially, curving evenly over the metanotum from near the base of the coxa; no lateral carina. Petiole of abdomen short and broad, only one half longer than broad, the tip twice as wide as the base and the spiracular tubercles large, angularly produced. Second segment only slightly longer than the third, fourth or fifth which are subequal. Ovipositor slightly longer than the petiole of the abdomen. Entire pleuræ evenly punctulate and subshining. Legs slender, the longer spur of the hind tibiæ one-third the length of the metatarsus which is two and one-half times as long as the second tarsal joint. Abdominal hairs sparsely placed.

Woods Hole, Mass.

This species is very similar to *P. maculicollis* Brues in the form of the antennæ and metanotal carina, but has strongly projecting spiracles on the petiole of the abdomen which are entirely absent in the other species.

Pezomachus foveatus sp. nov.

Male. Length 3.5 mm. Black. Antennæ pale brown, fuscous toward tips. Legs, including coxæ, pale brown; more or less infuscated on the four anterior femora medially, on the hind coxæ above and on the posterior legs except the trochanters, knees, middle of tibiæ along outer edge, and base of each tarsal joint. In some specimens with the four anterior legs quite or nearly as dark as the posterior pair. Head shagreened and subshining above, twice as wide as thick; seen from the front with the front above the antennæ fully one-half wider than either eye. Malar space with a slight carina from the corner of the eye to the base of the mandible. Cheeks more nearly smooth than the vertex; face and clypeus sculptured like the vertex. Antennæ moderately long, equalling the body in length; 21-jointed; first flagellar joint four times as long as thick and one-third longer than the second;

third to penultimate growing gradually shorter, the joints at the apical third of the antennæ twice as long as thick. Thorax three times as long as wide shagreened, but more nearly smooth and shining on the metathorax. Mesonotum one-half longer than wide, its lateral margins from the sides of the scutellum to before the tegulæ narrowly, but very distinctly reflexed; mesonotum laterally opposite the tegulæ with a small elongate foveate depression. Scutellum small, with a broad depressed line across its base. Wing vestiges pale, twice as large as the tegulæ. Metanotum evenly convex, with a very strongly sinuous, well marked transverse carina which connects with a complete, but nearly obsolete lateral carina. Petiole of abdomen with no distinctly projecting spiracular tubercles, gradually narrowed toward its base, one-half wider at the tip than at the base, along the sides with a distinct and complete longitudinal carina which includes the spiracles; also with a similar carina along the lower margin of its sides. Abdomen quite shining beyond the petiole; its hairs very sparsely placed; petiole and second segment with a pale brown band at the apex. Abdomen widest on the third segment. Legs rather stout; longer spur of hind tibia nearly half as long as the metatarsus which is twice as long as the second tarsal joint.

Three specimens, all males, collected by Mr. C. A. Frost at Framingham, Mass.

Pezomachus insolens sp. nov.

Female. Length 4 mm. Entirely ferruginous, very slightly infuscated on the posterior half of the dorsum of the abdomen and on the tips of the antennæ. Sheaths of the ovipositor piceous. Head above subshining, shagreened. Occiput strongly excavated medially, margined. Ocelli in a nearly equilateral triangle, the lateral ones closer to the median one than to the eye margin. Front at its narrowest part one-half wider than the eye. Malar space as long as half the width of the face below the antennæ, with a distinct but scarcely impressed furrow from the corner of the eye to the base of the mandible. Clypeus convex, with sparse punctures, its upper margin far below the lower corners of the eye and its sides each with a deep circular fovea. Cheeks only slightly shagreened and quite shining. Antennæ stout 19-20 jointed; first and second flagellar joints of equal length; third and following decreasing in length; at the apical third of the antenna slightly longer than wide; last joint half longer than the penultimate.

Thorax nearly three times as long as wide. Collar prominent, but the pronotum very indistinctly separated from the mesonotum. Mesonotum one-half longer than broad; its lateral suture distinct only posteriorly. Tegulæ indicated by minute tubercles. Scutellum not at all indicated. Surface of thorax above shagreened, more shining on the metathorax. Upper face of metathorax evenly convex, its posterior slope margined by a sinuous transverse carina which extends down the sides to the insertion of the posterior coxa; near each posterior angle is the vestige of another oblique carina, faintly indicating a small areola close to the coxa. No lateral carina. Abdomen nearly twice as long as the thorax, petiole broadly dilated, three times as broad at the tip as at the base, its sides straight, without the slightest indication of spiracular tubercles or teeth. Above on the sides with a complete longitudinal carina including the spiracle and below on the sides with a second carina. Petiole shagreened, but the remainder of the abdomen smooth and polished, its hairs sparsely placed; second segment slightly longer than the third; fourth and fifth growing shorter. Ovipositor as long as the abdominal petiole. Legs with the femora stout, especially the four anterior ones. Longer spur of posterior tibia slightly over one third as long as the metatarsus.

Mount Constitution, San Juan Co., Washington, July 1908, A. L. Melander.

Pezomachus delumbis sp. nov.

Female. Length 5 mm. A slender species with elongate legs and antennæ. Head slightly over twice as broad as thick, the occiput angularly excavated, but less strongly so than in *P. insolens*; ocelli in a triangle, the lateral ones farther from the eye-margin than from the median ocellus. Head above subopaque and shagreened. Front at narrowest part above the antennæ one half wider than either eye. Malar space as long as half the width of the front, with an indistinctly marked furrow from the eye to the base of the mandible. Clypeus with a large fovea at each side, weakly convex, with scattered punctures; its upper margin far below the level of the lower margins of the eyes. Cheeks smooth and polished. Pronotum indistinctly separated from the mesonotum, mesonotum nearly twice as long as wide, the scutellum indicated by a distinct transverse depressed line. Tegulæ visible as small tubercles, just inside of which the lateral margin of the mesonotum is indicated by a grooved line which extends along only the posterior third. Entire thorax above subapaque, shagreened, the posterior slope of the metanotum shining. Metathorax with a sinuous transverse carina which continues back to near the base of the coxa, but without any indications of areolæ at its lower hind angles. Abdomen nearly twice as long as the thorax, the petiole as long as the metathorax. Petiole gradually widened to the tip which is two and one-half times as broad as the base; laterally with a carina including the spiracles, which do not project as tubercles when seen from above. Petiole shagreened and subopaque; second segment less opaque; following segments growing smooth and shining; second and third segments subequal; fourth and fifth each half as long. Hairs on surface of abdomen very closely placed. Ovipositor one and one half times as long as the petiole of the abdomen. Pleuræ shagreened and subopaque like the thorax above. Legs long and slender, only the four anterior femora slightly thickened. Longer spur of hind tibia one third as long as the metatarsus which is slightly over twice as long as the second tarsal joint. Thorax, legs and first two segments of abdomen dull ferruginous, head and base of antennæ fuscous; remainder of antennæ and abdomen beyond the base of the third segment piceous.

Mount Constitution, San Juan Co., Washington (A. L. Melander); July 1908.

This resembles *P. insolens* quite closely, but differs by its longer and much more slender antennæ and the densely placed vestiture of the abdomen.

Pezomachus texanus Cress.

Canadian Ent., Vol. 4. p. 64. (1872).

This species differs in both sexes from any other *Pezomachus* known to me by the small size of the mesonotum. In the female this is scarcely more than one third as long as the metathorax, and in the male only half as long being considerably shorter than the pronotum in this sex and broadly enclosed by it on the sides. Both sexes have the metanotum smooth, without carinæ, and the hairs on the abdomen very sparsely placed. The head of the male is only one and one-half times as broad as thick, and scarcely at all excavated along the occipital margin.

Pezomachus wheeleri Brues.

Trans. Amer. Ent. Soc., Vol. 29, p. 123. (1903).

In this species the abdomen is clothed with very dense hairs, and the scutellum is faintly indicated as rather small and strongly transverse.

Pezomachus maculicollis Brues.

Trans. Amer. Ent. Soc., Vol. 29, p. 121 (1903).

In this species the antennæ are 20-jointed, the head quite distinctly less than twice as broad as long, and the malar line less than half as wide as the face. The metathorax is very strongly gibbous, its transverse carina slightly arcuately curved and not strongly sinuous as in most species. The abdominal petiole is scarcely twice as broad at the tip as at the base.

Pezomachus minutus Walsh.

Ins. inj. vegetation in Illinois, p. 36. (1861).

This little species as I have identified it has the transverse carina of the metanotum complete and no indication of a scutellum. The abdominal hairs are very sparsely placed.

Pezomachus angularis Brues.

Trans. Amer. Ent. Soc., Vol. 29, p. 122. (1903).

The abdominal hairs are densely placed, and the mesonotum has a very distinct, sharply projecting tubercle on each side behind. There is no indication of a scutellum.

Pezomachus birkmani Brues.

Trans. Amer. Ent. Soc., Vol. 29, p. 121. (1903).

This species has the hairs covering the surface of the abdomen very sparcely placed. The mesonotum is produced into an angular tubercle on each side above the tegulæ and the scutellum, indicated by a slight depressed line separating it from the mesonotum, is large and weakly convex.

Pezomachus crassulus Brues.

Trans. Amer. Ent. Soc., Vol. 29, p. 123. (1903).

The metanotum of this species is finely irregularly wrinkled, the transverse carina is very indistinct medially and there is a longitudinal furrow-like depression medially near the base. The scutellum is not distinctly separated, although suggested by a slight transverse groove. The abdominal hairs are moderately sparse.

Microcryptus (*Theroscopus*) **vernalis** sp. nov.

Length 5.5 mm. Head and thorax black; abdomen black, except for transverse bands at the base of the second and third segments;

legs reddish, paler basally and on the coxae, and darker toward the tips of the tibiae and femora; antennae with the first five joints ferruginous, the next four white and the remainder black. Head transverse, fully twice as broad as thick; above smooth and polished, with fine very scattered punctures. Ocelli placed on a raised triangular tubercle. Eyes elongate oval, twice as long as broad and conspicuously pubescent. Antennae only half the length of the body, stout and involute; 18-jointed; first and second flagellar joints of equal length, each four times as long as broad at tip; third three-fourths as long; fourth two-thirds as long as the third; fifth and following quadrate till the last which is twice as long as the penultimate. Thorax slightly over twice as long as broad. Mesonotum with a longitudinal slight convexity on each side of the median line; on the sides from near the posterior to near the anterior border with a deep grooved line close to the lateral margin, breaking into a foveate line anteriorly. Scutellum nearly quadrate, almost flat, with a deep transverse line across the base. Wing vestiges lanceolate, with the two basal cells well defined; reaching to the base of the metathorax. Postscutellum small, transverse, with a basal impressed line connecting two lateral foveae. Metanotum sharply declivous and medially concave behind; the transverse carina complete, strongly curved forward medially and sharply raised on the sides; lateral and pleural carina distinct, the former giving off inwards at its middle a short transverse carina which extends halfway to the median line. Petiole of abdomen gradually widened behind, without spiracular projections; width at tip a little less than half its length; base nearly half as wide as apex. Third segment a little longer than the second; following growing rapidly smaller. Ovipositor somewhat shorter than the first segment. Pleurae very faintly and sparsely punctulate; mesopleura with a small deep fovea behind near its upper edge. Legs strong and stout; longer spur of hind tibia as long as the second tarsal joint and nearly one half the length of the metatarsus.

Framingham, Mass., May 10, 1910; C. A. Frost.

The present form comes very close to *Microcryptus (Theroscopus) cingulatus* Först. from the European fauna. It differs in having the head much more finely sculptured than the mesonotum and in the different color of the legs and abdomen. It is also quite considerably larger.

FAMILY BRACONIDÆ.

Cœloides liopodis sp. nov.

Length 2 mm. Piceous, the head black, and the abdomen varied with yellowish brown; legs, including the coxæ, and basal part of antennæ pale testaceous. Head nearly twice as broad as thick, moderately narrowed behind the eyes. Head behind, including the occiput, very distinctly margined. Ocelli in a small triangle, the lateral ones being much farther from the eye than from each other. Vertex shining, very distinctly margined. Ocelli in a small triangle, the lateral ones the ocelli smooth and polished. Face smooth, with a very slight median elevation along its median fifth, which is indistinctly striated. This does not extend on to the short crescentric clypeus which is reddish brown in color and separated at each lateral angle by a small foveate depression. Mandibles brownish yellow, with black tips. Antennæ filiform, with cylindrical joints, nearly one-fourth longer than the body; 22-jointed, inserted on a level with the middle of the eyes; scape simple, thickened; flagellar joints gradually becoming shorter from the first which is five times as long as thick; sixth and following each about three and one-half times as long as thick. Collar brownish yellow. Mesonotum as long the wide, shagreened; parapsidal furrows converging posteriorly, just before the scutellum with a series of five longitudinal striations between them. Scutellum more finely roughened, at the base with a large transverse depression bearing a few elevated cross lines. Metathorax rounded behind, with a large petiolar and one large lateral area on each side; these areas nearly smooth; the pleuræ rugulose; tip of metathorax honey-yellow. Mesopleura smooth, shining. Abdomen sessile; first segment as long as broad at the tip, its surface aciculated, medially on the basal half with a pair of carinæ convergent posteriorly, and on each side with a spiracular carina. Second segment aciculate like the first, three times as wide as long, its aciculations extending over the weak constriction to the basal third of the third segment; abdomen beyond smooth and highly polished. Abdomen above honey-yellow, piceous on the sides of the third and following segments. Ovipositor half as long as the abdomen. Legs pale testaceous, with sparse white hairs; tibial spurs short. Wings hyaline, with a weak venation; stigma narrowly ovate; first discoidal cell with a very long petiole above, submedian cell slightly longer than the median; discoidal vein very oblique, joining the subdiscoidal in a slight curve; first transverse cubitus very indistinct below: radial cell attaining the wing tip; second section of the radius one-third longer than the first, and one-third as long as the third.

Bred by Mr. C. A. Frost from sumach twigs infested with *Liopus alpha* Say; Framingham, Mass., May 1906.

The present species belongs in *Cœloides* as defined by Schmiedeknecht in his "Hymenopteren Mitteleuropas" (p. 516) although it is evidently quite different from *Cœloides* as understood by Ashmead, who places the genus in the Braconinæ. *Cœloides initiator* Fabr. of Europe has been bred from several genera of Cerambycidæ, but to judge from the description of that species as given by Nees it can no longer be included in *Cœloides* on account of the triangular space at the base of the second abdominal segment.

Cenocœlius ashmeadii D. T.

C. Ashmeadii, D. T. Cat. Hym. Col. IV, p. 72 (1898). *Promachus rubriceps*, Ashmead, Proc. U. S. Nat. Mus. Vol. XI, p. 653 (1888) male, (nec Provancher).

Through the kindness of Mr. C. W. Johnson of the Boston Society of Natural History I have received a female of this interesting species, bred by Mr. C. A. Frost from *Liopus alpha* Say contained in sumach twigs. Ashmead's types were obtained from the same plant infested by this same beetle, so there can be no doubt that it is the host of the Cenocœlius.

FAMILY CLEONYMIDÆ.

Cheiropachys obscuripes sp. nov.

Length 2.3 mm. Metallic green, the head more coppery and the metathorax more bluish; abdomen with an obscure honey yellow band near the base; wings with two costal infuscated spots. Head two and one-fourth times as broad as thick; ocelli in a curved line, the lateral ones somewhat nearer to the median ocellus than to the eye margin. Eyes rounded ovate, bare. Antennæ inserted near the middle of the eyes. Malar space half as long as the eye, without furrow. Clypeus nearly truncate, with a slight median emargination. Mandibles stout, their apices broad. Antennæ with two ring-joints; 13-jointed, counting the short oval club as three jointed, although this really appears two-jointed, with a single suture. Scape honey yellow, somewhat flattened and curved, as long as the first three joints of the flagellum together; pedicel as long as the first flagellar joint, the latter nearly twice as long as thick; following growing shorter until the last (sixth) is nearly quadrate; club ovate, as long as the two preceding joints. Surface of head rugose-punctate, more finely so on the malar space and vertex. Thorax elongate, the pronotum short, longer on the sides which converge little anteriorly. Mesonotum with slight traces of furrows on the sides in front, as long as its greatest length at the tegulæ, its surface confluently punctate or rugulose; the scutellum and axillæ more finely so. Axillæ separated by one-half the width of the scutellum; the latter oval, broader behind, one-half longer than wide. Metathorax with a very distinct median carina which bifurcates behind; without spiracular sulci; not prolonged into a neck or globose at the apex. Pleuræ very finely rugulose, the mesopleura smooth above and with a wedge-shaped piece extending downward near its middle. Under side of thorax and sides of metanotum with conspicuous sparse white hairs. Abdomen as long as the thorax, sessile; first segment the longest, slightly exceeding the combined length of the second and third segments together; second to fourth increasing in length; fifth much shorter; sixth triangular, beset with stiff black hairs which also extend to the underside of the fifth laterally. Ovipositor when fully exserted over half as long as the abdomen; its downwardly curved spatulate tip short and the only part visible when the ovipositor is retracted. Legs yellowish brown, the hind femora more or less infuscated and the tarsi luteous. In some specimens the legs are almost entirely fuscous. Anterior femora thickened and with a blunt projection inwardly near their apical third. Hind femora quite broad, but simple; hind tibiæ with conspicuous stiff hairs. Wings hyaline, with two large fuscous spots on each anterior wing; basal spot nearly quadrate, extending about two thirds across the wing and ending anteriorly just before the tip of the submarginal vein; apical spot just encompassing the stigmal vein, reaching half way across the wing and nearly twice as long as wide along the axis of the wing. Marginal vein half as long as the submarginal and slightly exceeding the subequal postmarginal and stigmal veins. Stigmal vein slightly curved upwards at the tip where it bears a rather large oval knob.

Six female specimens reared by Mr. Walter Postiff of the Bureau of Entomology from a peach bark-beetle, probably *Phlœotribus liminaris* Harr. at Douglas, Michigan.

The specimens are quite close to the common and widespread European *C. colon* Linn, but are uniformly darker on the legs and the body is more metallic, while the wings are different both in venation and form of maculation. The European form is also parasitic on Scolytid beetles, having been reared from several species.

It is possible that the present species is identical with another European one referred to by Förster (Hym. Stud., II, p. 70) as *C. intermedius*, but never described.

FAMILY DIAPRIIDÆ.

Auxopædeutes lyriformis sp. nov.

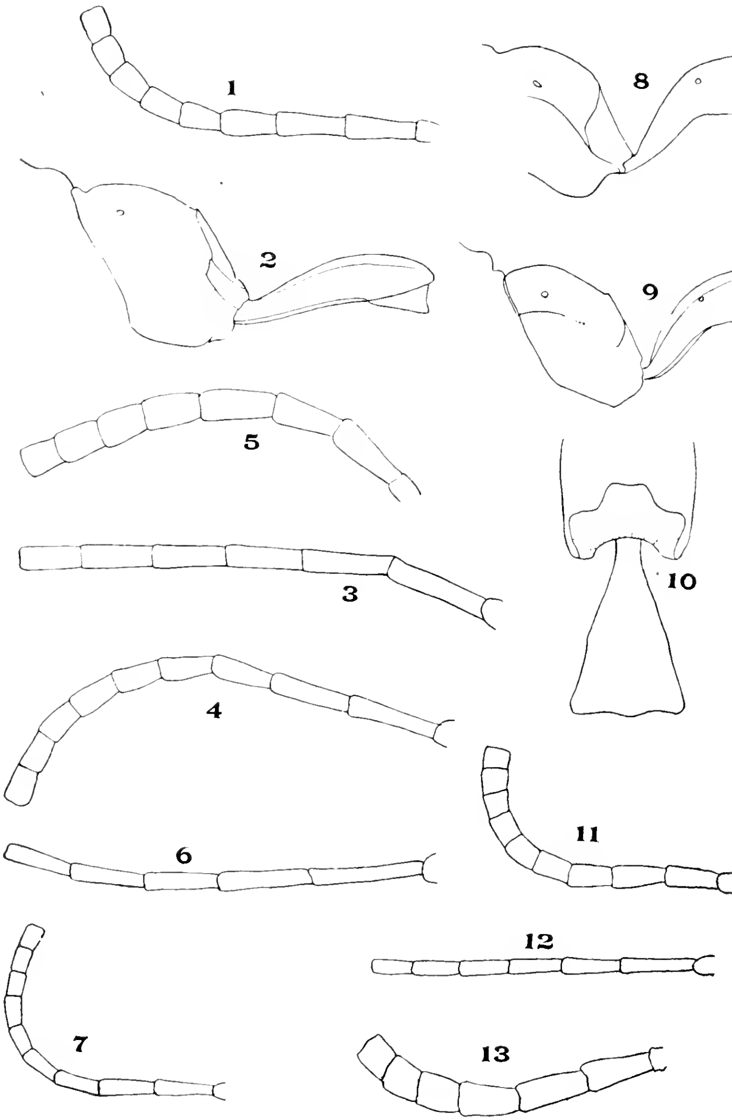
Female. Length 1.6 mm. Black: legs, including the coxæ, scape of antennæ and tegulæ, yellowish brown; funicle and club of antennæ fuscous. Head seen from the side with a large projecting frontal horizontal lamina below the antennæ making the head as thick as high. Seen from above, the head is as thick as wide, narrowed anteriorly to the frontal lamina which is two third as wide as the greatest width of the head and almost squarely truncate on the anterior margin; above it is hollowed out into two contiguous pits for the reception of the antennæ. Ocelli in a triangle upon the vertex. Antennæ 12-jointed; scape large and stout, as long as the following five joints taken together; pedicel cylindrical, half longer than thick; first flagellar joint narrowed at the base, a little shorter than the pedicel; second to seventh about equal in size, moniliform; eight moniliform, twice as large as the preceding; last two joints forming a large club nearly as long and about as wide as the scape, the penultimate joint being broader than the apical one. Eyes small, oval, with about ten rows of ommatidia. Mandibles small, bidentate. Surface of head entirely smooth and polished except for a shagreened space just below the middle of the edge of the frontal lamina. Thorax nearly truncate in front, the prothorax visible only as a line medially, but well developed on the sides of the mesonotum which is rounded and narrowed in front. Mesonotum as long as broad between the tegulæ which are large and contiguous with the line indicating the posterior margin of the mesonotum. Scutellum broad at the base with a depression near the center which gives off lateral depressions that divide it into two basal lateral convexities and a larger posterior one. Metathorax seen from above with a projecting truncate horn on each side which extends over the first segment of the abdomen, each horn being as long as the scutellum. The horns are longitudinally striated and project upwards in lateral view, while from above their inner margins are parallel. Entire pro- and mesothorax, including their pleuræ and the scutellum, smooth and polished. Metapleuræ thickly pale yellowish hairy, their posterior margin evenly concave from the coxæ to the tip of the horn above. Abdomen as long as the head and thorax, entirely shining, fully one half wider then the thorax. First segment thickly covered with dense pale yellow pubescence, only about one third as broad as the following segment, and about twice as broad as long. Second segment occupying nearly two-thirds of the remainder of the abdomen, its sides parallel on the greater part of their length; third to fifth segments subequal, narrowing in width; sixth minute, triangular. Ovipositor short, blunt. Legs with the femora slightly thickened; the tibiæ clavate, long and slender except the anterior ones.

A female collected at Forest Hills, Boston, Mass., May 4, 1910 by Prof. W. M. Wheeler in a nest of *Solenopsis molesta* Say.

This is the second species of this most remarkable genus to be discovered, the first, *A. sodalis* Brues[4] being also North American and occurring so far as known only in Texas. The present species may be distinguished by its longer metanotal teeth or horns, which have their inner margins parallel, and not divergent as in the Texan form. The configuration of the antennæ is also quite different, the antepenultimate joint being much larger in *A. lyriformis*.

The genus *Auxopaedeutes* is very closely related to the European *Solenopsia* Wasmann, which has the antennæ 11-jointed, not 12-jointed as in the American genus. After seeing the present species I am fully convinced that the genus belongs to the Diapriidæ and not to the Belytidæ as I had previously thought might possibly be the case.

4) Trans. Amer. Ent. Soc., Vol. XXIX, p. 126. (1903).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EXPLANATION OF PLATE.

Fig. 1. *Pezomachus insolens* sp. nov. Female, antenna.

Fig. 2. *Pezomachus urbanus* sp. nov. Male, profile of metathorax and abdomen.

Fig. 3. *Pezomachus urbanus* sp. nov. Male, antenna.

Fig. 4. *Pezomachus delumbis* sp. nov. Female, antenna.

Fig. 5. *Pezomachus obesus* sp. nov. Female, antenna.

Fig. 6. *Pezomachus fenestralis* sp. nov. Male, antenna.

Fig. 7. *Pezomachus habilis* sp. nov. Female, antenna.

Fig. 8. *Pezomachus fenestralis* sp. nov. Male, profile of metathorax and first abdominal segment.

Fig. 9. *Pezomachus foveatus* sp. nov. Male, profile of metathorax and first segment of abdomen.

Fig. 10. *Pezomachus insolens* sp. nov. Female, metathorax and first segment of abdomen.

Fig. 11. *Pezomachus cockerelli* sp. nov. Female, antenna.

Fig. 12. *Pezomachus foveatus* sp. nov. Male, antenna.

Fig. 13. *Microcryptus (Theroscopus) vernalis* sp. nov. Female, antenna.

Bussey Institution, Harvard University,
June 15, 1910.

THE DISTRIBUTION OF CERTAIN WISCONSIN MAMMALS.

By Hartley H. T. Jackson.

Since the publication of my "Preliminary List of Wisconsin Mammals" (Bul. Wis. Nat. Hist. Soc. Vol. VI, pp. 13-34, 1908) I have done very little mammalogical field-work, but while acting in the capacity of field icthyologist for the Wisconsin Geological and Natural History Survey opportunity was offered for learning much concerning the distribution of several of our mammals. It seems advisable to publish these observations at the present time. Altho very few specimens were preserved, I think that mammalogists will not question my determination of species in the field; no species are here recorded unless personally I feel positive of the identification.

Odocoileus virginianus borealis (Miller).

Northern Deer.

In many sections of the northern part of the state deer seem to be increasing in numbers. This is a direct result of deforestation. As the coniferous forests are cut away the "slashings" begin to support a dense second growth of deciduous trees such as birch, poplar, maple, etc., and in many places forage plants grow luxuriantly; thus food and protective covering are both increased. Deer were reported as becoming more numerous in parts of all the northern tier of counties.

Deer have become quite abundant in the hilly regions of Sauk County; so much so that during the early autumn of 1909 farmers frequently complained about the damage they did to growing crops. September 19, 1909, I saw a doe on the bluffs a mile west of Devils Lake; tracks of others were discernable also.

Sciurus carolinensis leucotis (Gapper).

Northern Gray Squirrel.

This species was seen near Grant River a few miles east of Cassville, near Little Jordan Creek in Green County and at Green Lake.

As a result of inquiries made at Winona, Minnesota, and at several places along the Wisconsin side of the Mississippi River, and at various points in the Trempealeau and Black River valleys, definite information was received concerning a migration of this species. The information as given from several sources is so universally the same in all essentials that it seems that there can be no doubt as to its reliability. Briefly summed, the facts are as follows: During the autumn of 1905 many squirrels migrated across the Mississippi River from the Wisconsin side into Minnesota. Most of these were in the gray pelage; a few were the melanistic phase. Many of them could be seen swimming across the river and a considerable number were killed in the water by boys. The migration was quite general; immediately following it there was a scarcity of gray and black squirrels in the regions of the Trempealeau and Black Rivers. Later a large number of these squirrels migrated back into Wisconsin. A few, however, remained and took up their abode in the city of Winona, where food was supplied them by the inhabitants. The direct cause of the migration was a shortage of nuts on the Wisconsin side of the river.

Tamias striatus griseus Mearns.

Gray Chipmunk.

As a result of observations made during the summers of 1908 and 1909 it appears that *Tamias* inhabits favorable places thruout the entire state with the possible exception of the extreme northeast portion. They were seen near Alma, Cornucopia, Hammills Lake, Minong, New Richmond and Upper St. Croix Lake. One was distinctly seen August 13, 1908 near Lost Creek, two miles west of Cornucopia and within one-half mile of Lake Superior; here it shared the habitat with *Eutamias borealis neglectus,* as it also did at Hammills Lake.

Citellus tridecemlineatus (Mitchill).

Striped Spermophile.

Citellus tridecemlineatus was observed at Hixton, Iron River, Platteville, Potosi and Sparta.

A short distance east of Iron River there is a small and apparently isolated colony of this species established in the midst of a colony of *Geomys* in a sandy jackpine region. September 9, 1908 three of the spermophiles and many of their burrows were seen. Mr. H. Hall, one of the older residents of Iron River and a man upon whose word one can rely said of the spermophiles, "They have come in recently. Only a year ago (1907) we saw the first one here. They are now quite common." It would be interesting to know in this case the method by which distribution was effected. The colony is located between the Duluth, South Shore and Atlantic and the Northern Pacific railroads. However it seems hardly possible that the spermophiles could have been transported by rail because: first, spermophiles are not arboreal mammals and the probability of their getting upon a railroad car is minimum; second, since a colony has been established, if they were introduced by this method it would have been necessary that either a pregnant female should have been the original stock, or that a male and a female by chance should have taken their abode in the same immediate vicinity after dislodging from the train. It is improbable that a spermophile could have had access to the locality from the west by any other than artificial means; a series of rivers flowing northward into Lake Superior and alternating with pine ridges creates a barrier which it seems would be prohibitous to a migration of members of this genus. The most feasible explanation at present is that ingression was by a gradual migration from the south. Careful field work may disclose several isolated colonies to the southward which finally connect with the area of general distribution which extends north at least to Barron County.

Marmota monax (Linnaeus).

Woodchuck.

A single woodchuck was seen September 2, 1908 in a clover field near Hammills Lake, four miles northwest of Cable, Bayfield County.

Geomys bursarius (Shaw).

Pocket Gopher.

The work of pocket gophers was observed at Bardon Lake, Chippewa Falls, Durand, Gordon, Iron River, Minong and Solon Springs. Pocket gophers are excessively abundant in parts of the sandy country thruout the southern two thirds of Bayfield and Douglas Counties.

Lepus americanus phæonotus Allen.

Minnesota Varying Hare.

Varying hares were reported abundant in favorable places in most parts of Ashland, Bayfield and Douglas Counties. One was seen at Odanah. Six specimens in the writers collection were taken December 26, 1908, near Cable, Bayfield County.

Sylvilagus floridanus mearnsi (Allen).

Mearns Rabbit.

Cottontail rabbits were noted at Alma, Black River Falls, Durand and Hudson. July 25, 1908 a young one, barely one third grown, was caught by hand in a patch of ragweed near a thin black oak woods two miles northeast of Hudson.

Lynx ruffus (Güldenstaedt).

Wild Cat.

An adult male was trapped at Hawleys Lake, six miles northwest of Cable, on August 23, 1908. The skull is in the writer's collection. A female, skin and skull, in my collection was taken near the same locality December 21, 1908. Wild cats are reported as occuring in the hills west of Devils Lake.

Urocyon cinereoargenteus ocythous Bangs.

Wisconsin Gray Fox.

A fine male is in the University of Wisconsin collection. It was collected by Mr. Phil Fox, February 9, 1907, in Lima Township, Pepin County. Scalps belonging to this species have been identified by Prof. George Wagner from Jackson County and Dunn County in 1907 and from Adams County in January, 1910. The last named specimen was seen by the writer. The scalps had been sent to the various county boards with a claim for "wolf bounty"; scalps of house cats have likewise been substituted for wild cat scalps. Professor Wagner deserves much credit for his effective efforts in thus preventing misdirected bounty funds in the state.

Lutra canadensis (Schreber).

Otter.

Two fine male otters were killed February 12, 1908 two miles west of Crandon, Forest County; a skull of one of these is in the writer's collection. Otters were reported as quite common in the vicinity of Black Oak Lake and Lake Mamie during the winter of 1908-1909.

Ursus americanus Pallas.

Black Bear.

Black bears have reappeared in Oneida County since 1907, and are reported more plentiful in Vilas County. In late June, 1908 a female and two cubs were killed near Wolf Lake, Oneida County, and there have been reports of others seen in the region nearby.

Scalopus aquaticus machrinus (Rafinesque).

Prairie Mole.

I have seen no moles of this genus in Wisconsin. Mole ridges, which are assumed to belong to this species, were noticed at Durand, Galesville, Menomonie and Trempealeau.

Condylura cristata (Linnaeus).

Star-nosed Mole.

A badly decayed mole was submitted to the University of Wisconsin for determination about three years ago and was identified by Prof. George Wagner as *Condylura cristata.* It was sent to the university by Mr. D. J. Howe, from Whitcomb. Another was received at the university November 12, 1908 from Bayfield and is now in the university collection.

Myotis lucifugus (LeConte).

Little Brown Bat.

A pair of *Myotis lucifugas* which flew into the hotel office at Cassville, June 29, 1908 was captured and preserved. Thousands of bats inhabit the old storage houses and cliffs along the Mississippi River, but at no place do they appear as abundant as at Cassville.

Bureau of Biological Survey,
Washington, D. C., June 6, 1910.

THE BEE-FLIES *(BOMBYLIIDÆ)* IN THEIR RELATIONS TO FLOWERS.

By S. Graenicher.

The *Bombyliidæ* represent highly specialized forms of the dipterous type, insects that are of importance to many of our flowers as regular and efficient pollen-distributors. Concerning their relations to flowers in general, as also to certain types of flowers, the results obtained from observations carried on in this country are in some respects quite at variance with those reported from European countries.

In Knuth's Handbook of flower pollination, the most recent and most important of its kind we meet in Vol. I, pp. 182 and 183 (Engl. translation) with the following statements: "Although the family of the bee-flies (*Bombyliidæ*) includes short tongued forms (*Lomatia, Anthrax, Argyromæba*) with a decided preference for flowers with exposed nectar, the species of *Bombylius, Systæchus* and *Dischistus* are provided with a long proboscis, with which they suck nectar as they hover."

"On the other hand social flowers are much less convenient for sucking while hovering, and are consequently only very rarely visited by these insects."

"Their preference for red, violet and blue is so remarkable that they were observed on three times as many flowers of these colors as on white or yellow ones. (Mueller, Alpenblumen 515)."

In the foregoing three points are involved: First, the preference of short-tongued species for flowers with exposed nectar; second, the relations to social flowers; and third, the theory of color preference as set forth by Herman Mueller.

The following discussion is based on a comparison of observations made by the author in Milwaukee Co. with the very extensive observations of Robertson[1] in Carlinville, Macoupin Co. in southern Illinois.

COLOR PREFERENCE.

According to Mueller's theory, as referred to above, these flies show a most decided preference for red, purple (or violet)

1) Cited in Knuth's Handbuch d. Bluetenbiologie. Vol. III. part 2, pp. 374-376.

and blue flowers; but the evidence furnished by the visits of the following 9 more or less common species of bee-flies does not agree at all with the theory in question.

1. **Anthrax alternata** Say.

Flowers visited: *Solidago juncea.*[2] Yellow.
Solidago canadensis. Yellow.
Anthemis Cotula. White.
Arctium Lappa. Purple.
Parnassia caroliniana. White.
Rhus glabra. Yellowish.
Verbena hastata. Blue.
Angelica atropurpurea. White.
Pastinaca sativa. Yellow.
Sium cicutæfolium. White.
Oxypolis rigidior. White.
Cicuta maculata. White.

Alltogether for the 12 flowers:
White and yellow 83.3%
Red, purple and blue 16.7%

2. **Anthrax halcyon** Say.

Flowers visited: *Aster puniceus.* Blue.
Eupatorium perfoliatum. White.
Eupatorium purpureum. Purple.
Solidago juncea. Yellow.
Solidago canadensis. Yellow.
Solidago graminifolia. Yellow.
Rudbeckia laciniata. Yellow.
Helianthus strumosus. Yellow.
Helenium autumnale. Yellow.

Alltogether for the 9 flowers:
White and yellow 77.8%.
Red, purple and blue 22.2%.

3. **Bombylius fulvibasis** Macq. (*atriceps* Loew).

Flowers visited: *Allium canadense.* Reddish.
Smilacina racemosa. White.
Viburnum dentatum. White.
Stellaria longipes. White.

2) Nomenclature according to Gray's Manual of Botany, 7th edit. (1908)

Alltogether for the 4 flowers:

White 75.0%.

Red 25.0%.

4. **Bombylius major** L.

Flowers visited: *Antennaria neglecta.* White.
Rudbeckia hirta. Yellow.
Anthemis Cotula. White.
Arctium Lappa. Purple.
Sanguinaria canadensis. White.
Claytonia virginica. Reddish.
Hepatica acutiloba. Purplish.
Caltha palustris. Yellow.
Ranunculus septentrionalis. Yellow.
Vicia caroliniana. Bluish.
Cardamine Douglassii. Purplish.
Prunus nigra. White.
Isopyrum biternatum. White.
Salix rostrata. Yellow.

Alltogether for the 14 flowers:

White and yellow 64.3%.

Red, purple and blue 35.7%.

5. **Systœchus vulgaris** Loew.

Flowers visited: *Eupatorium purpureum.* Purple.
Solidago juncea. Yellow.
Heliopsis scabra. Yellow.
Helianthus strumosus. Yellow.
Verbena hastata. Blue.
Blephilia hirsuta. White.
Melilotus alba. White.
Monarda fistulosa. Purplish.
Teucrium canadense. Reddish.

Alltogether for the 9 flowers:

White and yellow 55.6%.

Red, purple and blue 44.4%.

6. **Sparnopolius fulvus** Wied.

Flowers visited: *Aster paniculatus.* White.
Aster Drummondii. Blue.
Aster puniceus. Blue.
Aster novæ-angliæ. Purple.

Eupatorium urticæfolium. White.
Solidago canadensis. Yellow.
Solidago graminifolia. Yellow.
Rudbeckia hirta. Yellow.
Helianthus strumosus. Yellow.
Helianthus giganteus. Yellow.
Helenium autumnale. Yellow.
Grindelia squarrosa. Yellow.
Bidens lævis. Yellow.

Alltogether for the 13 flowers:
White and yellow 76.9%.
Purple and blue 23.1%.

7. **Exoprosopa decora** Loew.
Flowers visited: *Aster puniceus.* Blue.
Aster novæ-angliæ. Purple.
Solidago juncea. Yellow.
Heliopsis scabra. Yellow.
Rudbeckia laciniata. Yellow.
Helianthus strumosus. Yellow.
Verbena hastata. Blue.

Alltogether for the 7 flowers:
Yellow 57.1%.
Purple and blue 42.9%.

8. **Exoprosopa fascipennis** Say.
Flowers visited: *Aster furcatus.* White.
Eupatorium perfoliatum. White.
Eupatorium purpureum. Purple.
Rudbeckia laciniata. Yellow.
Helianthus strumosus. Yellow.

Alltogether for the 5 flowers:
White and yellow 80.0%.
Purple 20.0%.

9. **Exoprosopa fasciata** Macq.
Flowers visited: *Eupatorium perfoliatum.* White.
Eupatorium purpureum. Purple.
Liatris spicata. Reddish.
Verbena hastata. Blue.

Alltogether for the 4 flowers:
White 25.0%.
Red, purple and blue 75.0%.

The percentages for the same species of Bombylids as derived from Robertson's data for southern Illinois are as follows:

1. **Anthrax alternata**. (6 flowers). White etc. 100%.
Red etc. ——
2. **Anthrax halcyon.** (12 flowers). White etc. 100%.
Red etc. ——
3. **Bombylius fulvibasis.** (6 flowers). White etc. 16.7%.
Red etc. 83.3%.
4. **Bombylius major.** (11 flowers). White etc. 72.7%.
Red etc. 27.3%.
5. **Systœchus vulgaris.** (24 flowers). White etc. 54.2%.
Red etc. 45.8%.
6. **Sparnopolius fulvus.** (21 flowers). White etc. 90.5%.
Red etc. 9.5%.
7. **Exoprosopa decora.** (7 flowers). White etc. 85.7%.
Red etc. 14.3%.
8. **Exoprosopa fascipennis.** (12 flowers). White etc. 83.3%.
Red etc. 16.7%.
9. **Exoprosopa fasciata.** 20 flowers). White etc. 40.0%.
Red etc. 60.0%.

From these figures for the 9 species of bee-flies under consideration we obtain the following average for each locality:

	White and yellow.	Red, purple and blue.
Milwaukee, Wis.	66.1%	33.9%
Carlinville, Ill.	71.5%	28.5%

Several other species of Bombylids have been observed as flower-visitors in Milwaukee Co., and for the sake of completeness I add a list of these, together with the flowers visited:

Spogostylum albofasciatum Macq. visiting *Monarda fistulosa.*
Spogostylum œdipus Fabr. visiting *Eupatorium urticæfolium.*
Aldrichia ehrmanni Coq. visiting *Erigeron philadelphicus.*
Anthrax fulviana Say. visiting *Aster paniculatus, A. puniceus* and *Solidago canadensis.*
Anthrax lateralis Say. visiting *Ceanothus americanus.*
Anthrax parvicornis Loew. visiting *Verbena hastata.*

Anthrax sinuosa Wied. visiting *Solidago juncea, Tofieldia glutinosa* and *Monarda fistulosa.*

Phthiria punctipennis Walk. visiting *Eupatorium perfoliatum, Heliopsis scabra, Rudbeckia hirta, R. laciniata* and *Helianthus strumosus.*

Geron calvus Loew visiting *Rudbeckia hirta.*

In this account alltogether 18 species of bee-flies figure as visitors to 52 species of flowers, which latter represent the following 17 families:

1. **Liliaceæ.** *Tofieldia glutinosa.*
   Allium canadense.
   Smilacina racemosa.
2. **Salicaceæ.** *Salix rostrata.*
3. **Caryophyllaceæ.** *Stellaria longipes.*
4. **Portulacaceæ.** *Claytonia virginica.*
5. **Ranunculaceæ.** *Ranunculus septentrionalis.*
   Hepatica acutiloba.
   Isopyrum biternatum.
   Caltha palustris.
6. **Papaveraceæ.** *Sanguinaria canadensis.*
7. **Cruciferæ.** *Cardamine Douglassii.*
8. **Saxifragaceæ.** *Parnassia caroliniana.*
9. **Rosaceæ.** *Prunus nigra.*
10. **Leguminosæ.** *Melilotus alba.*
    Vicia caroliniana.
11. **Anacardiaceæ.** *Rhus glabra.*
12. **Rhamnaceæ.** *Ceanothus americanus.*
13. **Umbelliferæ.** *Cicuta maculata.*
    Sium cicutæfolium.
    Pastinaca sativa.
    Oxypolis rigidior.
    Angelica atropurpurea.
14. **Verbenaceæ.** *Verbena hastata.*
15. **Labiatæ.** *Teucrium canadense.*
    Monarda fistulosa.
    Blephilia hirsuta.
16. **Caprifoliaceæ.** *Viburnum dentatum.*

17. **Compositæ.** *Eupatorium purpureum.*
Eupatorium perfoliatum.
Eupatorium urticæfolium.
Liatris spicata.
Grindelia squarrosa.
Solidago juncea.
Solidago canadensis.
Solidago graminifolia.
Aster furcatus.
Aster novæ-angliæ.
Aster Drummondii.
Aster paniculatus.
Aster puniceus.
Erigeron philadelphicus.
Antennaria neglecta.
Heliopsis scabra.
Rudbeckia hirta.
Rudbeckia laciniata.
Helianthus strumosus.
Helianthus giganteus.
Bidens lævis.
Helenium autumnale.
Anthemis Cotula.
Arctium Lappa.

According to this list we are dealing with 37 white and yellow flowers (about 71%) as against 15 red, purple and blue (about 29%), in other words more than twice as many white and yellow flowers have received the attention of these flies than red, purple and blue ones, and this is just the opposite of what H. Mueller found. These figures taken in connection with those given for the 9 species of Bombylids which were considered separately justify the conclusion, that these flies do not show a preference for any particular color. *Bombylius fulvibasis*, for example furnishes at Milwaukee a much greater percentage of visits to white and yellow flowers, while the same insect was seen at Carlinville, Ill. on a greater number of red, purple and blue flowers.

Quite recently Langhoffer[3] published the results of his observations on the visits of two European species of *Bombylius: B. discolor* and *B. fuliginosus*. These observations cover a period of

3) A. Langhoffer Bluetenbiol. Beobacht. an Dipteren. Zeitschr. f. Wissensch. Insektenbiol. Vol. VI, pp. 14-17 and 57-61 (1910).

7 years, and show that *B. discolor* is a very regular visitor of *Pulmonaria offcinalis (Boraginaceæ)*, and that it prefers the flowers of this to those of any other species, visiting other flowers in the case of necessity only. In *Pulmonaria offcinalis* a change of color takes place from red in the younger to blue in the older flower, and *Bombylius discolor* is seen to favor the red flowers and spend more time at them for the simple reason, as Langhoffer states, that they contain more nectar than the blue ones. In the case of *Bombylius fuliginosus* this author noticed a preference for the blue tubular flowers of *Muscari neglectum (Liliaceæ)*.

In our region *Bombylius major*, the earliest of our Bombylids flies from about the 26th of April to the end of July. During the first few weeks of its period of flight it may be seen at the white flowers of *Antennaria neglecta, Prunus nigra* and *Sanguinaria canadensis* (the latter a so-called pollen-flower, one in which no nectar is secreted), the yellow flowers of *Caltha palustris, Ranunculus septentrionalis* and *Salix rostrata* (probably also on some other species of *Salix*), the red flowers of *Claytonia virginica*, and the violet flowers of *Vicia caroliniana, Cardamine Douglassii* and *Hepatica acutiloba*, the latter also a pollen-flower.[4]) It is a rather frequent visitor at the red flowers of *Claytonia virginica*, without however showing a decided preference for this species.

Structure of the flower, odor, taste and supply of nectar determine probably more than anything else the extent to which a flower is attractive to such an insect. As stated above Langhoffer explains the more frequent and longer visits of *Bombylius discolor* to the younger red flowers of *Pulmonaria* as being due to the greater amount of nectar contained in these than in the older blue flowers. If we could change the color of such a flower to white or yellow without changing its structure and the odor and taste of its nectar there is hardly any reason to doubt, that it would prove as attractive to *Bombylius discolor* as otherwise. The same may be said for the blue flower of *Muscari neglectum* in its relation to *Bombylius fuliginosus*.

II. FLOWERS VISITED BY SHORT-TONGUED BOMBYLIDS.

For the short-tongued species belonging to the genera *Lomatia, Anthrax* and *Argyramœba (Spogostylum)* it has been

4) Regarding pollenflowers and Bombylids we have the following in Knuth's Handbook, Vol. 1, p. 183: "The species of *Bombylius* like those of *Empis* are also able to bore into succulent tissues." Further on, following a discussion of the anatomy of the mouthparts we read: "I have often seen species of *Bombylius* thrust their proboscis into nectarless flowers (e. g. *Bombylius canescens* Mik into *Hypericum perforatum*), and I imagine that here the boring apparatus was brought into action."

claimed, as mentioned above, that they exhibit a decided preference for flowers with exposed nectar.

A glance at the list of flowers visited by *Anthrax alternata* shows that 7 of these belong to the type with exposed nectar, while in the remaining 5 (4 *Compositæ* and *Verbena hastata*) the nectar is concealed. Of the 6 flowers visited by the same insect at Carlinville, Ill., only 1 has exposed nectar (*Euphorbia corollata*).

For *Anthrax halcyon* we find all of the flowers visited at Milwaukee as well as at Carlinville belonging to the *Compositæ, i. e.* with concealed nectar. In those figuring in the Milwaukee list the nectar is concealed at the bottom of tubes ranging in length from 1 mm.,[5] as in *Eupatorium perfoliatum* and the 2 species of *Solidago*, to 4 or 4.5 mm. (*Eupatorium purpureum* and *Helianthus strumosus*).

In the case of the 4 additional species of *Anthrax* referred to above (*fulviana, lateralis, parvicornis* and *sinuosa*) only 1 of the species of flowers visited (*Tofieldia glutinosa*) has exposed nectar.

As to *Spogostylum* (of which *Argyramœba* mentioned by Knuth is a synonym) *Monarda fistulosa* visited by *S. albofasciatum*, and *Eupatorium urticæfolium* visited by *S. œdipus* are both flowers with concealed nectar.

Summing up our results for the 6 species of *Anthrax*, and the 2 species of *Spogostylum* observed at Milwaukee we note that among the 31 species of flowers visited 8 or only 26% have exposed nectar. The statement that the short-tongued bee-flies belonging to the genera *Anthrax* and *Spogostylum* (*Lomatia*, the third genus referred to in this connection in Knuth's Handbook does not occur in our region) prefer flowers with exposed nectar does not hold good for our region.

III. RELATIONS OF BOMBYLIDS TO SOCIAL FLOWERS.

The *Compositæ* are the most important among the so-called social flowers. In the temperate regions of our North American continent they occupy a prominent position in the make-up of the flora. In the latest list of the flora of Milwaukee County published by Mr. Howland Russel[6] 921 species of ferns and flowering plants are enumerated, and the *Compositæ* figure in this list with 152 species or 16.5% of the flora. Data obtained from specimens in the herbarium of the Public Museum of Milwaukee, as

5) S. Graenicher: Wisconsin flowers and their pollination. Compositae. Bull. Wis. Nat. Hist. Vol. VII. pp. 19-77. (1909).

6) Howland Russel, Check list of the flora of Milwaukee County. Bull. Wis. Nat. Hist. Soc. Vol. V, pp. 167-250 (1907).

also notes of my own have enabled me to construct a flowering curve for 122 of our species of *Compositæ*. Some time in April or around the beginning of May, according to meteorological conditions, the flowers of the earliest species, the dandelion make their appearance, followed a few days later by *Antennaria neglecta*. During the first half of May two other species of *Antennaria* begin to bloom, towards the end of the month two species of *Erigeron* and one of *Senecio* arrive on the scene, and we notice a gentle rise of the curve up to the beginning of July, from which time on a very rapid rise leads to a maximum around the end of August. From there on a more or less gradual decline is noticeable, and the flowering season is, as a rule cut short by the appearance of a severe frost around the end of October or the beginning of November. According to the available data only 18 of the 122 species considered appear before the 1st. of July, the bulk of the family is therefore made up of summer and fall bloomers.

This curve agrees quite closely with the curve presented by Robertson[7] for Carlinville, Ill.

Judging from the enormous number of individuals by which these plants are represented in our flora we are led to consider this type of floral structure a very successful one, one possessing a rather favorable combination of characters. It is therefore not surprising to learn that these flowers prove very attractive to the flower-visiting insects, and that in some instances the relations between flower and insect are quite close. Robertson[8] in referring to the most important visitors of the *Compositæ* includes the Bombylids and gives a flight curve for this family, according to which the greatest number of species is on the wing from about the middle of June to the end of August when the maximum is reached. A corresponding curve for the *Bombyliidæ* of Milwaukee Co., based on observations covering 22 species has its starting point near the end of April, rises slowly to the beginning of July, and from there takes a rapid spurt upwards to a maximum lasting throughout the month of August. This curve bears much resemblance to the flowering curve of the *Compositæ*.

In the list of flowers for which the visits of Bombylids have been recorded, and which are arranged according to families (p. 95) 24 out of the 52 species or 46% belong to the Compositæ. If we consider the number of flowers visited by each of the 18 species of Bombylids referred to in this paper, we have out of a

7) Chas. Robertson. The philosophy of flower seasons etc. Am. Nat. Vol. XXIX, pp. 97-117 (1895).

8) Chas. Robertson. Loc. cit. p. 110.

totality of 94 visits 60 credited to species of *Compositæ,* and this amounts to 64% in favor of these flowers. These figures prove rather conclusively that, so far as the relations of the bee-flies to social flowers are concerned, the statement that the latter are very rarely visited by the former does not apply to the temperate regions of our continent.

THE IDENTITY OF TWO ODONATA FOSSILS.[1]

By Dr. F. Ris.

The following observations are based on the two species of Odonata fossils described by Scudder in Bulletin 93 U. S. Geological Survey and figured on Plate 1, figures 1 and 2.

1. Stenogomphus carletoni Scudder.

The first impression of the wing is, that it is a Gomphine; more especially, that it is much like *Progomphus*. This, in fact, was the conclusion reached by De Selys and Hagen, who individually determined the species as related to *Progomphus* from separate figures furnished them by Scudder.

But this view does not stand upon closer examination. It is then found to be a Libellulid, more specifically a Corduline, probably nearer to *Aeschnosoma* than to anything else; *Neocordulia*, *Neurocordulia* and *Platycordulia* also may be compared. The following are my reasons for this determination:

A.—*The Gomphine supposition.*—In favor of this view we have: The antenodals of the costal and subcostal series are not coincident. The triangle is much like *Progomphus*, *Gomphoides*, or *Ictinus*; the crossing by three nervules is not common for a Libellulid, indeed none of the *Libellulinae* known to me possesses a triangle in the forewing crossed in **Y**-fashion; the angulate distal side of this triangle too is much like many *Gomphinae*, only I should want for such a condition of the distal side of the triangle at least a trace of a "triangular supplement" (Williamson); no such supplement is figured by Scudder.

Against the Gomphine supposition, there are the following arguments:

1) The present paper originated through my casual inquiry as to the probable relations and position of *Stenogomphus carletoni* Scudder, if Dr. Needham's statement "—it is in fact a Libellulid in every line" (Proc. U. S. Nat. Mus., 26, p. 761 1903), which unfortunately was not further elucidated, was to be accepted. Dr. Ris examined a figure of the fossil and in a letter dated April 6th summarized his views for sustaining Dr. Needham's opinion. Dr. Ris' remarks seemed to me of such moment to Odonatologists that I requested his permission to transcribe the letter (of which he retained no copy) for publication, which was readily granted. As far as possible I have adhered to the original letter; a few changes were unavoidable, owing to the exigencies of publication.—R. A. Muttkowski.

1. None of the antenodals is thickened. This, indeed, could be an error in reproduction. It is evident, that the first one or two antenodals are not figured at all; so the first thickened antenodal would be lost. The second of the represented antenodals could possibly be thickened, although it is not so figured. So this argument carries little weight.

2. The bridge is of Libellulid form. The Gomphine bridge shows at its proximal end a nervule towards M_3, and all *Gomphinæ* known to me have supplementary bridge-cross-nervules. This argument, too, it not of great moment, as the nervules in question could be omitted by the author of the design.

3. No *Gomphinæ* are known to me, in which the distance between arculus and triangle is so great as that figured. It is perhaps greater in *Ictinus* than in any other living Gomphine, but still considerably less than in the figure. I think this argument is of very considerable weight, the point specified being not easily subject to error in drawing.

4. The distance between the subnodus and the first nervule between R and M_1 is too great for a Gomphine, but regular for a Libellulid. Another argument of only relative importance, as a nervule might be omitted.

5. There is a very distinct radial supplement, parallel to Rs. This is a well-known feature among *Libellulidæ*, indistinct only in some of the most primitive genera. No Gomphine wing is known to me, where a *supplement parallel to Rs* is developed. Some *Gomphinæ* may have a nervure for which the term radial supplement might be claimed (as instanced in Needham, Proc. U. S. Nat. Mus., 26, 1903; pl. 34, fig. 3—*Gomphidia*); but it is in these cases a nervure branching off from Rs and running to the wing-edge in a direction divergent from Rs. This seems to me an argument of sufficient importance to *exclude* the Gomphine hypothesis for Scudder's wing.

B.—*The Corduline supposition—allied to Aeschnosoma.*

2, 3, 4, and 5, as above, are all in favor of a Libellulid.

6. None of the *Libellulina* is known to have a triangle like Scudder's figure; such a triangle is to be found in *Neurocordulia*, *Platycordulia*, and *Aeschnosoma*. I have before me a specimen of *Aeschnosoma* from Surinam, possibly *forcipula*, where even a trace of the fractured distal side of the triangle may be observed. So it is reasonable to look for the allies of our species (*Stenogomphus carletoni*) rather

among the *Corduliinæ* of the *Aeschnosoma* group than among the *Libellulinæ*. The internal triangle will do for such a Corduline (and would do for many of the *Libellulinæ).*

7. The rather particular form of the discoidal field, produced by the waved form of M_4 (and less so M_3) is not known to me among the *Libellulinæ*. In Scudder's figure it is somewhat intermediate between the forms of *Aeschnosoma* and *Neocordulia volxemi*.

8. The form of the radial supplement is very much like that of the mentioned Corduline genera.

9. The postnodal part of the wing is relatively too long for *Aeschnosoma* (which has nearly the proportions of *Macromia* or *Macrothemis)*, but is much like *Neurocordulia* and *Platycordulia*.

10. Little importance can be attached to the anastomosing of the sectors of the arculus in Scudder's figure. The long stalk is even far too long for any of the *Libellulinæ*. I think either the conservation of the specimen or a mistake of the artist are responsible for this *impossible* feature of the wing.[2]

My conclusion: Needham is right (as might be expected from one who has so profoundly studied the development of dragonfly venation). The specimen as figured by Scudder is not a Gomphine; it is a Corduline, more especially something between *Neurocordulia* and *Platycordulia* on one side, *Aeschnosoma* on the other side.

2. Trichocnemis aliena Scudder.

The figure of this fossil appears on the same plate with *Stenogomphus.*

There is little reason to look for such a far off relationship as that of *Trichocnemis* for Scudder's fossil; (it must be remembered that the "legion *Platycnemis*" is not represented in America at all). The wing seems to me most probably a hind wing of *Argia*. If compared to nature, one will find that the quadrangle in *Argia* (hind wing) is much like that figured by Scudder; the proportions of sectors, the origin of Cu_2, the position of the nodus, the number of postnodals, too, correspond with *Argia*. The second cubito-anal cross-vein is very probably either anomalous for an addition by the artist (more probably the second); it would

2) In a letter dated June 1, Dr. Ris writes: "—since writing, I received from the Hamburg Museum an *Aeschnosoma forcipula,* labelled by de Selys; this specimen shows remarkable similarity to *S.carletoni*—supposing that the stalked sectors of the arculus n the latter are, as quite possible, due to casual superposition of the veins in the fossil." —R. A. M.

be anomalous for *Trichocnemis* as well as for *Argia* or any other Agrionine. Besides *Argia*, there could be thought of *Amphiagrion saucium*, of the Chilian *Antiagrion*, or of the group represented by the "Agrions" figured by Perkins in the Fauna Hawaiiensis and which I dare say are perhaps more like *Antiagrion* than anything else (only I have not seen them in nature). Indeed, there is material enough in America to compare with Scudder's Florissant specimen and little reason to go to India to look for its allies.

Rheinau, Switzerland,
April 12, 1910.

ADDITIONAL NOTES ON *TRICHOCNEMIS ALIENA* SCUDDER.

By Richard A. Muttkowski.

The foregoing notes were transmitted to me by Dr. Ris in a letter and are published with his permission. I believe, that there is little more than can be said on *Stenogomphus carletoni*. The remarks on *T. aliena* were, however, of such interest that I began a comparison of the figured specimen with living genera.

The species has been repeatedly discussed. The crucial point of all these discussions has been the additional cross-vein in the subquadrangle. But, as stated by Dr. Ris, this is anomalous or due to an error by the artist. I incline to the latter assumption. For it is not to be expected that Scudder would omit mention in his text of such an unusual feature as an additional cross-vein in the subquadrangle. Hence it is rather to be assumed that the drawing is inaccurate, as, in fact, already instanced by Dr. Ris for *Stenogomphus*. Furthermore, another specimen obtained by Mr. Cockerell shows no indication of an additional cross-vein.

In a published correspondence between Prof. Cockerell and Mr. Williamson,[1] the following relationships were considered (besides the*Platycnemis* supposition, which Williamson also questions):

a) The vertical subnodus, which would ally *T.aliena* to *Oxyagrion*, *Argia*, *Hyponeura*, and *Ischnura* (partly). Mr. Williamson does not regard this as indicating generic relationship.

b) Allied to *Hesperagrion* because of similarity of wing form, quadrangle and subquadrangle, and the relation of their parts to the antenodals, the origin of M_2; also "the length and direction of the subnodus are not far out of the way."

c) To which may be added those given by Dr. Ris: *Amphiagrion*, *Antiagrion*, and the Hawaiian *Agrion*.

1) Amer. Jn. of Sci., 26, pp. 73-75, 1908.

	Argia violacea.	*T. aliena*
orm of wing	widest opposite the supplement in fork of M_1 and M_2	similar
ostnodals	10-14 (11 most often), the last 3 or 4 rarely continuous with the cross-veins between R and M	11, all continuous with cross-veins between R and M.
uadrangle	superior almost equal ($^5/_9$) to distal side ($^4/_9$); widening distally.	superior longer ($^3/_5$) than distal side ($^2/_5$); width equal.
ubquadrangle	shorter, since cross-vein below Cu is nearer to the quadrangle	longer, as cross-vein is nearer to origin of Cu than to quadrangle.
osition of nodus	7 mm. from base, wing 20.5 mm.	7.33 mm. from base, wing 20 mm.
ubnodus	somewhat oblique	nearly vertical.
rigin of M_1	from arculus., distinctly separate from quadrangle	similar.
rigin of M_2	5 to 7 cells beyond nodus; (when at cell 5, there are 3 nervules in fork of M_1 and M_2 before supplement).	5 cells beyond nodus.
rigin of M_3	with abrupt curve from M_1.	similar.
rigin of Cu_2	from hind margin, the cross-vein midway betw. quadr. and origin, the length of Cu each side $^3/_2$ of cross-vein.	hind margin, cross-vein nearer to base. Cu basad $^2/_3$ length of cross-vein, distad $^3/_2$.
ngulation of M_1 begins	1-2 cells before origin of M_2.	1 cell beyond origin of M_2.
ngulation of Cu_2 begins	on level of or 1 cell beyond nodus.	2 cells beyond nodus.
u_2 angled opp. quadr.	obtusely, but distinctly, (45°).	nearly birectangular (80°).
ells along h. margin	regular.	of Argian form.
ells along apical margin. M_2-M_4	irregular, broken, very numerous.	regular, large, small number.
ells in fork of M_2 before suppl.	1-4 cross-veins (3 once in 6).	3 cross-veins.
ostnodal cell.	very little longer than following cell (variable, as other species show larger cell).	distinctly ($^1/_3$) longer than next cell.

Of these *Oxyagrion* and *Amphiagrion* are out of question, differing in arrangement of cells and form of stigma. *Hyponeura* need not be considered because of the large number of postnodals, stigma, arrangement of cells, and origin of veins, which do not in the least resemble the fossil. *Antiagrion* and the Hawaiian Agrions may be set aside for geographical reasons. Hence only *Hesperagrion* and *Argia* need be considered as possible allies. While *Hesperagrion* offers many points of similarity, it also differs in several important respects, as:

a) the stigma, narrow in *Hesperagrion*, more equal-sided in *aliena*.

b) the origin of vein M_3, gradually bent at the origin in *Hesperagrion*, abruptly arising in *aliena* (teste Scudder).

c) vein M_4 is angulate opposite the origin of M_2, beyond the nodus in *aliena*.

d) the angulation of Cu_2 formed by the first cross-vein on both sides nearest the base i. e., by the cross-vein continuing the distal side of the quadrangle and the postero-marginal cross-vein continuing the distal side of the quadrangle and the postero-marginal cross-vein situated a trifle before it) is very faint and obtuse in *Hesperagrion*; in *aliena* both cross-veins are so placed as to form a nearly birectangular angulation, as of a straightened **Z**.

e) vein M_1 arises from the junction of the arculus and the upper angle of the quadrangle; in *aliena* M_1 arises from the arculus, disinctly separate from the quadrangle.

The Argia supposition.—For comparison the smaller series of *Argia* were selected, as typified by *A. violacea*, this species having the widest known distribution among smaller Argias. Although the type of the genus, *A. fumipennis* is not a synthetic type in the present case. Series of clear-winged Argias, as true synthetic types, were compared also.

From the table it appears, that *aliena* can be placed with neither *Argia* or *Hesperagrion*, although in its important features it seems more nearly allied to the former. Yet the absence of apical multiplication of cells in the fossil (by no means an unimportant feature), the relation of Cu to the subquadrangle, and the quadrangle itself, would tend to show nearer kin to *Hesperagrion*. Assuming that Scudder's figure is correct in these essentials, the fossil occupies a position intermediate between *Argia* and *Hesperagrion*, combining elements of both genera.

If Scudder's *Trichocnemis* hypothesis is not allowed, *aliena* stands without a genus name; which, however, can be authoritatively given only after a careful study of the fossil, and not of the figure alone.

Public Museum, Milwaukee, Wis.
June 13, 1910.

BRIEFER ARTICLES.

GOMPHUS CORNUTUS TOUGH (*ODONATA*) IN MILWAUKEE COUNTY.

By Richard A. Muttkowski.

On June 29, 1910, while collecting crayfish and fish with Mr. A. Katze-Miller, of the Museum, I noticed an extremely agile species of *Gomphus* flying around the pond where we were ploying our nets. The species, even in flight, appeared different from any of the local Gomphines known to me. It was extremely wary and only after half an hour's chase did I succeed in obtaining a specimen, a male. A few minutes later I caught another male; for further captures I could not spare the time. Upon examination of the appendages I saw immediately that the species was different from any I had seen before. Later comparison proved it to be *Gomphus cornutus* Tough.

Hake's pond, Township Franklin, where the specimens were collected, is a shallow, muddy affair, covering half an acre, supplied with a few springs, which keep the water fairly cool. Except for a few reeds and rushes and several scraggly bushes, no vegetation exists along the shore. Toward the east, about 100 feet distant, is a large woods, which, however, the Gomphines showed no inclination to visit. Neither did they fly in such spots, where the shorewater was clear.

The flight of the species is peculiar and characterized by remarkable agility, as noted above. Eight specimens were seen, but only one female, which was lost in pursuit. The species apparently found great pleasure in playing with *Plathemis lydia*, which was out in large numbers. In fact, so much did their flight resemble that of *P. lydia*, that at a distance it appeared the same as the other. Only on nearer approach did its yellow front and occiput show it to be different. Their method of settling down on dead reeds or twigs and pieces of wood—anything of brownish hue, at a distance of from eight to ten feet from the shore—just sufficient to place them beyond reach of the net, was aggravating. Seemingly imperturbable against all net-strokes, against flinging of stones, drift-wood and earth, they again were extremely wary upon closer approach.

The chase of the first male was particularly interesting. After more than twenty futile strokes with the net, when I felt certain each time that I had captured him, I at last succeeded in finding a place sufficiently near to permit more careful manouvering. Aiming to outmanouver his previous upward escapes at each stroke, I swept my net about six inches over him;—outside of the flutter caused by the current of the stroke he did not stir. Another stroke—he sat still. A third sweep—he refused to move. And then, as if laughing at the trials of his ardent enemy, he calmly arose, circled before me and settled on the same twig as before, where at last I got him.

Their immovability after alighting was striking. A peculiar position was very often assumed. Namely, after a minutes' pondering, they would bite into the reed or twig, at the same time thrusting their abdomen high into the air and wiggling it in a manner which was quite amusing.

The time of their capture was the exact noon-hour, and the species cavorted in the brightest and hottest sun-shine. The temperature of the day may be of interest; in fact, the official record shows it to have been the hottest day Milwaukee has experienced in the last 39 years, with a temperature of 96.3 degrees Fahrenheit. Notwithstanding the light breeze, the atmosphere was close and oppressive.

Upon examination of the generic character I find that the species belongs in the *Arigomphus* group, which Needham characterized as having the posterior genital hamule directed posteriorily and with a single, elongated (but not margined) cell between A_1 and A_2 at their origin in the hind wing.

Public Museum, Milwaukee, Wis.

July 1, 1910.

BOOK REVIEWS.

ANTS; their Structure, Development, and Behavior, by William Morton Wheeler, Ph. D., Professor of Economic Entomology, Harvard University; Honorary Curator of Social Insects, American Museum of Natural History. New York, The Columbia University Press, 1910, (Col. Univ. Biological Series, IX), pp. xxv+663, figg. 286 incl. front. 23 cm. "Literature" pp. 578-648. Issued Mar. 23, 1910.

Students and lovers of ants will welcome Prof. Wheeler's "Ants" as a masterly condensation of our scattered knowledge of *Formicidæ*, with a wealth of research material, some of which is published for the first time. While the book covers the ants of the world, Professor Wheeler's labors for over a decade have been devoted more especially to the ant fauna of North America; hence the major place is given to these species. His work proclaims a mastery of myrmecology not yet evidenced by any other entomologist of the Western Hemisphere. Altho the bibliography is 70 pages long, it is a model in bringing complete references into the smallest possible compass, and bears witness to the fact that we shall never know whether we ever exhaust the literature touching upon ants, or not.

Space fails to detail the 30 chapters into which the 544 pages of solid text are divided except as shown by the title above, the topic "Behavior" occupying the last 20 chapters, rather more than two-thirds of the book. For the general reader this is a wise division of space, since the ethological considerations are the most far-reaching in their applications to general information. The preface records that the book was written with a four-fold purpose: "to the general reader; to the zoologist, who cannot afford to ignore their polymorphism or their symbiotic and parasitic relationships; to the entomologist, who should study the ants if only for the purpose of modifying his views on the limits of genera and species; and to the comparative psychologist, who is sure to find in them the most intricate instincts and the closest approach to intelligence among invertebrate animals Of course, the desire to interest so many must result in a work containing much that will be dull or incomprehensible to any one class of readers."

In a fair criticism of over a column in the New York Times Saturday

Review of Books, May, 1910, the work is pointed out as rather dry reading to the uninitiated. Let us take up the cudgels here, for that reviewer certainly does not appreciate that the study of ants is the most complicated field of enomology today, if considered only from the standpoint of "Ants as Dominant Insects," the title of Chap. I. If our reviewer friend was seeking a popular book for a hammock pipe-dream which would titillate his cerebrum, at the same time imparting true science, he should certainly be familiar with the pleasing work of Dr. Henry C. McCook, "*Ant Communities and how they are governed; a study in natural civics*," 1909. Dr. Wheeler's fat volume would have expanded into a "five-foot shelf" to compass his knowledge, if he had adopted the same entertaining style of the other. Even so, the lay reader must find it difficult to cease marveling at the unraveled problems in the fascinating chapters on Sanguinary and Degenerate Slave-Maker Ants (XXV to XXVII), as well as recent light on some of the Ant Guests (XXI-XXII), which savor of the ogres, the knights errant, the crusades, slavery, fairies and the like of the Middle Ages. He says (p. 503): "He who without prejudice studies the history of the paragon of social animals, mankind, will note that many organizations that thrive on the capital accumulated by other members of the community, without an adequate return in productive labor, bear a significant resemblance to many of the social parasites among ants. Space and the character of this work, of course, forbid a consideration of the various parasitic or semi-parasitic institutions—social, political, ecclesiastical, and criminal—that have at their inception timidly struggled for adoption and support, and, after having obtained these, have grown great and insolent, only to degenerate into nuisances from which the sane and productive members of the community have the greatest difficulty in freeing themselves." There is nothing dull and dry in this challenge to greater sanity on the part of mankind, as deduced from the intimate study of ants; and what is more, this method of deduction from scientific work seems to be growing popular, as witness the speech at Oxford, England, of our former President, Mr. Roosevelt, "Biological Analogies of History." (Reprinted in The Outlook, June 11, 1910.)

Many of the illustrations are reproduced from excellent photographs from life. Little more can be desired to show the indoor life of ants. The wealth of line drawings and figures, mostly original, executed with splendid accuracy by Miss Ruth B. Howe under Prof.

Wheeler's direction, force us to admit that this is the finest textbook of a specialty in entomology that has been issued. As the only adverse criticism, we would note the uncut pages and uneven fore edge as dirt catchers for a book so thoroughly valuable for reference.

Taxonomically, the book gives only a short key (Appendix B) to the genera and subgenera of North American ants, of which 451 described forms are listed (Appendix C) ; but the preface promises us in time a monograph of the ants north of Mexico. Now that we have the various phases of myrmecophilous research brought together in this admirable book, it appears that there remains only for workers to monograph and bibliograph the life histories of the individual species as the need arises or time permits.—A. C. Burrill.

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Vol. 2, No. 2, "Spiders of the Marptusa Group of the Family Attidæ," G. W. & E. G. Peckham, Nov., 1894.

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.

"The Wisconsin Archeologist," Vol. I, No. 1, Oct., 1901; Vol. I, No. 2, Jan., 1902; Vol. I, No. 3, Apr., 1902; Vol. I, No. 4, July, 1902; Vol. II, No. 1, Oct., 1902, each .... 25 cents

This publication is now issued by the Wisconsin Archeological Society of Milwaukee, from whom the later volumes may be obtained.

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Vol. 8 JULY, 1910 No. 3

BULLETIN

OF THE

Wisconsin Natural History Society

PUBLISHED WITH THE
COOPERATION OF THE

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EDITOR: RICHARD A. MUTTKOWSKI.

Associate Editors: DR. P. H. DERNEHL, I. N. MITCHELL, HOWLAND RUSSEL, EDGAR E. TELLER.

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OFFICERS AND DIRECTORS.

PUBLICATION.

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EDITORS.

Editor: Richard A. Muttkowski, Public Museum, Milwaukee, Wis.

ASSOCIATE EDITORS.

Dr. P. H. Dernehl............................Department of Zoology
I. N. Mitchell................................Department of Biology
Howland Russel.............................Department of Botany
Edgar E. Teller.............................Department of Geology

MEETINGS.

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room at the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

MEMBERSHIP DUES.

Active Members, $3.00 per annum; Junior Members, $1.00 per annum; Corresponding Members, $2.00 per annum; Life Members, one payment of fifty dollars.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 8. JULY, 1910. No. 3

PROCEEDINGS.

Milwaukee, April 14, 1910.

Meeting of the combined sections.

President Barth in the chair. 27 people present. Minutes of last meeting read and approved.

Mr. I. N. Mitchell gave an illustrated lecture on the subject of Heredity.

Upon motion the meeting adjourned.

Milwaukee, April 28, 1910.

Annual meeting of the society. President Barth in the chair. 22 people present. Minutes of the last regular meeting read and approved.

The following nominations were presented by Dr. Barth: F. Stresau, 295 9th St., Walter Allen, 932 Hackett Ave., Henry Harnischfeger, 3416 Grand Ave., August Luedke, 283 11th St., O. G. Gilbert, 1127 18th St., Charles H. Bauwald, 1321 Cedar St.; all were subsequently elected members by the board of directors.

The lecture of the evening was given by Prof. W. D. Frost, of the Bacteriological Department of the University of Wisconsin, on the topic "Life of Pathological Bacteria" outside of the body. Saying that there are no bacteria outside of the animal body except a very few, such as the Tetanus germ and the lumpy jaw (in cattle) bacillus, Prof. Frost traced the development of our knowledge of the typhoid germ from the old theory that it is due to low ground water to the present accepted view that it is transmitted by direct contact. Resistance formed an important part of the lecture and was instanced by the tuberculosis germ, tetanus, typhoid and other bacteria; because of the comparatively low resistance of all of these germs as shown by laboratory experiments the view is now becoming widely accepted that infection is probably carried more directly from one medium to another than by intermediates, such as water, air, etc. Several instances of disease-distributing persons were instanced, as of the famous "typhoid Mary." Insects as disease-bearers were also discussed.

After the lecture the meeting proceeded to the reports of officers. The reports of the treasurer and general secretary were read and accepted by vote of the members. An auditing committee consisting of Dr. S. Barrett and Mr. E. E. Teller was appointed to audit the treasurer's books, which subsequently reported that it found everything in order.

Nominations of officers were called for by the chair. Mr. Russel moved that the secretary be instructed to cast a united ballot for the previous officers of the society. Seconded and carried. The secretary then cast one ballot for Dr. George P. Barth for president, Henry L. Ward for vice president, Dr. P. H. Dernehl for treasurer, Richard A. Muttkowski for general secretary, and Edgar E. Teller for additional director.

The question of the society electing a trustee for the Museum Board was then brought up for discussion. Moved by Mr. Russel that the question be referred to the directors. Seconded and carried.

Dr. S. Graenicher then moved a vote of thanks to Prof. W. D. Frost for his lecture. Seconded and carried.

The following committees were appointed by the chair:

1. For Programs for general meetings:
   Chairman: Henry L. Ward;
   Members: Miss Helen Sherman, Dr. S. Graenicher.
2. For Programs for section meetings:
   Chairman: George W. Colles.
   Members: Howland Russel, I. N. Mitchell.
3. Membership committee:
   Chairman: Dr. George P. Barth.
   Members: Henry L. Ward, I. N. Mitchell, Howland Russel.
4. Associate editors:
   Editor in chief: Richard A. Muttkowski.
   Associates: Edgar E. Teller, Dr. P. H. Dernehl, Howland Russel, I. N. Mitchell.

5. For Compilation of Check-list of the Flora of Wisconsin:
   Chairman: Dr. S. Graenicher.
   Members: Howland Russel, Wm. Finger, E. Monroe, Dr. H. V. Ogden. (This committee has the power to add to its members).

The annual banquet to be held in June was brought up for discussion. Dr. P. H. Dernehl moved that the expense from the general fund for this banquet be limited to ten ($10) dollars. Seconded and carried.

Upon motion the meeting then adjourned.

Milwaukee, May 12, 1910.

Meeting of the combined sections.

Mr. E. E. Teller in the chair. 28 people present. Minutes of the last section meeting read and approved.

The name of Mr. August Schoenebeck, Lena, Wis., nominated by Mr. H. Clowes, was presented to the society and referred to the directors for action.

The session was devoted to Biography. As of special interest "Darwin and His Contemporaries" had been assigned for the evening.

Dr. J. J. McGovern opened the session with a paper on Charles Darwin, his Life and Work. In brief outlines Dr. McGovern summarized the youth and student days of Darwin, his distaste for the study of medicine and his early love for nature, and his abhorrence of the dissecting room; the turning-point of Darwin's career, his first ocean voyage, and the important collections obtained on this voyage. the later profound results of which the world knows, formed the body of Dr. McGovern's paper. A brief estimate of the lovable character of the great scientist marked the conclusion.

Dr. George W. Peckham spoke on Darwin's friend, A. R. Wallace. Dr. Peckham reviewed the somewhat erratic career of Wallace as surveyor and traveler, his brief pursuit of spiritualism, and the aid given by him to Darwin. He effected an interesting comparison of the different natures of the two great friends, Darwin and Wallace, the painstaking effort of the former, the brilliant genius of the latter. A letter from Dr. Wallace, containing his views on animal instincts, was read by the speaker.

A paper by Mr. H. L. Ward, on T. H. Huxley, was read to the meeting by Dr. S. Graenicher. An outline of Huxley's life, an estimate of his scholarship and character, and a summary of his early experiences in the studies of invertebrates and birds on the voyage of the Rattlesnake and the results arrived at in this profound study which later caused him to accept Darwin's theory and to become its foremost exponent, formed the topics of Mr. Ward's contribution.

Mr. George W. Colles then took up the life of Sir C. Lyell. Speaking of the early days of Lyell Mr. Colles narrated the slow evolution of the law student into the geologist. The importance of his greatest work "The Principles of Geology" was ably extolled by the speaker and the peculiar repellant attitude of American Geologists toward Lyell's work deplored. Mr. Colles compared the work of Dana and Lyell and advocated the preference of the latter, quoting from the works of both geologists to contrast their merits.

Upon motion the meeting then adjourned.

Milwaukee, May 26, 1910.

Regular meeting of the society. President Barth in the chair. 24 people present. Minutes of the annual meeting read and approved.

President Barth announced the election of Mr. August Scheenebeck, Lena, Wis., to corresponding membership. The following nominations were presented: Edwin Flancher, 1201 North Ave., nominated by Dr. G. P. Barth; Herbert Lee Stoddard, 218 25th St., nominated by H. L. Ward; Lewis Van Tyne, State Normal School, Milwaukee, and Dr. Wm. Colby Rucker, Health Commissioner, Milwaukee, both nominated by Prof. I. N. Mitchell; Carl Schoenebeck, Lena, Wis., nominated by H. Clowes. The nominations were referred to the Board of Directors for action, who subsequently elected these gentlemen to membership in the Society.

An informal report of Mr. Colles, chairman of the banquet committee, was received by the Society.

The resignation of Prof. I. N. Mitchell from the committee for programs for section meetings was accepted by the meeting, and Dr. J. J. McGovern appointed in Mr. Mitchell's place.

Dr. Barth then relinquished the chair to Mr. Teller and opened the evening's lecture "Some Observations on Solitary Wasps about Milwaukee." This represented a resume of over two years work on the nesting habits of wasps. The purpose of this work had been to discover whether there were any features in the nest structure which were characteristic of families or even species. The results, while too few for definite conclusion, offered many points of interest, and apparently indicate that a general difference does exist between the nests of various groups.

Beginning with *Ammophila* Dr. Barth described on an ascending scale the manner of building the nests, the nest itself, the prey, etc. of the most important wasps.

Ammophila builds a very simple nest, consisting of a round gallery, extending into the ground, either straight or slightly inclined, to a depth of about 1 to 1½ inches, and ends in a large, usually oval, chamber in which the prey is stored.

The nests of *urnaria* and *abbreviata* differ in size only. The wasps collect caterpillars as prey for the young. The gallery is then closed some distance from the opening, by a well-fitting stone, and the remainder filled in with debris and sand.

The *Larridæ* build a nest very similar to that of *Ammophila*, except that the gallery is usually at a considerable slant, and varies in depth according to the hardness of the ground. The prey consists of grasshoppers. Both the above nests are of one cell.

Pompilus builds a nest very similar to the above, but the gallery varies very materially with the species which is engaged in building. In some it is one inch in length, in some it is fully six inches long, in both ending in an oval cell. The prey is usually one spider, and the egg is laid on the abdomen, longitudinally to its axis, or transversely.

Gorytes: A long channel is made by the wasp, usually somewhat curved in construction, with the sides smoothed and round, and the end of the gallery formed into the first cell. It is closed up and a second cell started. The wasp thus continues until it has from three to four cells, when the nest is completely filled in and finished. 24 nests examined contained leaf-hoppers exclusively, in both the larval and imago stages.

Philanthidæ and *Cerceris*: These wasps build complicated, curved nests. That of *Philanthus* is characterized by the very coarse, irregular gallery, the sides of which are not smoothed, and penetrates to a great depth in a very tortuous manner, one nest measured being 22 inches in length. *Cerceris* is more careful in its building, the gallery being less irregular or tortuous, the depth not so great. Both carry in bees as prey, usually *Halictus*.

Aphilanthops: Nests similar to *Philanthus*. Prey queen ants exclusively. Dr. Barth called attention to our lack of knowledge as to the mode in which this wasp captures the queen ants, and referred to a recent article saying that the wasp went to the nest for the queens.

Oxybelis: Builds a beautiful nest, in which the gallery penetrates in an inclined way, with sides nicely smoothed. The end of the gallery is made into the first cell, closed up, and one or more further cells made in this manner. The wasp then proceeds to make lateral galleries and stores them similarly. Flies exclusively are used by this wasp for prey.

Astata unicolor and *bicolor*: Seem to prefer ground to sand. In the nests found the first inch was tubular and then an area varying from two to three inches of loose earth was encountered, which was thoroughly permeated by the plaster in the pouring. The central portion of this loose earth was tubular, contained no cells, penetrating in a rather tortuous manner to a depth of from 8 to 14 inches. In these nests the prey was found to be a flat bug, which was placed transversely in the bottom of the cell.

Bembex and *Microbembex*: These present some evidence of the social instinct, as nests are found more or less in groups or colonies. The wasps heretofore mentioned close their nests upon leaving. Those following were not observed to do so. *Bembex* and *Microbembex* are probably a little higher in the scale inasmuch as the larva are fed from day to day, the nest remaining open during the excursions. This would probably account for the fact that the young are frequently found parasitized. When the larva is ready to spin its cocoon the cell is closed up and the nest completed.

The nest of *Bembex* usually has a tubular gallery some five or six inches in length in the sand, and forms a wide curve to the larval chamber at the bottom.

Crabronidæ: Wasps of this family may be divided into ground, pith and wood borers. The ground borers (*Crabo lentus* and *errans*) construct a nest very similar to that of *Oxybelis*, and store with flies and bugs. The pith borers excavate the pith of the stem in a straight tube and then store a series of cells, separating each by a varying depth of chewed pith. No lateral galleries are formed. Nest usually occupies major portion of the pithed cavity of the stem. The wood borers frequently utilize an old beetle burrow and from the bottom or the end of this continue excavations or begin the nest de novo. Usually quite complicated, the galleries proceeding in all directions with varying groups of cells, until frequently the entire soft portion of the wood is utilized, the cells again being separated by a varying depth of sawdust.

Mimesa: Also a wood borer. Makes a nest very similar to *Oxybelis* in general characteristics, except that there is found a sharp ridge between the cell and the gallery. In one case a *Mimesa* began its cell in the debris beside a log, penetrated this and the ground underlying, and the cell was found in a small piece of wood one inch by one inch, buried about six inches beneath the surface.

Trypoxilon: With these wasps we begin the consideration of constructive work as well as destructive in the provision of a breeding place for the young. *Trypoxillon* usually uses a gallery already prepared by some other insect. Sometimes the base of the gallery is filled in with mud, at other times it is not. Spiders as food for the growing larva. The divisions between the cells are usually beautifully molded earth. On completion of the nest the entrance is also blocked with earth.

Odynerus: Also uses cavities having already been prepared and, like *Trypoxilon*, makes partitions of mud. Caterpillars are the prey selected. In other cases *Odynerus* constructs its entire nest of clay, placing it against the side of some convenient house, shed or tree, dividing it into several cells.

Eumenes: Goes a little further than *Odynerus* and provides its young with a beautifully constructed house.

Following this we have the large, complicated structures of the social wasps.

Dr. Barth exhibited over 30 plaster casts of nests and numerous photographs of others in the course of his lecture.

Dr. and Mrs. Peckham, Messrs. Ward, Burrill, Graenicher, Dernehl, and Colles informally discussed the lecture. Upon motion the meeting adjourned.

Milwaukee, June 9, 1910.

The second annual banquet was held in the Republican House, and was attended by 40 members and guests. The following speakers addressed the assembly: Mr. Edgar E. Teller, Mr. Geo. A. West, Mr. I. N. Mitchell, Mr. Charles E. Monroe, Mr. Charles B. Whitnall, Dr. Wm. Colby Rucker, Mr. Charles L. Mann, Mr. Chas. Carpenter, Dr. P. H. McGovern, and Mr. Geo. W. Colles. President Barth acted as toastmaster.

Milwaukee, June 30, 1910.

Regular meeting of the society.

President Barth in the chair. 21 people present.

Minutes of the last regular meeting read and approved.

The advisability of discontinuing the section meetings during the present summer was discussed by Messrs. Colles, Teller, Doerflinger and Barth. Dr. S. Barrett moved that such meetings be discontinued until September. Seconded. Mr. H. L. Ward moved an amendment that the evening's meeting be included because of the sweltering heat, which amendment was lost through non-support. The previous motion was then put to vote and carried.

Mr. Henry L. Ward gave an informal talk on Some Features of Eastern Museums as noted during an Inspection Tour Recently Made. This was an account of a three weeks tour through the East in which 35 institutions besides several private collections were visited, participated in by Mr. Ward, Dr. S. Barrett and Dr. S. Graenicher. The tour had its inception in the convention of the Museums Association at Buffalo. From there Albany, Boston, Cambridge, New York, Philadelphia, Washington, Pittsburgh and Chicago were visited. Mr. Ward said that the purpose of the tour was primarily the study of the Museum buildings, their lighting and ventilation, their equipment and their relations to the public; the scientific side of collections was only secondarily considered.

Upon motion the meeting adjourned.

HOW SANGUINARY ANTS CHANGE AT WILL THE DIRECTION OF COLUMN IN THEIR FORAYS (*F. SANGUINEA* VAR.).

By A. C. Burrill.

For several years, I have been interested in the habits of our American Sanguinary or Slave-making ant, especially the variety *Formica sanguinea rubicunda* var. *subintegra*,[1] watching forays of certain nests for several consecutive summers. I have not failed to note the great variability in trail-following by these sanguinaries, in marked contrast, for example, to *Cremastogaster lineolata* Say, which follows the minute sinuosities of a zig-zag ground trail with a slavish zeal that would seem to betray complete dependence on scent to the decadence of sight or of a general sense of direction. Individuals or even squads of Sanguinaries have been seen to leave a well-travelled trail at right angles to investigate some side attractions independent of the goal of the expedition.

It is still more interesting to find that, approximately three times out of fifty or more expeditions, the whole expedition may change its course, apparently about as quickly and as markedly as the individual.[2] The fact that ants change their course at will presents to my mind one of the most serious difficulties which we have to contend with in coming to a complete understanding of what is called direction through scent as the chief guiding sense, and to the adoption of this theory as a working principle in the psychological study of ants generally. It appears to indicate that the sense of smell may be superseded any moment by that of sight or by the individual's will to fluctuate in its adherence to scent. It appears in *Sanguinea* that the sight of the many or some social responsiveness of the many (a responsiveness considered usually

1) Identified through the kindness of Prof. W. M. Wheeler, Feb. 1908; but raised to subspecific rank in Wheeler's "Ants," 1910, p. 570, *F. sang. subintegra*.

2) Sir John Lubbock has already noted that a neuter ant will seek to straighten out many unnecessary kinks and curves in the trail. Ants, Bees & Wasps. 1901 ed. D. Appleton & Co. N. Y. pp. 270-1.

to be communicated through the sense of touch in the antennæ) may supersede the trail scent equally well.

Let me state, therefore, the few examples I have recorded, which seem to bear out this idea of marked change of route of a foray at short notice. In the first place, as we grant the sense of smell to be quite important, it is evident that the observer who cannot see scented trails must be quite familiar with the probable scented trails of all species in the neighborhood of the nests to be observed and tested. While I cannot myself pretend to claim omniscience as to the unknowable scent trails in such a case for the region of observation, yet the care of this plat and its small size, less than a quarter of an acre, under close scrutiny in ant study for several years, should betoken a fair acquaintance with the subject. And while I could not know the trail scent of every stray ant wandering about the lawn, it was possible, during the two years noted below, to be well acquainted with every regularly travelled trail to a tree, bush or nest, and it was possible to know soon enough of every regular foray from the two nests of *sanguinea* observed.

If one does not know what the ants of a given nest have been doing above ground throughout a given year, one is not competent to judge whether a trail at its inception is being laid out as a new trail or a trail in use is changed to a stale trail days or weeks old (and no evidence yet shows how long a stale trail retains odor enough for later ants to follow). In the following examples, I claim to know nearly all the trails used during the two years in question, and for the two sanguinary nests cited, as I have a couple of notebooks of data of what these two nests did in those two years.

From this data, I will first illustrate by citing instances of straightening out the line of scent of a crooked trail. I will give examples from two different nests, so proving at the same time that such change is not a unique case. Then I will demonstrate from my observations of one of the same colonies how a straight trail may change to a roundabout, crooked, curved trail, and will try to show that the latter example does not prove as Mark Twain's immortal ant tried to,—that the ants are perfectly inane,—but that it was done for the sake of ease in travelling the trail. If my explanation of the last case is acceptable, it will be seen that we must conclude that all ants do not tend to straighten out the trail universally and invariably.

The following two instances of straightening out the line of scent are by two different nests of *Formica sanguinea rubicunda X subintegra* in forays directed against *Formica fusca subsericea* at the homestead, North Brookfield, Mass. The first account, Aug. 23, 1899, is of a nest whose red ants marched about four meters (12′), over a lawn east northeast, to a colony purely of blacks (Fig. 1, o opposite a) which they subdued by 11 A. M. I found the black queen hiding with 60 or so attendant blacks in a grass clump about 1.2 meters northeast of their home, a direction at an oblique angle with the line of foray. As an experiment, I brushed my hand over the grass from the invested nest towards the queen, as a lure to red soldiers to give chase. Hardly a dozen outposts of these warriors responded, the rest being too intent on the captured nest. But I kept on attracting the few, till some four came in touch with blacks on the outskirts of the clump, and five or six more were straggling along that way. The whole manner of the first four, on meeting the blacks, changed at once,—from the purely aggressive at my disturbance, they became cautious but more excited, and two started back on the double quick, to their comrades at the captured nest. In two minutes from the time these two had reached and mingled among the many at the captured nest, excited jerks—the well-known jerk signal of antennae, somewhat like a small pup making feints at a cat,—began passing among all red ants about the region, most red ants south and east of the captured nest were called in, and many groups of them began hurrying off to this quarter northeast of the nest; the news passed on in the same manner down the line between nests and quickened the column all the four meters of march between nests within a period of three minutes more. In the meantime, the queen was startled out of hiding and dragged by her antennae by a black attendant, .3 m. further off, while the rest of her body-guard was becoming badly scattered or engaged at the clump by the red ants. Within five minutes more, the reds were swarming all over the clump.

The most remarkable thing to me was the speed of mobilization of the red ants: within ten minutes from the time the first messengers produced excitement at the captured nest by their return from the grass clump 1.2 m. (4′) away, about 200 soldiers arrived at the clump, another 200 were streaming across the 1.2 m. (4′) of lawn, and 5-600 more (estimated) including a great number of callows who had not been in evidence at the first attack, were

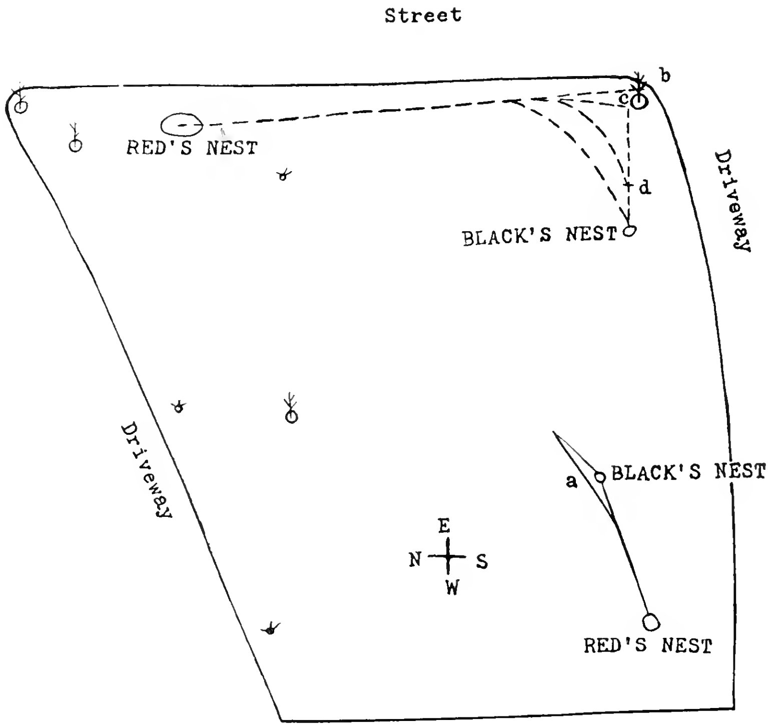

Fig. 1. Two examples of Trails and the angles subsequently cut off by Reds—*Formica sanguinea r.X subintegra* in Forays against Blacks—*F. fusca X subsericea*. Scale 14.8′ : 1″ or 1.775 m. : 1 cm.

running at accelerated speed (my notes say top speed) out of the home nest along the 4 meter route between nests. But the point of this example is my note on direction,—"The line of soldiers arriving at the captured nest began soon to bear away more and more to the northeast," instead of east northeast as before, thus cutting off an oblique-angled turn as shown (Fig. 1, a). Again, I noted that the messengers (special messengers in the sense that their speed and other motions differed from the majority) who, as later observations showed, were evidently hurrying back for reinforcements, "did not stop at the captured nest but cut 'across lots' slightly and started on the run home." Thus both those reinforcements coming from the home nest laid out quickly a new trail,—a curved hypotenuse to the oblique angled triangle of which the captured nest was the apex,—and also the returning messengers cut off even more, making a more nearly straight hypotenuse (Fig. 1, line a).

The second example, Aug. 6, 1900: While the soldier nest cited above was undergoing a swarming of sexed ants (apparently only winged females), another nest of the same variety, *F. subintegra*, some dozen meters northeast of the above nest, sent a foray south across the lawn at 9:30 a.m., to the region just beyond (south, Fig. 1, b.) a sugar maple; but by noon, most of the reds had returned without any sign of an attack being made. At 4:30 p.m., the same route was again thronged, only they did not go so far, staying more on the hither side of the maple (north and east, Fig. 1, 3.) with their advance spread out over 5 or 6 square meters. Fifteen minutes later: suddenly, with nervous jerks they concentrated in a compact mass rushing west, a direction at right angles to the end of the main trail, and continued for over 60 c.m. where they concentrated about four or five captured blacks. During the five minutes occupied by this shifting of the advance, I found, about a meter beyond them, an inconspicuous black colony into which nervous blacks were hurrying. I presume that the foraging trail of these blacks to the maple had given by scent the secret of the direction of their nest to the soldiers, who, as noted at 9:30 a.m., had been baffled in trying to locate blacks caught about the tree. To continue the narrative of the advance, the soldiers began to leave the captured blacks and work onward excitedly. Not five minutes elapsed before this new advance covered the remaining distance to the inconspicuous nest of blacks, while all the hundreds of ants over the large area of five or six square meeters had been completely drained off, like water out of a dish, into this new course. After a moment of creeping march (not a true halt, Fig. 1, d.), in which the advance apparently gave time for reinforcements to gather until the advance became a thick pack a foot and a half wide," the soldiers with a cheer of antennae touches, plunged like a drove of hounds, straight at and down the holes. Blacks swarmed out only to fall in death grapples with eager soldiers in their overwhelming rush. By this time the line of march all the way back to the home nest was quickening its pace."[3] In three minutes appeared the first soldier with a pupa trophy, and within six minutes from the attack, a stream of burdened soldiers was on the way home. Ten minutes later; 140 burdened soldiers passed a given point in five minutes, fifteen minutes later another 5-minute count gave 180 burdened red ants homeward bound and similar counts could have been repeated until nearly 7 p.m. But to omit my further notes with details about apparent mobilizing officers, messengers, etc., as soon as the new advance began, the right-angled turn was cut off more and more into a sweeping curve, which the booty-laden reds followed in preference to the right-angled turn by which they had come. This is in harmony with Lubbock's conclusion[4] about a different kind of test, an artificial one, and may explain also the confusion of reds at the end of my next example. Lubbock says of his test, "They knew they were being sent a long way round, and were attempting to make a shorter cut."

In contrast with the above two examples is this one of choosing a roundabout route for its ease (?). Aug. 16, 1900, the nest last mentioned of *Formica sanguinea rubicunda* X *subintegra* sent out just before 2 p. m. a squad of fifteen to twenty reds. It was after a previous day and a half of rain, including the morning of the above date, and the wet lawn was drying off fast. This squad of reds crossed the sunlit lawn and driveway, up the grass banking, across a narrow strip of tar walk, into thicker grass still dripping

3) There is a chance for error here in judging varying speeds of ants, for, after an observer has been bending over on hands and knees to watch attentively, and then jumps up to watch another part of the trail, the too frequent changes in the blood circulation is sufficient to make one's eyes swim and it may have other psychological disconcertments that only a trained psychologist would appreciate. Ants do not wait, however, for observers to become normal, so the seeming changes in speed are given for what they are worth. These changes in speed have been noted under many other conditions of observation,—changes, especially in the cases cited in this paper, when the ants were under intense excitement. It should be perfectly feasible for some one to test the speed of foraying ants at diffrent points, or better, at the same point at different times, preferably on some foot or two of a smooth part of the trail, where their speed could naturally keep uniform, and thus show the results of communication or excitement from fresh scent in terms of speed.

4) Ib. p. 271.

wet in the shade of the house and of bushes. They had traveled quickly and seemed laying out a route after the rain; but in the damp shaded grass (Fig. 2, b),—where a dying maple dropped many leaves, now curled and filled with rain water pools, like pitfalls or wells to the sanguinary ants,—the squad became confused, draggled, scattered, and aimless by 2:15 p. m., having previously traveled about 8 m. (25') in 20 minutes. Not foreseeing that anything more important would happen, I left them and missed seeing how they got out of their predicament. If they had continued

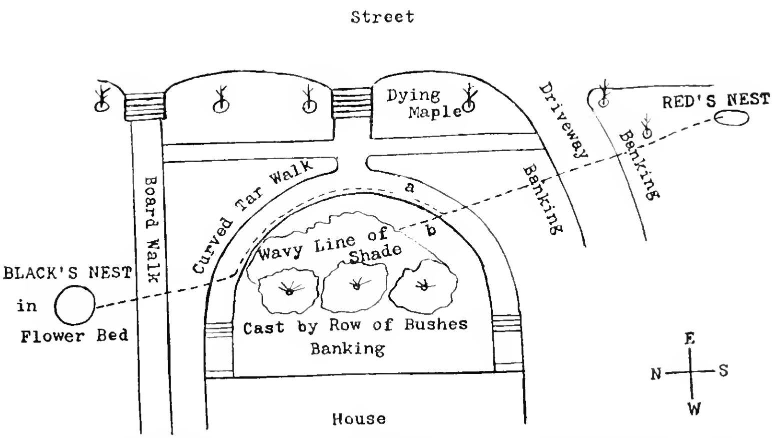

Fig. 2. Example of Trail with subsequent Curve adopted for apparently greater Ease of travel. Sketch based on scale of about 17.9' : 1" or 2.148 m. : 1 cm. as now reduced. Reds—*F. sanguinea r.X subintegra.* Blacks—*F. fusca X subsericea.*

straight on their course through the wet grass, they would again have crossed the smooth tar walk, the latter being in the shape of a half circle (Fig. 2, a). I was surprised, then, at 4 p. m., to find a large train of soldiers not taking this chord (b) of an arc (the curved tar walk a.) but following around the edge of the dried-off tar itself, all the way round to the point where they would have emerged by continuing on the chord (b). At this point, the line of march turned as if in continuation of the line of the chord, passing through thinner grass, over a board walk, and for some distance over sunlit lawn where the grass was drier, to a nest 20 m. (66′) away, which they captured about 4:15 P. M.

I believe it was Prof. W. S. Miller of Wisconsin University, who was staying at the next house at the time, who looked over the course with me and suggested that the very wet grass had had something to do with the marked veering out of the straight course, and to this I add the easily travelled smooth walk. It may have been some old trail of their own slaves that they were following, or more likely the trail of the nest attacked, which they and the scouting party thus attempted to follow through the wet grass. It cannot be denied also that such original trail may have had the same detour, made so faint by rains that the first party of sanguinaries did not perceive the turn until they had become confused in the wet grass. But I do not think they were depending on such a possible trail, which, if possible, must surely have been faint after a 36-hour rain, since, in my familiarity with the region, I had failed to note any well travelled route so thronged in the past days by any species as to attract my attention to it as an established route, altho I had been busy in the previous weeks in locating all such travelled routes in advance. So I must deduce that the ants' preference for easy travel over the dried-off tar, tho' roundabout, was quite clearly the reason for the change of route, inasmuch as no more ants continued to travel onward in the wet.

This example is not as clear-cut a case of choosing a roundabout course for the sake of ease only, as I should like to cite for illustration, for this reason:—my notes read "The reds had great ado to follow the curve, sometimes swerving too far into the grass or too far out on the walk. This was particularly true at the points where the ants turned to the curve and where they left it. Some wanted to start for the bushes, got lost, as I judged from their actions, and turned back" till they resumed the popular route. This showed to my mind that there was such a complex of trail scents here, that nothing but their eyes, perhaps, showed them which way to go. Again, perhaps "they knew they were being sent a long way round" (Lubbock) and only the instinct to keep with their fellows restrained them from trying marked cut-offs even before they had learned by experience why the ants ahead had curved their course. I suppose, then, the instinct to straighten the trail was here continually in conflict with that of the ants ahead who curved the trail on purpose, seemingly, to avoid the wet grass region and choose the easier traveling on the tar.

In the present state of our insect psychology, we cannot feel very well satisfied with any reasoned explanation of insect activity, since our anthropomorphic viewpoint is continually upsetting sane conclusions. Forel warns us "When we judge of the sensations of animals, we must assume nothing of their quality, properly so-called;" and in his general platform of principles for judging insect behavior[5] he says "We can only judge of the animals' sense of smell by the reactions which occur when it runs away from or searches for what it has just perceived." We see then, how slight is the objective criterion on which to build our hypothesis of scented trails. "In the case of the sense of touch and its varieties, following upon immediate contact," etc. It should appear, then, we are, equally, only able to judge of the reactions of the animal that the chief desideratum in the study of ants on the trail is the exacting geometrical and mathematical record of habits observed, from which, as methods of observation are refined, we may hope to organise some more exact science of the subject.

Public Museum, Milwaukee, Wis.
June 16, 1900.

5) A. Forel. The Senses of Insects. 1908 trans. p. 2. Methuen & Co., London.

THE WHITEFISH OF SILVER ISLAND LAKE, MINNESOTA.

By George Wagner.

In August, 1909, Mr. W. D. Tomlin, a mechanical engineer of Duluth, Minnesota, and a wellknown writer on outdoor things, submitted to Mr. Jas. Nevin, Superintendent of the Wisconsin Commissioners of Fisheries, a sketch and a small photograph of a whitefish, taken by him in Silver Island Lake, Minnesota. These were referred to me for identification, but proved insufficient for that purpose. In February, 1910, Mr. Tomlin sent me three specimens of the same fish, brought to him at Duluth by trappers.

Silver Island Lake is located on the border between Cook and Lake Counties, R 6 W - 61 N., in the extreme northeastern part of Minnesota. The region is but little explored and I have been unable to obtain very definite data as to whether Silver Island Lake drains into Hudson's Bay or into Lake Superior. I am inclined to think, however, that the former is the case.

The specimens submitted to me were unfortunately gutted, with the gills removed, and were slightly damaged by the fact that they arrived while I was out of town. However, their external features were fairly well preserved. It was immediately apparent that they were rather different from anything known to me from Lake Superior or Michigan, or from the inland lakes of Wisconsin.

The principal measurements made on the specimens are as follows:

Number	1711a	1711b	1711
Sex	?	?	?
Length, mm.	304	313	317
Head in length	4.2	4.2	4.5
Depth in length	3.4	3.4	3.5
Eye in head	4.8	5.0	4.7
Maxillary in head	3.6	3.4	3.6
Dorsal height in head	1.0	1.1	1.0

Snout to dorsal fin in length	2.1	2.2	2.0
Caudal peduncle in head	2.3	2.3	2.2
Gillrakers in eye	?	?	?
Gillrakers	?	?	?
D.	13	12	12
A.	12	12	12
Scales	12-77-9	12-75-9	10-78-9

All three specimens are very dark. The dorsal and caudal fins are wholly black, the others nearly so. The upper half of the head, and of the body to the lateral line, are very black; the body is lighter below but still of a decidedly blue tinge. The scales are strongly punctulated with black, except on the surface between the paired fins. There is a distinct notch at the nape. The caudal peduncle is rather short, the body much compressed.

The form has considerable resemblance to what I consider to be *Coregonus clupeaformis*, Mitchill (using this name in the sense that Jordan and Evermann apply it: Proc. U. S. Nat. Mus., Vol. 36, p. 171), which occurs in Lakes Superior and Michigan, as well as in Trout Lake, Vilas County, and Stone Lake, Forest County, both in Wisconsin. The Silver Island Lake specimens differ, however, in the following particulars: the depth of the body is greater, the dorsal fin is higher, the caudal peduncle is shorter and higher, the supplemental maxillary is deeper and more nearly semicircular, the pectoral fin is longer, the line of the back is more deeply notched at the nape, and the color as a whole is decidedly darker.

In a letter last year President David Star Jordan informed me that in his opinion the forms in Lake of the Woods (on the Canadian boundary of Minnesota) and off to the northwest were *Coregonus richardsonii*, Günther. This species was described by Günther in 1866, from dried specimens brought from British America, the exact locality being unknown. All we know about this form up to the present may be found in Evermann and Smith's "The Whitefishes of North America" (Report U. S. Commissioner of Fish and Fisheries, 1894, p. 295). On comparison of the Silver Island Lake specimens with this description it appears that they agree with it quite closely, certainly as closely as any whitefish I have seen will agree with any description extant. We can therefore, for the present at least, follow Jordan's suggestion. and call them *Coregonus richardsonii.*

I say "for the present," because in my mind the specific separation of the forms *clupeaformis, albus, richardsonii,* and *nelsoni,* is a matter much in doubt, and not to be finally settled except by the accurate study of many specimens from each of many localities.

Zoological Laboratory,
University of Wisconsin,
May 27, 1910.

A NEW SPECIES OF *CHALCOPHORA (COLEOPTERA-BUPRESTIDÆ)* FROM WISCONSIN.

By Richard A. Muttkowski.

Chalcophora melanotum. sp. nov.

Male. Black. Length 22.1 mm.

Head small, narrow (4.2 mm), the smooth elevations black; punctures somewhat coarse, irregular, sub-cupreous, with a distinct luster; frontal depression triangular, as *brevicollis*, but smaller and deeper, the punctures in the depression finer and closer than to sides and greenish in hue; eyes somewhat prominent, antennæ black; labrum yellow, emarginate.

Pronotum transverse (6.5 mm.), black; sides subparellel, faintly widening toward apical third, then broadly rounded; at the extreme base obtusely angulated; median line elevated, smooth, the customary sulcus on each side of it very shallow; the two lateral impressions weak; punctuation irregular, but fine, dull sub-cupreous, without any luster as on the head.

Elytra 16 mm. long, wider than the prothorax (7.7 mm. at humeri, 8.1 at three-fifths), elevations shining black, the depressions finely punctuate, very dull cupreous; sutural groove attaining basal fourth, then interrupted; otherwise as usual; apices with short spine. Held at a distance the dorsum is black; held within 6 inches from the eye in lateral view, the dorsum appears streaked with deep brown.

Beneath brassy sub-cupreous, the luster as distinct as in *brevicollis*; with fine white hairs on all plates which extends to the front of the head around the eyes. Prosternum flat, wedge-shaped, sides straight, with two straight sulci meeting opposite front coxæ. Abdominal sulcus distinct, margined by smooth elevations, reaching apex of second segment. Emargination of apical segment one third of width of base of segment and two fifths of length, rounded. Femora dull subcupreous, tibiæ and tarsi black; tibiæ with brassy punctures.

Described from one male collected by Mr. Charles T. Brues, while a member of the Milwaukee Museum Expedition to Apostle

Islands, Ashland Co., Wis., July 4-11, 1907. Holotype Cat. no. 24972 Milwaukee Public Museum.

The species can at once be distinguished from all others by its black color, as indicated by the name, which renders it unique among *Chalcophoræ*. In Major Casey's recent monograph (Studies in the American *Buprestidæ*, by Thos. L. Casey, Proc. Wash. Acad., Vol. XI, no. 2, pp. 47-178, 1909) *melanotum* would go under a sub-head (B) in the table of *Chalcophoræ* (p. 79) below *brevicollis*.

While describing *melanotum* as a distinct species I do not feel satisfied that this identity can be maintained. The specimen shows relation to *brevicollis* in too many respects. Aside of the color, the differences are slight and may be summarized as follows: frontal depression narrower, deeper, eyes more prominent, lateral impressions of prothorax feeble, prosternum with straight sides and sulci (as in *virginica*), abdominal sulcus distinctly defined and with elevated smooth edges.

I believe that a series of *melanotum* will prove that this is only a northern melanic variety of *brevicollis*. As such I had sent it to Mr. Casey for examination, with the result here quoted: "—As to the black *Chalcophora*, it is wholly unknown to me." Some months previous Mr. Casey had determined whatever other Buprestidæ the Museum collections contained. It is through his courtesy that I am enabled to describe this "unique," which I felt should not be buried "blushing unseen" in the confines of a cabinet.

Only two other species of *Chalcophora* have thus far been taken in Wisconsin: *C. lacustris* Lec. from Bayfield (Wickham) and Apostle Islands, Ashland Co., July 4-11, 1907 (Brues); and *C. fortis* Lec., labeled Wis.

Milwaukee Public Museum,

June 4, 1910.

THE RELATION OF THE CALIFORNIA GROUND SQUIRREL *(CITELLUS BEECHYI)* TO BUBONIC PLAGUE.

By William Colby Rucker, M. S., M. D.

Whole volumes have been written regarding the maneuvers which have been gone through in the detection of the source of crime, and these romances are devoured with avidity by the seeker after new sensations. It is only within recent years that the advances of science have enabled us to undertake the unraveling of sanitary crime, and it has been found that the work of the sanitary detective is no less absorbing and no less romantic than that of the pursuer of human criminals.

Bubonic plague, that ancient enemy of mankind, had lain quiescent in the mountain fastnesses of the Himalayas until, in 1893, stirring into new life, this dragon of Oriental disease began its predatory march around the world. Hongkong was first attacked, the enemy securing a permanent base at the cost of frightful slaughter, and then spreading out along the lines of commerce the pest launched itself upon the entire civilized world, attacking each of the continents in turn, there to scourge humanity. In 1900 it landed its forces upon our western coast, establishing itself in the Oriental quarter of San Francisco, from which it did not recede until 225 human lives had been taken and an arduous campaign, ending in 1904, had been waged. In 1907, taking cowardly advantage of a city already stricken by fire and earthquake, it again opened the attack, only to be repulsed and permanently evicted after 160 persons had been stricken, of whom 77 died. The record of that compaign has been given sufficient publicity and is familiar to all.

The question of the etiology of the second outbreak was a very puzzling one to the officers in charge of the sanitary work. The first case occurred in the person of a sailor, Oscar Tomei by name, from the tug "Wizard," and by some strange whim of fate this vessel put out to sea directly after the unfortunate victim was landed and was lost off the coast of Northern California with all hands, closing all avenues of investigation in that direction. Those officers, however, who were familiar with the history of the plague in California, had a feeling that the disease was in some way connected with the California ground squirrel, the *Citellus Beechyi.* It was known that for several years some epizootic was spreading among these animals, and several human cases had been seen which had not been in the infected zone or in intimate contact with any other rodent save the ground squirrel. During the first year of the plague-eradicative work, however, time did not suffice for the investigation of this important problem. During the summer of 1908, however, two cases occurred in northern Contra Costa County which could not be traced to rats. During the investigation which followed, the officers having this work in charge became convinced of the fact that the disease was undoubtedly related in some way to ground squirrels.

In order to understand the situation more clearly, it should be borne in mind that San Francisco is situated on the northern extremity of a peninsula, being separated from the mainland on the east by the large Bay of San Francisco. Emptying into this bay at the north are the Straits of Carquinez, formed by the junction of the San Joaquin and Sacramento rivers. Just south of these straits is the County of Contra Costa.

As a result of the investigation of the two cases mentioned above, four naturally plague-infected squirrels were found, the first ever seen in the world. Owing to careful investigations it was known that these animals could be artificially infected in the laboratory, and ample opportunity had been thus afforded for the careful study of the gross lesions of the disease in this species. On the basis of these four naturally infected ground squirrels, a small grant was secured from the Federal Government for the continuance of the investigation, and the following spring, 1909, an officer with a number of men, was despatched to Contra Costa County for the purpose of carrying on the work.

Imagine a most diverse terraine: hills and valleys, woods and meadows, small hamlets, desolate mountain sides and thriving cities. Conceive of the elements of distance, time, bad roads and summer heat, and the multitude of details which surround any new piece of investigative work, and you will have some conception of the problem which confronted these men. Experiments were first made with the various poisons to be used in the eradication of ground squirrels, and then an active campaign of scouting was begun. Each of the hunters was supplied with a shot gun, necessary ammunition and equipment. All of the details of the size and number of shot, the quality and amount of the powder to be used, the best ways of securing the samples, transporting them to the nearest express office and shipping them to the laboratory in San Francisco—all had to be evolved. Methods of reports, inspections, and forwarding of supplies all had to be created de novo. For six weeks these men worked without finding a single infected squirrel, and the hopes of even the most optimistic were dropped far below the zero point before the first plague-stricken squirrel was found, twenty miles away from where the sample had been secured the previous year. Then followed another nerve-racking period of quiescence, until on one hot summer's day, after a number of federal officers and representatives of the State Board of Health had traversed many weary miles of country, looking over the work and had stopped at a little country hostelry for the night, they were suddenly electrified by a telephone message from the laboratory to the effect that fourteen infected ground squirrels had been found that day.

From that time on, it was an easy matter to find the infected rodents. The periphery of the scouting zone was gradually enlarged, until it was known that all of Contra Costa County, all of Alamenda County to the southward, a portion of Santa Clara County, part of San Benito County, a section of Santa Cruz County, and the northern end of Monterey County were infected. To date it is known that an area of over 10,000 square miles contains the disease among these little grey-coated pests.

So much has been said of the ground squirrel that it may prove of profit to step aside for a moment and consider some of the characteristics of the animal in question. The *Citellus Beechyi* has been described as follows:

Size smaller than *Otospermophilus grammurus* (nearly as large as the eastern grey squirrel) with a more slender body and shorter tail. Ears high and pointed. Mammæe, six pairs (P. 2, A 2, I. 2=12). Color above brown, grizzled, and annulated with black in a vermicular pattern; darkest anteriorly, and most grizzled and vermiculated posteriorly. Nape and sides of neck silver grey; this color prolonged backward above the shoulder in the form of stripes which are sometimes faintly traceable to the root of the tail, though usually ending about the middle of the body. Ears black outside, grayish or faintly rusty inside, and along posterior border. Top of head bister, slightly dusky above orbits, which are encircled by white. Sides of head grayish, mixed with yellowish brown. The tail, which is less bushy and shorter than in O. grammurus, is yellowish gray, the lateral hairs thrice annulated with black. Feet yellowish gray. Under surface of the body grayish white. The interscapular region is often blackish, more or less vermiculated with pale annuli. Length, 410 mm.; tail vertebrae, 170; hind foot, 55; ear above crown, 21; ear above notch, 27; length of head, 62; skull, 57 by 34 mm.

They live in colonies and migrate twice a year, taking up their habitation in the high hills during the wet weather, where they breed and where the young are born, and descending to the cultivated lands in the valleys in the spring time. They dig holes in the ground, the burrows being constructed in quite a systematic manner. There are usually several entrances, the angle of the tunnel depending very largely upon the character of the soil in which it is sunk. Often it is found that the tunnel forks, one branch going to a store house and the other to the nest. In this store house are found various seeds, the corms of a weed which grows in great abundance in that region, acorns, beans and the pits of fruit, such as peaches and prunes. The nest is lined with pieces of bark, straw and similar debris, and is usually alive with fleas. Extending from the nest there is frequently found a vertical shaft connecting with the surface of the ground. This is believed to be built for the purpose of ventilation, although sometimes it is utilized for an avenue of escape. The earth dislodged in digging the burrow is usually piled in a mound in front of the hole, and there are usually seen in the neighborhood of the home burrow small, incomplete tunnels which are really hiding holes into which squirrels drop when pursued. Some of the warrens are very extensive and contain several hundred squirrels. Frequently an entire hillside is undermined, its entire face being dotted with little mounds of earth or soft limestone thrown out in making the excavations.

Squirrels breed once a year, the exact time depending very largely upon climatic conditions. The young are usually born in

March, the average litter containing seven or eight. Litters as large as eleven have been found. On account of the great fondness of the gopher-snake, the red winged hawk, the coyote and the red fox for the young ground squirrels, they usually spend the first month or six weeks in the hole, under the guardianship of the wary old females. As soon as they have become able to look after themselves, the migration into the lower lands begins. By this time the rainy season has closed, the ground has become fairly dry, the barley is reaching maturity, and before long the cherries, peaches, pears and prunes begin to suffer from their depredations.

Two species of fleas are commonly found upon ground squirrels—the *Ceratophyllus fasciatus* in greatest abundance, and the *Hoplopsyllus anomalus* more rarely. Recent experiments have definitely proven that these fleas will transmit plague not only from squirrel to squirrel, but also from squirrel to rat and from rat to rat. It is therefore very easy to see how in the suburbs of the city, where the life zones of the rat and the ground squirrel overlap one another, an interchange of fleas may take place, and if these fleas leave a plague-infected ground squirrel, finding lodgment upon a well rat, that animal may thus receive the disease and become the starting point of an epizootic among city rats and an epidemic among human beings.

Here then we have an explanation of the way in which plague entered San Francisco the second time. It is not altogether improbable, however, that until very recently a second factor had to be dealt with. As is well known, the ground squirrel has been considered a delicacy and has been eaten in large numbers by the people of California. In fact, there are numerous poor families who have no other kind of meat. The danger in this regard is twofold. One aspect of this question may be best illustrated by the following case:

On July 17th, 1909, hunter employed in the work of plague scouting, shot near the Fish ranch, a few miles out of Berkeley, infected ground squirrels. On the 21st of October following, a young butcher named Frank Bonfils, in spite of the warnings which had been issued broadcast by means of posters, circulars and notices in the public print, shot twelve ground squirrels in the same locality. On October 23rd he was stricken with bubonic plague.

Now, in this case the fleas happened to attack the hunter, but it is quite conceivable that the fleas, leaving the carcass of the squirrels after he carried them into Berkeley, might have found lodgment upon rats, thus relighting the epizootic among a species which comes in daily contact with man, in whom an epidemic would be launched.

It would seem as though plague among ground squirrels might be a providential thing. These animals are a continual economic menace to the rancher, and any disease which would reduce their numbers would be welcomed. Unfortunately, (and this is the all-important point) this species rapidly acquires a certain degree of immunity to plague, and we received specimens showing healed or chronic lesions of the disease. The animal living would perpetuate the pest among his species. We might, then, liken the ground squirrel to a reservoir for the holding of the infection, with the rats as a connecting channel between this reservoir and man.

It is found in India that the animal which keeps the disease alive is very similar to our ground squirrel. It is called by various names, the tarbagan, the marmot and the *Arctomys bobac*. In West Africa a wood rat somewhat similar to our *Netoma fuscipes* is supposed to keep the disease alive, and in the third great focus on the western coast of the United States, it is the *Citellus Beechyi* which perpetuates this Oriental monster of pestilence.

The solution of this problem is an Herculean task. Plague is a hydra-headed monster, sinuously entwining itself about the intricacies of human life. In order to eradicate plague forever from the United States, it is necessary that the *Citellus Beechyi* in the infected zone be entirely exterminated. Secondly, that the rodent population of the entire nation be made a subject of careful inquiry, to discover if perchance the seeds of pest have been dropped in a soil hitherto unsuspected; and, having assured ourselves that we are free of the disease, our quarantines should take cognizance of the rat rather than the human passenger as the vehicle for the transportation of the germs of the scourge.

It has been estimated, and I consider it very conservative, that it costs $1.00 per annum for the sustenance of a single ground squirrel. I myself have seen entire vineyards despoiled by the marauding bands. A beautiful almond orchard in the San Ramon Valley has been abandoned because of their depredations, and in the Acalanes Grant I saw a prune orchard, in which at least 30% of the crop had been destroyed by these subterranean thieves. It is therefore quite as important from an economic standpoint as from the aspect of the protection of the public health that this species die.

This means a large expenditure of money. Two million dollars is a conservative estimate. It means that a large number of men must be employed so that a vast area may be made the object of a simultaneous attack. The best season of the year is during the rainy months, when food is relatively scarce and the ground is moist enough to hold the fumes of carbon bisulphide. This latter agent has been found very efficacious and is employed by soaking a ball of waste the size of an orange with the chemical. The charge is then thrust into the hole, which is closed by sod, and the gas being heavier than air it sinks into the uttermost recesses of the tunnel. Another way, and quite as efficacious, consists in the explosion of the charge. The squirrels are stunned by the detonation, and subsequently asphyxiated by the large quantities of sulphur dioxide, sulphur monoxide, hydrosulphurous acid, and various other gases which are generated. Experiments have also been made to determine the value of poisons to be used. Taken into the alimentary canal strychnine is especially lethal. It is an interesting fact that the squirrels will stand more strychnine in their stomachs than they will in their cheek pouches, and inasmuch as they carry the grain to the burrows in their cheek pouches, it is in this way that they are killed. The best medium for such a poison has been found to be barley, one of its chief advantages being the fact that it is not so readily taken by birds as wheat and other grains. There are several ways of applying the strychnine to the barley, either in a menstrum of starch paste or a mixture of honey and eggs. Experiments have been made with both means, and there seems to be little choice between them.

It is believed that when the large exterminating campaign is begun, the co-operation of the individual land holder can be secured, but it should be borne in mind that there are large areas of wild land which at present are not under cultivation, being used chiefly for the grazing of cattle. It is in these regions that the hardest part of the fight must occur. Such a campaign will be an enormous undertaking, but it must come, and not until it has reached a successful close can we hope for the answer to the piteous prayer which has gone up from mankind since the dawn of life—that no plague may come nigh our dwelling.

Office of the Health Commissioner,
Milwaukee. Wis., June 9, 1910.

STUDIES IN PLANT DISTRIBUTION.

By Ernest Bruncken.

9. The Shore of Lake Michigan.

(For previous articles in this series, see Proceedings, 1902.)

The immediate neighborhood of Lake Michigan has a floristic and ecological character so distinct from the rest of the Milwaukee region, that it deserves separate consideration in any study of the plant distribution in the vicinity of Milwaukee. In the following pages it is not attempted to furnish an exhaustive list of the species occurring in this area. Such a list ought to be made and will undoubtedly throw further light on the matters here discussed. But the present aim is simply to give a description of the general features of the area and offer some suggestions regarding their explanation.[1]

The character of a given area is determined by two sets of factors, one physical, the other historical. The physical factors are the sum of the edaphic and climatic influences active at any given moment; the historical factors include all changes that have ever taken place in these physical conditions as well as in the organic life of the area. Both sets of factors are interdependent and cannot really be separated from each other.

It is the aim of this discussion first to describe the present condition of Lake Shore vegetation, and secondly to inquire into the manner in which this condition has been brought about by the two sets of factors mentioned.

A. *Physiographical Character.*

The area discussed extends from a little south of the north line of Racine County to the south line of Ozaukee County, an extent, following the sinuosities of the shore, of about 25 miles. The whole

1) It may be said that the publication of an account admittedly so fragmentary is premature. The author's excuse is that probably he will in the future have very limited opportunity to continue his studies in this particular region.

coast line, with the exception of about three miles near the mouth of the Milwaukee River, is formed of clay banks of varying height, rising in places to 100 feet, and hardly anywhere falling to below 50 feet. The lowland at the river mouth has been modified out of all semblance by human hands, being in the city of Milwaukee. The same is true of small parts of the high shore.

The clay banks are of lacustrine origin. They rest generally on the boulder clay, the top of which is, roughly speaking, level with the present beach. The lacustrine clay contains few boulders or pebbles, but is interrupted in many places by bands of pebbles and sand, which indicate old temporary beach lines. To the northward. the clay is exceedingly cohesive, baking in dry weather almost to the hardness of rock. But a few miles south of the city it is much looser, mixed to a greater extent with very fine-grained sand, and yellowish instead of drab in color. Near the Racine county line, the boulder clay underlying the lacustrine is but little developed, and in some places absent, so that there the bank rests on a rather soft shale, which apparently is related to the Hamilton cement rock found north of the city.

Between the bank and low water line there is almost everywhere a strip of beach, of varying width; while north of the city there is also a series of terraces, filling former shallow bays. Numerous ravines cut deeply into the bank. The area may therefore be divided into beach, bank, terrace and ravine. As the conditions vary widely in each of these, each class will be separately discussed.

The beach may be subdivided into shingle, gravel and sand beach, which of course grade into each other, especially by the sand being deposited and kept in place between the cobble stones and boulders forming the first class. Shingle and gravel beaches are formed principally near the headlands, where the current is strong enough to carry the sand along, while sand beaches are formed in the bays. The shingle beach is not formed by deposition, but is rather the remnant of the boulder clay, the finer portions of which have been carried away; the width of the beach varies from a few feet to about 20 rods, being widest in the most sheltered places. At a few points, the cliff descends directly into the water without any trace of beach.

Erosion along the shore is exceedingly active, operating principally on the bank, but influencing both beach and terrace. Three kinds of erosion must be distinguished: Lacustrine, pluvial and rivuline. Lacustrine erosion takes place chiefly at the few promontory points where beaches are absent. Here the undercutting by the waves causes the bank to be vertical or even, for short periods, overhanging, and the recession of the easily eroded cliff must be very rapid. Of far greater importance is pluvial erosion. The rain and melting snow wash material down the steep slopes, at a rapid rate. Thereby deep and narrow gullies are formed, with more or less considerable alluvial fans forming at their lower ends. Moreover, landslides occur with great frequency. As a result, the top of the bank is usually perpendicular or nearly so. But at least three fourths of its height is covered with a talus of varying steepness, on which of course the erosion processes continue. The gullies have a tendency to develop at almost equal distances; the consequence is that the talus forms a series of tongues, shaped like the roofs of houses with their gable ends toward the Lake. This feature appears very conspicuous from the board of a vessel some distance off shore. Often the top of these tongues is flattened, and in many cases several of these flat-topped tongues run into each other on account of insignificant development of the intervening gullies, thus forming a terrace of considerable extent and comparatively long duration.

Generally speaking, the topography of the bank is exceedingly unstable, changing with every rain storm and every winter thaw. The downwash of material upon the beach not only raises the level of the latter, but also increases its fertility. This however, is subject to-exception. In several places, especially where the Hamilton shales are found, the downwash forms a hard crust on the surface of the beach, exceedingly hostile to plant growth. In other places there are similar crusts of conglomerate, the pebble and sand-grains of the beach and the finer earth derived from the bank being cemented by a deposit usually colored reddish by oxides of iron.

Some of the gullies gradually develop into ravines. The transition from one to the other may be put at the point where a permanent water course shows itself at the bottom. Springs of more or less regular flow are very common along the banks, and their water contributes much to the occurence of landslides. When a regular watercourse has been formed, rivuline is added to the pluvial erosion, deepening and later on widening the ravine, giving rise to branch ravines, and often forming a complicated river system in miniature. Most of these ravines cut back into the highland for less than a quarter of a mile. But a few have a different origin and consequently a larger extent. These, like that of Oak Creek in South Milwaukee, are formed by some brook taking its origin in one of the many swampy depressions far inland and meandering sluggishly about as a peaceful meadow stream, doing very little erosive work, till it strikes the edge of the plateau. Then it cuts rapidly through the bank, till it has formed a winding canyon more than a mile in length.

The erosion terraces mentioned above are of far less extent than others which we may distinguish as diastrophic, without prejudging their origin.[2] These are a feature of Lake Shore topography for a long distance northward. Two are included in the present area: One in Lake Park; the other, larger one, at Fox Point. They are practically level, from five to forty rods wide, and raised some fifteen feet above low water mark, while their landward side is bounded by the continuation of the shore cliff.

B. Local Climate.

The local climate of the area is evidently quite different from that of the uplands, although exact data on this point are lacking, no accurate and long-continued observations having been made. The principal differences seem to be greater average moisture of the atmosphere, and slightly less extreme temperatures.

The number of foggy days, when the atmosphere is saturated and transpiration of plants much depressed or suspended, is much greater along the shore. It is not uncommon to see the fog rise precisely to the top of the bank, filling the ravines, but not visible anywhere on the uplands. The dry northwest winds, which are very prevalent in the region, are quite ineffective under the lee of the bank. Sometimes, while a strong wind is blowing above, not a breath stirs a few feet below the edge. On the other hand, the shore region is exposed to the full force of the cool, but comparatively moist easterly winds, which prevail especially during

2) They were quite evidently part of the floor of the Lake, when the water stood at a much higher level than now, and are possibly correlated in time to the river terraces in the Menomonee Valley.

the spring. Their influence will be noticeable in retarding the beginning of the growing season, while they tend to increase the relative moisture of the air, by which transpiration is regulated.

The proximity of so large a body of water has, of course, the usual effect of reducing temperature maxima. This is true especially of the beach and terraces. On the bank, the steepness of the slope is the cause of greater insolation, and thereby the influence of the water is counteracted to an undetermined degree. The increase of soil temperature caused in this manner would be even greater, if most of the slopes were not of an easterly or northeasterly exposure. In places where the exposure is more towards the south, the greater xerophily of the vegetation is quite marked.

The ravines, though more shaded, are often warmer than the beach and terraces. The difference is very noticeable during hot summer days, as one steps from the sultry atmosphere of the ravine out on the open shore. The difference is undoubtedly due to the absence of air currents in the ravines, which allows a heating up of the atmosphere by radiation. During cool weather, the difference is far less, and the relation may even become reversed.

C. The Historical Factors.

The changes which have taken place in the area may readily be divided into three classes, not peculiar to the locality, but applicable everywhere. The first of these includes all changes in physiography and climate due to purely physical causes. It is well established that there was a somewhat complicated series of changes in the water level of the Lake, following the recession of the last continental glacier.[3] In the course of these vicissitudes, forests were covered with water and finally buried in mud, as shown by the large extent of buried forest areas in the state. What may possibly be parts of these forests are now being uncovered by the erosion of the Lake Shore banks, as will appear below. As to climatic changes, we are still very much at sea regarding the climate prevailing during the latter part of the Glacial and in the Champlain period, and consequently are unable to say what changes may have taken place.

The second historical factor is biological. No matter how well

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3) Geol. Survey Wis., vol. I, page 292.

adapted a plant species may be for growth in a particular locality, it will not be found there, unless its spores, seeds or vegetative brood bodies at some time were brought to the place.

The third is a combination of the two factors just mentioned. Organic beings, by their presence, cause certain changes in their physical surroundings, sometimes of a very considerable character. On land at least, such changes are due to plant much more than to animal life, and especially the most complex of vegetative formations, the forest, is the cause of very far-reaching alterations. In a former paper of this series [4] it was suggested that the progress from oak to basswood-maple-beech forests was due to the gradual accumulation of humus in the former, preparing the soil for the latter, which afterwards gradually drives out the oak by their greater shade tolerance. Similar processes may be looked for in the history of the Lake Shore flora.

D. The Beach.

Dr. Cowles, in his paper on "The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan (Botanical Gazette, vol. XXVII, 1899) divides the beach into lower, middle and upper, applying the former name to that portion constantly washed by ordinary summer waves; the middle, to that portion exposed to wave action during storms only; and the upper to that above danger of submersion. This classification is serviceable and based on real distinctions.

The lower beach, here as in Chicago, is practically devoid of plant growth. Even the larger boulders of the shingle beaches, where one might expect some lithophilous algae, are usually devoid of such. On the sand beach, however, is found an occasional specimen of *Cakile edentula.* This most successful of beach plants is enabled to sprout in such places by sending a strong tap root vertically down for more than three inches before it develops any foliage leaves. I have found such seedlings in the cotyledon stage as late as July 20, but whether such venturesome individuals ever reach fructification, I do not know. As a matter of fact, this part of the beach is in some respects less unstable than the higher portion. The sand, being always wet, packs and is not subject to constant shifting, like the drier zone above. On the pebble beaches,

4) January 1902, page 17 et seq.

vegetation is entirely absent, not only in the lower, but also the middle zone. The shingle beach, being very narrow, hardly shows zonal differences. But the sandy middle beach is the special abiding place of *Cakile*. Of course it is very far from covering it,—its plants stand singly, many feet apart; but it is practically the only species found in this zone. In great contrast to this is the upper beach, where a fairly considerable number of species may be found. The number of both species and individuals increases in proportion to the amount of material that has been washed down from the clay bank. Generally speaking, the nearer the foot of the bank, the more luxuriant the vegetation.

Among the species most abundant on the upper beach are: *Cakile edentula, Lathyrus maritimus, Elymus canadensis, Potentilla anserina, Euphorbia polygonifolia, Equisetum arvense, Physalis pubescens, Salix longifolia, Salix nigra, Populus deltoides, Rhus typhina.* The willows, cottonwood and sumach are invariably plants but a few years old, which would indicate that their success is precarious. In a few places such weeds as *Salsola tragus*, and *Xanthium canadense*, which are now absent from few vacant places on the uplands, have established themselves.

Of these species, *Cakile, Euphorbia* and *Potentilla* are found exclusively on the beach [5], *Lathyrus* occasionally invades the bank; all the rest are far more generally distributed on the bank, and may therefore be safely considered as invaders from above.

The upper beach is very far from being completely clothed with vegetation. At most on a few alluvial fans this condition is approximated. The following were the number of plant individuals found in 1902 on a stretch of sandy upper beach near Whitefish Bay, two hundred feet long and twenty wide, which may be considered as fairly typical: *Cakile edentula*, 25 individuals; *Equisetum arvense*, 10; *Physalis pubescens*, 3; *Populus deltoides*, two years old, 3; same, one year old, 1; *Rhus typhina*, two years old, 1. Other species, of course, will come in elsewhere, but the number of individuals will, I think, be fairly constant, and so will the proportion of *Cakile* and *Equisetum*.

At Milwaukee, the upper beach is remarkable for being quite different from the floristic aspect of similar stations both north and

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5) *Euphorbia polygonifolia* is common in a few places only. Near Ryan in the town of Oak Creek, it grows abundantly in an upland pasture, near the shore, on clay soil.

south. At Chicago, and along the east shore, Dr. Cowles found the following species to be most characteristic almost everywhere: *Artemisia caudata, Artemisia canadensis, Cirsium pitcheri, Euphorbia polygonifolia, Lathyrus maritimus, Oenothera biennis,* and *Agropyrum dasystachyum*, the two last-named especially northward.

On the other hand, the writer found, in the summer of 1902, on a more Northern beach, to-wit at Mackinaw City, the following: *Potentilla anserina, Oenothera biennis, Salix adenophylla, Cornus stolonifera, Rosa Sayii, Anemone multifida;* and not far away, on Bois Blanc Island, where the beach was rather shingly and contained some small lagunes: *Carex hystericina, Carex aurea, Gentiana sp., Lobelia Kalmii, Gerardia paupercula, Prenanthes racemosa, Impatiens fulva, Larix Americana, Thuya occidentalis;* while a neighboring sand beach showed: *Artemisia canadensis, Elymus canadensis, Lathyrus maritimus, Rosa Sayii, Prunus pumila, Rhus toxicodendron, Arctostaphylos uvaursi.* Certainly very different types of vegetation on apparently similar stations. But it should be remembered that these Northern beaches are on low shores instead of at the foot of clay banks.

From the above it appears that the beach flora of Milwaukee is unusually scanty. Leaving out of account the stragglers from the bank (and also some undetermined algae which are common in spring at the upper edge of the lower beach), there are really only four characteristic beach species: *Cakile, Euphorbia, Lathyrus* and *Potentilla*, and even of these *Euphorbia* and *Lathyrus* are not confined altogether to the beach.

E. The Unforested Banks.

Far more complicated than the flora of the beach is that of the banks. There are portions of the latter totally devoid of vegetation; these are the vertical and rapidly receding cliffs of the headlands and other portions where erosion is unusually active. There are other portions partially clothed with herbaceous and shrubby species; and still others bearing fairly prosperous forests.

Evidently a cycle of development starts with complete bareness. Plant invasion begins either from the upper edge, or more frequently from below. Very often also the inner sides of erosion terraces, or the immediate surroundings of the numerous little springs form the starting point of vegetation. It is quite apparent that the degree of rapidity of erosion is the determining factor in this. The pioneers among the settlers are species with long, creeping rootstocks or stolons. *Rhus typhina*, in many places, sends down its suckers from the upper edge, and in a few places has succeeded in transforming large portions of the bank into thickets, in which it is the decidedly dominant species. *Rubus canadensis,* in several forms, has likewise managed to establish itself here and there. But the most successful pioneer is *Equisetum arvense*, perhaps the most abundant plant of the area, although it is very often killed by having its long rootstocks exposed in the progress of erosion.

The places which are first covered with a fairly continuous carpet are the upper portions of the erosion tongues and terraces, while the gullies, the vertical top-bank, and the steeper portions everywhere remain still bare or scantily overgrown. The progress of vegetation everywhere tends to counteract the destruction of the bank by washing and landslides, but again and again the erosive forces obtain the upper hand, and the incipient vegetation is destroyed.

Where comparatively stable conditions have existed for some time, nearly all the more common species of the neighboring uplands begin to establish themselves, most prominent among them being, as usually on newly-colonized areas, those species which have seeds with flying apparatus. In many cases the appearance of species on the bank is not really a colonization, but the first comers were bodily transferred from the upland by landslides. This seems to be especially true of many patches of *Poa* and other pasture grasses, which are now covering the larger erosion terraces.

Among the herbaceous species commonly found on the stabler portions of the bank, and which are abundant on the neighboring uplands, are the following: Several species of *Solidago*, *Aster* and *Erigeron*: *Rudbeckia hirta*, *Asclepias syriaca*, *Verbascum thapsus*, *Melilotus alba*, *Trifolium pratense* and *Trifolium repens*, *Cirsium arvense*, *Taraxacum officinale*, *Elymus canadensis*, *Physalis pubescens.* Added to these are some species usually found along the Lake Shore, but absent inland: *Artemisia canadensis*, *A. caudata*, *Lathyrus maritimus*; finally there is*Psoralea onobry-*

chis, which is of Southern range and has not heretofore been reported from Wisconsin.

Two features are characteristic of this list: All but the specific coast plants are species of very wide distribution, many being the common weeds of the region; and all are flowering in summer or autumn. None of the common spring-flowering herbs are found in the unforested portions of the bank.

Rather surprising in such a locality is the presence, in numerous island-like patches, of typical hydrophyte societies. Due no doubt to the slight permeability and great water capacity of the clay, most of the little springs have small areas of water-soaked soil surrounding them. In such places are found various species of *Cyperus, Carex, Scirpus, Juncus*, even *Typha latifolia; Tofieldia glutinosa* is apparently confined, in the Milwaukee region, to just such places.

Practically simultaneous with the arrival of these herbs is the arrival of a number of woody species, again chiefly those with flying seeds: *Salix longifolia, nigra, amygdalina, discolor*[6]; *Populus deltoides, Cornus stolonifera; Rhus typhina* has already been mentioned. To these are added occasional specimens of all the trees found in the neighboring bank and ravine forests to be described forthwith.

These shrubs and young trees are apparently the forerunners of a forest on the bank. Their presence tends to diminish the effect of pluvial erosion, which ceases practically altogether, as soon as an area is completely covered with vegetation.

F. Bank and Ravine Forests.

The most astonishing feature of the forests covering portions of the clay banks along the shore and the sides and bottoms of the ravines, is their comprehensiveness. Probably every species of tree or shrub found in the Milwaukee region, from the hemi-xerophytic white-oaks, hickories and hawthorns to the hemi-hydrophytic elms, cottonwoods and black ashes, are found somewhere in this area. The only exception seems to be a few species almost extinct near Milwaukee, such as *Betula lutea* and *Celtis occidentalis*. Moreover, they are so thoroughly mingled that it is quite

6) Near Whitefish Bay, there are numerous young individuals of a willow appearing like some form of *Salix alba* with fastigiate branches, in shape resembling a Lombardy poplar.

impossible to distinguish various sub-associations, as has been done for the inland forests.[7] To them is added a number of species not found elsewhere near Milwaukee, or only in a strip along the shore, scarcely more than a mile wide. These are *Pinus strobus, Thuya occidentalis, Juniperus nana, Juniperus virginiana, Populus balsamifera, Betula alba.*[8] They are all frequent farther North. *Larix Americana*, which is elsewhere found growing in swamps, is growing here on the steep banks. Accompanying these trees are various dwarf shrubs and herbs, also found commonly farther north and in association with white pine and paper birch, but not found elsewhere near Milwaukee; or, if at all, only in the "boreal islands" of the tamarack swamps. Such are: *Shepherdia canadensis, Pedicularis canadensis, Ptelea trifoliata, Pyrola rotundifolia, Habenaria hyperborea, Castilleia coccinea, Lilium philadelphicum* and *Parnassia caroliniana.*

It is not, apparently, the undoubted xerophily of the trees and some of the herbs and dwarf shrubs just mentioned, that makes them occur in this area. The pine, arbor vitae, juniper, tamarack and balsam poplar are all of prevailing northern range. All of them, to be sure, are found farther south than Milwaukee, but probably in all the more southern stations, some similar local conditions will be discovered if the examination is thorough enough. In other words, like the tamarack and *Ericaceæ* bogs elsewhere, the Lake Shore is a boreal island.

Nor do these northern species seem to be unable to hold their own in the competition with the mesophytic species prevailing inland, and which also form the greater part of the inhabitants of the shore area. Reproduction of the pine, arbor vitae, juniper and birch is good in all places where they have to contend with no adverse circumstances except mesophytic competition. In fact, at present nearly all these trees are young, old specimens having been removed by human hands. Yet there is some evidence left, that within recent years they attained considerable age and dimensions.

There is a paper birch stump near Whitefish Bay, 26 inches in diameter two feet from the ground. Tamaracks were measured

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7) See former bulletins of Wis. Nat. Hist. Society, New Series.

8) The only wild specimens of paper birch I know of away from the Lake Shore are a few small trees on the rocky bluff in the Soldiers' Home Grounds. There are a few young balsam poplars at the mouth of Honey Creek, in Wauwatosa.

with 8.9 and 17-inch breast-high diameters, which are considerable dimensions for this region. Arbor vitae forty feet high and 9 inches in diameter breast-high occur. No large white pines are left, but near Fox Point there are vigorous saplings, up to 3 inch breast-high diameters. Red cedars (which, however, are southern rather than boreal trees) are quite numerous and vigorous in the southern part of the area, though absent northward.

As one walks up the ravines, it is evident that these boreal elements rapidly diminish, until one finds a typical maple-beech-basswood society in the upper reaches of the longer ravines, with hemi-xerophytic elements prevailing on the slopes, especially the north sides. It is apparent, therefore, that conditions are favorable for the northern xerophytes only so far as the immediate lake influence goes[9]; farther inland they succumb to the broad-leaved forest.

The question arises: Are these boreal species invaders which settled among the mesophytes of the shore and on account of Lake influences are able to hold their own; or are they relicts from a former period, when boreal xerophytic forests predominated in the Milwaukee region? All these species occur in numerous places along the lake, to the south as well as the north. These stations are not infrequently separated by considerable spaces, where they are wholly absent under conditions which exclude human agency. Colonization is not impossible, but it is made difficult by the fact that the seeds would most likely have had to come from across the lake, which is not quite credible. In the case of the junipers, birds might carry them from the shore side. But winds carrying the pine and birch seeds would necessarily have to be lake winds. This is quite inconceivable. Ice rafts might possibly do the work, the wind blowing the seeds up the bank, after they had been landed on the beach. It is a fact that ice rafts bearing tree seeds can be observed every winter.

But these methods are so precarious that the other alternative seems decidedly more plausible. In the distant past, the Milwaukee region was covered with pine forests similar to those now occurring farther north. Changes, perhaps of a climatic nature, caused these to succumb to broad-leaved species; and now the

9) However, as stated above, paper birch occurs commonly anywhere east of the Milwaukee River; and at the time of the settlement white pine is said to have been common in the same territory—a mile or more from the Lake.

lake shore, where the new climate is locally modified in the direction of what the old climate may have been, is the last stronghold of the formerly dominant society. A xerophytic conifer society would be postulated, on a priori grounds, as that of the end of the Glacial and Champlain periods. When the buried forests of Eastern Wisconsin [10] shall have been thoroughly examined, the postulate may be established by evidence.

The future of the boreal species will be dependent on the progress of erosion. While pluvial erosion is practically absent in the forested parts of the shore, the little brooks in the ravines are rapidly undercutting the steep sides, thus destroying the forests clothing them. In time, the sides may thereby be re-converted into naked banks, to be gradually conquered again by vegetation as described above; the only difference would be that the south sides of the ravines would be more shaded and therefore less xerophytic than the north sides. At the present time, the mouths of most of the larger ravines are in this condition of bareness; that a forest formerly clothed their sides is shown by the fallen logs, more or less buried by bank material, which are strewn over the slopes.[11]

Little is to be said about the vegetation of the two diastrophic terraces included in our area. The southern one is part of Lake Park, the northern principally cultivated field. From the remnants of the original forest still visible, one would conclude that the maple-beech society was dominant, but whether the boreal elements were represented or not, is now impossible to say. The banks in the rear of the terraces seem to be a little less favorable to the latter than the banks closer to the lake.

Washington, D. C.

March, 1910.

10) See Bull. Wis. Nat. Hist. Soc., 1902.

11) Logs are also buried in the bank of the lake front itself, and occasionally brought to light again by erosion. These may have been buried in the same way; or they may be older and part of the Champlain forest.

THE APPLICABILITY OF CERTAIN GENERIC NAMES OF ODONATA.

By Richard A. Muttkowski.

1. **Agrion** versus **Calopteryx**.

Kirby's reversion of *Agrion* to *Calopteryx* and the renaming of the other (=*Coenagrion*) were not uniformly accepted by Odonatologists. In fact, but three authors besides Kirby took cognisance of the change at all for systematic use, although it had caused considerable discussion and protest in the years following the publication of Kirby's work (Synonymic Catalogue of Neuroptera Odonata, London 1890.

Kirby's change was based on Latreille (Histoire naturelle, generale et particuliere des Crustaces et des Insectes, 1805); so Mr. Kirby very kindly informed me, at the same time citing the full quotations bearing on the change. The decision of the International Commission on Zoological Nomenclature (see Bulletin Milwaukee Museum, I, pp. 14, 17, 27, 65, 1910) in his favor should have settled the applicability of *Agrion*; but as Latreille's description is somewhat indefinite some doubt may have been had as to the advisability of this decision. Further, Dr. Stiles had in one of his letters to me referred to Latreille 1810 as more pertinent and decisive. My correspondence with Dr. Stiles on the matter was delayed owing to his illness, until it was too late to enter the final results in my recent catalogue. I quote the opinion verbatim from Dr. Stiles' letter:

Referring to the case of *Agrion* Fabricius, 1775, I would state that it is now possible to give you a definite answer without referring the subject to the Commission.

If you will consult "Science," 1910, Jan. 28, p. 150, you will find the following ruling by the International Commission:

Opinion 11. "*The Designation of Genotypes by Latreille, 1810.*"—The "Table des genres avec l'indication del'espece qui leur sert de type," in Latreille's (1810) "Considerations generales," should be accepted as designation of types of the genera in question. (Art. 32.)

This decision was finally adopted by the Commission by a vote of 12 to 1, two members of the Commission not voting.

I have consulted the book in question, namely Latreille, 1810, and find that on page 434 he gives, "Agrion. *Agrion virgo*, Fab."—C. W. Stiles, Secretary International Commission on Zoological Nomenclature.

The full title of Latreille 1810, is as follows: Considerations generales sur l'ordre naturel des animaux composant les classes des Crustaces, des Arachnides et des Insectes avec en tableau methodique de leurs genres disposes en familles, Paris, 1810, pp. 1-444.

This should settle the applicability of *Agrion* for once and all. The synonymy of Kirby's catalogue on *Agrion* and *Coenagrion* is thereby proven correct and *Calopteryx* can no longer be used with any semblance of authority by systematists.

2. The Genotype of **Gomphoides** Selys.

Again quoting from Dr. Stiles' letter of May 23, 1910:

Referring to the case of *Gomphoides*, it seems to me that no legitimate question can arise as to the procedure under the premises given.

By examination of Selys-Longchamps, 1850, p. 360, I find that the type of *Gomphoides* is definitely fixed as *Diastatomma obscura*. See Science, 1907, Oct. 18, p. 521, Art. 30 (g).

The fact that this species was based on a specimen the abdomen of which was lost does not come in the question. See Article 27a of the Code which reads as follows: "The law of priority obtains and consequently the oldest available name is retained:

"When any part of the animal is named before the animal itself." —C. W. Stiles, Secretary International Commission on Zoological Nomenclature.

The reference from de Selys-Longchamps (1850,—Odonates d' Europe, p. 360) reads as follows: (in note to *Gomphus brodici*) "Je pense que c'est de mon nouveau genre *Gomphoides* de l'Amerique, que cette aile se rapproche le plus par la disposition des triangles de l'aile. Le type actuel est la *Diastatomma obscura* de Rambur."

As a result of this opinion the name *Gomphoides* must revert to the genus of which *Diastatomma obscura* is the type, which is

Progomphus, the latter falling into the synonymy of *Gomphoides. Gomphoides* as used by de Selys in 1858 must be renamed. (This has been done by me in Bull. Milwaukee Museum, 1, p. 81, 1910 =*Negomphoides).*

Milwaukee Public Museum,
May 31, 1910.

BRIEFER ARTICLES.

A NEW SPARROW RECORD IN EASTERN WISCONSIN.

By I. N. Mitchell.

On the 29th of March, 1910, some school children found a dead sparrow in the road at Mayville, Wis.

They took the bird to their teacher, Miss Myrtle Clark. Finding it to be an unusual sparrow, Miss Clark conferred with two other bird students of the place, Mr. and Mrs. E. A. Ross. The three agreed that it was a LeConte's sparrow.

The sparrow was mailed to the writer for verification and was found to be correctly determined. In the Birds of Wisconsin [1] it is stated, "It is rather remarkable that the closest search has failed to produce a single specimen in spring, none having been noted before August."

Mr. Wells W. Cook of the U. S. Biological Survey reports one from La Crosse, Wis., May 13th, 1907. Prof. J. H. Congdon of La Crosse reported one at that place on May 11th, 1907. Mr. and Mrs. I. N. Mitchell reported seeing one at Milwaukee June 6th, 1907. This latter observation was not technically verified. The Mayville specimen, now in the National Museum, therefore extends considerably the known spring range of this species.

EUFALLIA, A NEW NAME FOR *BELONIA* FALL (*COLEOPTERA*).

By Richard A. Muttkowski.

In a recent attempt to determine two *Lathridiidae* I had occasion to refer to Mr. H. C. Fall's excellent monograph of this family of minute *Coleoptera* (Trans. Am. Ent. Soc., 26, pp. 101-190,

1) Bulletin Wis. Natural History Soc., Jan., Apr., & July 1903.

1899; pls. 3-5). In his tables I noticed the new genus *Belonia*, which was known to me to be preoccupied for *Odonata*, applied by Mr. W. F. Kirby in the monograph of the *Libellulinæ* (Trans. Zool. Soc. London, 12, 1889) to a part of the previous genus *Libellula*, although it was later relegated to the synonymy of *Libellula*. Having been used previously, *Belonia* Fall is a homonym.

Mr. Fall was thus informed by me, but declined to rename the genus, saying that he preferred others to do so. I therefore offer the name *Eufallia*, to replace *Belonia* Fall, as a token of appreciation of the great monographer, whose name is heard as the foremost of workers on small *Coleoptera*.

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Vol. 2, No. 2, "Spiders of the Marptusa Group of the Family Attidæ," G. W. & E. G. Peckham, Nov., 1894.

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.

"The Wisconsin Archeologist," Vol. I, No. 1, Oct., 1901; Vol. I, No. 2, Jan., 1902; Vol. I, No. 3, Apr., 1902; Vol. I, No. 4, July, 1902; Vol. II, No. 1, Oct., 1902, each .... 25 cents

This publication is now issued by the Wisconsin Archeological Society of Milwaukee, from whom the later volumes may be obtained.

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MEETINGS.

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room at the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 8. OCTOBER, 1910. No. 4

PROCEEDINGS.

Milwaukee, Sept. 29, 1910.

The regular meetings were resumed this evening.

President Barth in the chair. 35 people present.

Minutes of last regular meeting read and approved.

The resignation of Mr. H. Russel from the committee for programs for section meetings was read and accepted. A communication from the Milwaukee County Dental Society was read, inviting the members of the Society to be present at a lecture by Dr. W. G. Ebersole of Cleveland, Ohio, on Oral Hygiene, Dental Inspection of Public Schools and Free Dental Clinics.

The nomination of Miss Lucie Harmon, 172 21st St., to active membership. was presented by Mr. Ward, and referred to the board of directors, who subsequently elected Miss Harmon to membership.

Mr. Alfred C. Burrill gave the evening's lecture on The Basis of Ant-Socialism. Mr. Burrill presented a brief review of castes in an ant colony, the present swarming activities about Milwaukee, and two of the methods of founding of ant colonies; the first being the reprisal of a dealated queen by workers and the resulting communal life, the second, the solitary activity of the dealated queen who founds her home alone and begins one of the largest periods of apparent starvation of an active creature in the animal kingdom. This oppositeness of founding methods proves that the communal tie is not blood relationship as often stated. For we see the circle of nurse ants attending the queen whether they be members of the colony of her adoption, or her own daughter.

With the aid of lantern slides the lecturer featured an anatomical investigation for points of dependence, for which he selected the Foraging Worker Ant, pointing out the buccal cavity, the crop, the gizzard, the stomach, and their uses. The method of these ants feeding each other from a "social stomach" or "communal stomach" was illustrated by an observation made by the lecturer during the summer, a case of ant-maze and an ant nurse who fed the young at a distance from the nest.

Three types of ants and their use of the crop were explained. First, the enormous distension of the crop in Honey Ants, "movable pantries," as they have been called, who, despite their weight—such that they cannot crawl—hang to the ceiling of the nest, and there may die and not drop till two or four days later. When dead the ant is cut in two at the pedicel and the anterior part and the honey pot cast on the kitchen refuse; but if a live ant is mashed the others unmercifully suck up her juices. In the honey ant, therefore, the crop takes a place similar to that of the bees' honey cells.

The second illustration was that of the Mushroom Growing Ant, where the queen carries the "spawn" in her buccal pocket and starts and manures her own garden. Here the worker's crop plays a little part, no doubt, but the young, the queen and workers are fed from the fungus products.

A third example are the Seed-Collecting Ants. But the use of the crop is here in doubt, unless it be to store the sugary solution of seeds. Mr. Burrill also touched upon the licking and mouthing propensities of ants, so necessary to clean the members of a nest and to keep the latter free from harmful fungi. This propensity likewise interfered with the lecturer's attempt to mark ants with aluminum paint.

Ant communism, therefore, appears to be based on: first, on a communal stomach which makes each the servant of all and so everything naturally becomes the property of all; secondly, on the love of tasting and licking things, which, applied to each other, cleanse the whole community and cares for the health of it. No close parallel can be drawn with the human race. Yet we can see that, overlooking the dependence of the babe on the mother's milk, on an intellectual plane we accomplish what the ants do on a physical, viz.—first, by our great transportation systems we redistribute our food crops and supplies; secondly, by our slowly-growing sanitary and similar commissions, we clean the community and keep up the tone of health. Human Socialism must be on an intellectual plane, while ant Socialism is on a physical plane. Before people can ever hope to own everything in common like the ants, there must evidently be a greater likeness of intellectual ideals, as the basis for Socialism.

The lecture was illustrated by lantern slides and many pamphlets, handed to the audience for examination.

After a brief discussion by Miss Elmer and Mr. Burrill the meeting adjourned.

NEW ZEALAND'S EXPERIENCE WITH THE RED CLOVER AND BUMBLEBEES.

By S. Graenicher.

The red clover *Trifolium pratense* L. is one of the numerous flowers, that depend more or less on the visits of bumblebees for their pollination. Darwin[1] expressed the opinion that these were the only insects capable of effecting cross-pollination, but Herman Mueller[2] presented a list of 39 visitors to these flowers, and stated, that although bumblebees are considered the most important pollinators, there are quite a number of other insects, the visits of which may produce the same results. Knuth[3] reproduces Mueller's statements as follows: "In order to reach the nectar legitimately, an insect must have a proboscis of at least 9-10 mm. in length, corresponding to that of the corolla-tube. Many species of bumblebees and other bees are regular pollinators, and some Lepidoptera are casual agents of cross-pollination. The pollen, on the other hand, is accessible to all short-tongued insects which are skillful enough to depress the carina. Such insects, e. g., the honey-bee, also effect regular cross-pollination. Nectar is also stolen from the red clover, especially by *Bombus terrestris* (with a proboscis only 7-9 mm. long), and the honey-bee (with a proboscis of 6mm.). These perforate the flowers from without, and thrust their proboscis through the hole to the desired booty. The opening is made use of by other thieving insects."

On account of its importance as a food-plant the red clover, a native of Europe, has been introduced into many, if not all, countries where cattle are raised. In New Zealand, a country originally without bumblebees, the experience with the red clover was at first not at all satisfactory, and it was therefore deemed necessary to import bumblebees from Europe. A letter from the New Zealand Government, emanating from the Canterbury Agricultural and Pastoral Association of Christchurch, New Zealand, dated

1) Chas. Darwin, Origin of Species; Chapter III.
2) Hermann Mueller, Die Befruchting der Blumen, pp. 222-224.
3) P. Knuth, Handbook of Flower Pollination (Engl. translation by J. R. Ainsworth Davis); Vol. II, pp. 290-291.

May 26, 1905, and received by the Agricultural College at Guelph, Ontario, shows, that in spite of the activity of the bumblebees, the results have not come up to the expectations. This letter reads in part as follows[4]: "Before the introduction of the bumblebee into New Zealand from England in 1855, the yield of red clover seed was not sufficient to be commercially payable. Since the introduction, however, the yields have been more prolific, but it is still thought that the best results have not yet been obtained.

"We have in New Zealand, as far as we know, three kinds of bumblebees, the descendants of those imported in 1855, viz., *Bombus terrestris*, *Bombus hortorum*, and *Bombus hortorum*, variety *Harrisellus*. *Bombus terrestris* is the most numerous and is, I believe, considered quite unsuitable on account of the shortness of its proboscis.

"My association would deem it a great favor if you could forward me any information you may have gathered as to what bees or insects you have in Canada most suitable for the fertilization of red clover."

In connection with the publication of this letter Jarvis informs us that three species of bumblebees, viz., *Bombus fervidus*, *B. ternarius* and *B. borealis* were collected from the flowers of the red clover; he further states, on the authority of Dr. Brodie, that *Bombus consimilis* is common around Toronto, and that, according to Dr. Fletcher *Bombus fervidus* is the most common species at Ottawa, while *B. borealis* is rare.

As to the habits of *Bombus terrestris*, one of the bumblebees imported into New Zealand, we have seen above (Knuth), that this species is unsuitable not only on account of its short tongue, but that, to make matters worse, it mutilates the flowers without giving them the benefit of cross-pollination. For these reasons it is to be considered more harmful than beneficial, so far as the pollination of red clover is concerned, and it would probably never have reached New Zealand if those in charge of the importation of bumblebees to that country had been familiar with its habits. *Bombus hortorum*, on the other hand (and its variety *Harrisellus*) is a long-tongued bumblebee, in which, according to H. Mueller[5]

4) P. D. Jarvis, Bumblebees that Fertilize the Red Clover; thirty-sixth annual report of the Ent. Soc. of Ontario (1905), pp. 128-129.

5) Hermann Mueller, Die Entwickelung der Blumenthaetigkeit der Insekten; Kosmos, Vol. IX, p. 360.

the tongue reaches a length of 19-21 mm. Undoubtedly this species would be able to produce the desired results if present in sufficient numbers, but being in the minority (as the letter from the New Zealand government indicates) its influence is noticeable to a slight degree only.

At Milwaukee the following bees have been seen on the flowers of the red clover: *Apis mellifera* L. (honey bee), *Osmia atriventris* Cr., *Megachile wootoni* Ckll., *Synhalonia atriventris* Sm., *Bombus virginicus* Oliv., *B. americanorum* Fabr., and *B. pennsylvanicus* DeG. (*fervidus*). Of the three bumblebees *B. americanorum* and *B. pennsylvanicus* are more frequent visitors than *B. virginicus*.. At Carlinville, Macoupin Co., in southern Illinois Robertson[6] took among other visitors of the red clover five bumblebees: *B. americanorum* Fabr., *B. pennsylvanicus* DeG., *B. ridingsii* Cr., *B. separatus* Cr., and *B. vagans* Sm.

On account of the tube-length of the flower no bumblebee with a tongue-length under 9 mm. can be regarded as a reliable pollinator, as has been shown above. A measurement of the mouthparts* of eleven species of bumblebees from the Milwaukee region has furnished the following figures:

Bombus americanorum Fabr. about 14 mm.
" *pennsylvanicus* DeG. about 14 mm.
" *auricomus* Rob. about 12 mm.
" *ridingsii* Cr. about 10 mm.
" *separatus* Cr. about 8 mm.
" *virginicus* Oliv. about 8 mm.
" *consimilis* Cr. about 7 mm.
" *huntii* Greene (*tenarius*) about 7 mm.
" *juxtus* Cr. about 7 mm.
" *terricola* Kirby about 6 mm.
" *affinis* Cr. about 5 mm.

According to these figures only the four species at the head of the list would fulfill the requirements. Of these *B. auricomus* and *B. ridingsii* are, in our region at least, not so common as *B. americanorum* and *B. pennsylvanicus*, the last named being espe-

6) Chas. Robertson, Flowers and Insects, VIII; Bot. Gaz., Vol. XVII (1892), p. 177.

*) In comparing the mouthparts of a number of American and European bumblebees, Cockerell and M'Nary have taken the length of the first joint of the labial palpus as an index. (Canad. Ent., Vol. Vol. XXXIV, pp. 71-72).

cially frequent. Both of these species show a wide range of distribution.

The figures presented above (tongue-length) were all derived from females (queens). Around the middle of June the workers begin to fly and are present in great numbers throughout the summer months. There is a considerable difference in size among the workers belonging to the same species, the larger ones being termed major workers, those of smaller size the minor workers. Four such workers of *Bombus pennsylvanicus*, repesenting different sizes, were selected and their tongue-lengths determined as follows:

1.	Body length	17 mm.	Tongue length	11 mm.
2.	" "	15 mm.	" "	9 mm.
3.	" "	11 mm.	" "	6 mm.
4.	" "	9 mm.	" "	5 mm.

From this we gain the information that not only the female, but also the larger workers of this species are able to figure as efficient pollinators of the red clover. For the purposes under consideration the introduction of *B. pennsylvanicus* as also of *B. americanorum* into any foreign country with suitable climatic conditions would probably prove satisfactory. Both of them are hardy and vigorous, and might, in the case of New Zealand, be able to counterbalance the harmful activity of *Bombus terrestris*, if numerically well represented.

Milwaukee Public Museum,

October, 19, 1910.

MISCELLANEOUS NOTES AND RECORDS OF DRAGONFLIES (*ODONATA*).

By Richard A. Muttkowski.

The following notes are based chiefly on a collection of dragonflies in the Museum of the Brooklyn Institute of Arts and Sciences, recently sent to me for determination. Other records are taken from specimens in the collections of the Milwaukee Public Museum.

The main interest of the records attaches to the commingling of Western and Eastern species in Utah and Arizona. At best the collections of *Odonata* from the Rocky Mountain States have been few and those of the dilatory order. One of the most extensive is that by Prof. F. H. Snow (deceased) for the Snow collections in Kansas University, from which I have received a number of specimens here cited.

Specimens in the Brooklyn Institute are designated by the parenthesized (Brooklyn). Similarly specimens collected by Prof. Snow and others, which are now in the Milwaukee Public Museum.

LESTINÆ.

Archilestes grandis Rambur. One female, Utah (Brooklyn).

CŒNAGRIONINÆ.

Hyponeura lugens Hagen. Four Males, Oak Creek Canon, Ariz., 6,000 ft. (Snow). Three males, Los Angeles Co., Calif., July, and one female, August.

Argia mœsta Hagen. Four males, Utah (Brooklyn).

Enallagma doubledayi Selys. Three males and two females, Florida (Brooklyn).

Enallagma anna Williamson. Three males; two from Utah and one from Arizona (Brooklyn).

Enallagma prævarum Hagen. Two males, Manitou Park and Colorado Springs, Colo., August (Snow). Three males, Pasadena, Calif., August.

Table of the species of **Ischnura** Charpentier.

The following includes all North American species, but refers only to the males:

1. Antehumeral green stripe present (a superior spot and inferior stripe in *posita*) 2
   Antehumeral green stripe indicated by superior and inferior spots 12
   No trace of green antehumeral stripe..................**denticollis**
2. Abd. segment 9 black on dorsum.............................. 3
   Abd. segment 9 with blue on dorsum........................ 4
3. Abd. segment 8 blue, antehumeral stripe complete........**ramburi**
   Abd. segment 8 bronze black, antehumeral stripe like an inverted ....**posita**
4. Abd. segment 9 entirely blue (occasionally in *verticalis*).... 5
   Abd. segment 9 with lateral black stripes or spots............ 9
5. Abd. segment 10 with a dorsal bifid process.................. 6
   Abd. segment 10 with cylindrical, entire process............ 8
6. Abd. segment 8 entirely blue.................................. 7
   Abd. segment 8 with lateral black markings..............**demorsa**
7. Superior appendages decurved, one-half the length of 10, with an acute, curved apical process; inferiors nearly the length of 10, with an outer, acute process.....................**barberi**
   Superior appendage apparently consisting (in lateral view) of a small rounded lobe one-fourth the length of 10, in rear view a short acute process extending obliquely downward and inward; inferiors one-half the length of 10, an outer acute process with the tip deflected inwardly....**utahensis** n. sp.
8. Abdomen brassy green, markings pale green............**prognatha**
   Abdomen bronze black, markings blue..................**kellicotti**
9. Abd. segment 8 with lateral black markings.................. 10
   Abd. segment 8 entirely blue............................**credula**
10. Process of inferior appendage not bifid at apex............... 11
    Process of inferior appendage bifid or trifid at apex.....**perparva**
11. Inferior appendage much longer than superior, cylindrical, notched at tip; superior appendage with slender, straight prolongation ....**erratica**
    Inferior appendage hardly longer than superior, a rectangular superior basal lobe; not notched at the apex; superior appendage with decurved prolongation................**verticalis**

I. prognatha should fall under 6 with *demorsa*. Until recently this species was known to me only through a broken male, and I accepted Hagen's description of the process on 10 as "cylindrical" for this table. However, from several specimens sent me by Mr. Williamson, I find that the process is bifid, though narrowly so, in its apical sixth.

12. Bifid process on 10 as high as 10, forked in apical half......**cervula**
Bifid process on 10 one-fourth as high as 10, forked in less than apical half....................................**damula**

Ischnura utahensis n. sp.

Male—Black, without metallic lustre, orange and blue.

Labium and labrum yellow, rhinarium pale green, nasus dark metallic green, frons orange, vertex black, ocelli brown, occipital spots large and green, the narrow stripe between them interrupted at one-third. Eyes green (type), head yellow in rear.

Prothorax with anterior lobe black above, margined with green. Median lobe green. Posterior lobe black, margined with green; at the anterior edge a narrow black line is given off at the lateral fourth which crosses the median lobe and extends slightly beyond the base of the anterior lobe. Posterior margin regularly convex, the black at the side being obtusely excavated.

Thorax with a broad black dorsal stripe, a green antehumeral stripe one-half as wide, a black humeral of equal width, which is narrowed above and below. Sides green, a very fine black line at the upper third of the second suture (one specimen with a similar one the first suture). Paler green beneath. Legs yellow, femora and tibiæ with a black external line, the line strongest on the anterior tibiæ, barely indicated on the posterior ones; tarsal joints ringed with black, apical half of claws black; all spines of the legs black.

Abdomen: segment one green, two small median twin spots on dorsum; two black above, the stripe wide at the base, narrowing gradually to apical fourth, then widening broadly to the apex, where the black extends half way down the sides, which are green; segment three to six black on dorsum, the stripe narrow, except on the apical fourth where it is broad and cup-shaped, narrowing to a point basally and at the apical fourth, but interrupted only at the base; segment seven with the black stripe extending half way down the sides; sides of three to seven orange, except the base of three, which is green; segment eight and nine entirely blue; ten black above, blue on the sides below.

Forked elevation on segment ten hardly half as high as ten, rising gradually from the base, forked in less than apical half, forming a right angle, the branches acute at the apex. Superior appendages hardly one-fourth as long as ten, in lateral view showing as a small rounded lobe, in rear view an acute process which is directed obliquely downward and inward, the process black at the tip and imbedded in the base. Inferior hardly one-half the length of ten, wide at base, then cylindrical, the apex acute and curved inward; color yellow, except at the tips, which are brown.

Wings clear. Fore wings with 7-9 postcubitals (7 only in the type), hind wings with 6-7 (6 in the type only). Vein M_2 arising a trifle before or at the fourth postcubital in all fore wings, at the third in five hind wings (between the third and fourth in the right hind wing of the type). Pterostigma of fore wing black, white in

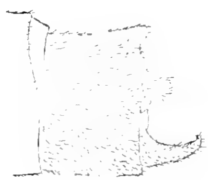

Fig. 1. Appendages of Ischnura utahensis n. sp., lateral view.

the distal corner; lighter and brown, surrounded with white in the hind wings.

Female unknown.

Length of abdomen 26-27 mm., hind wing 16-18 mm.

Described from holotype and one paratype in the Brooklyn Museum and one paratype in the Milwaukee Public Museum, all three males from Utah (Brooklyn). Specific locality not indicated.

The species is almost identical in markings with *Ischnura barberi* Currie and differs chiefly in the form of appendages and the general size.

Ischnura credula Hagen. Two males and two females, Galveston, Texas, May, (Snow).

Ischnura cervula Selys. Four males and two females, Los Angeles, Co., Calif., August and September.

But one of the males has the superior process of segment 10 as high as the segment. On the others it is considerably less, on one scarcely one-half the height of ten.

Chromagrion conditum Hagen. Two males, one from Kentucky, the other from Lakehurst, N. J., May (Brooklyn).

CORDULEGASTERINÆ.

Cordulegaster diadema Selys. Four males, Oak Creek Canon, Ariz., July and August (Snow).

Cordulegaster dorsalis Hagen. Six males, Los Angeles Co., Calif., and one female, San Marino Co., Calif., (Grinnell).

In bulk the female appears larger than the males. In fact, it much resembles C. *diadema.* The vulgar lamina form a narrow trough about four times the length of segment ten.

Cordulegaster erroneus Hagen. One female, Lake City, Florida.

Vulvars about three times the length of segment ten.

GOMPHINÆ.

Negomphoides. Aphylla and **Cyclophylla.**

Dr. Calvert holds that these three genera cannot be differentiated. In accordance with his view the new name *Negomphoides* Muttk. for *Gomphoides* Selys must be suppressed and *Cyclophylla* take its place.

Hagenius brevistylus Selys. One male, Lava, Sull. Co., N. Y., (Brooklyn).

AESHINÆ.

Gomphæschna furcillata Say. One male and one female from Ramapo Mountains, New York, June and one female from Lakehurst, N. J., May (Brooklyn).

The species also occurs in Florida. I have one female from Lake City, Fla.

Aeshna palmata Hagen. One male, British Columbia (Brooklyn).

Aeshna umbrosa Walker. One male, Saquenay River, Prov. Quebec, July, and one male labelled Calif., (Brooklyn).

Aeshna multicolor Hagen. One male, Utah (Brooklyn).

Aeshna verticalis Hagen. One male, Florida (Brooklyn).

MACROMIINÆ.

Didymops transversa Say. Two males, Turkey Lake, Fla., March.

CORDULIINÆ.

Neurocordulia obsoleta clara n. subsp.

Female—Pale olive brown, markings yellow and brown.

Face olive brown, labrum and front anteriorly yellow, vertex and occiput olive brown, the latter with central indeterminate yellow markings. Eyes margined with yellow behind.

Thorax olive, clothed thickly with fine white hairs, which are longer at the anterior edge of the dorsum. Dorsal carina yellow, with a broad brown stripe on each side covering half the distance to the humeral suture; this stripe is somewhat obscure, though distinct, and sends off a narrow acute process at its upper end to the humeral sutnre. Sides of thorax olive, an elongated yellow spot on the lower half of the first lateral suture, a triangular spot above below the fore wings and a quadrangular spot at the front edge of the hind wings, both yellow. Above with yellow spots at the bases of all wings. Legs olive, the carinas yellow, these markings, however, not very distinct. Spines of the legs and tips of the tarsal claws brown.

Abdomen: segments one and two and basal half of three olive, two with a latero-inferior basal yellow spot, three with a very narrow yellow nasal ring. The remaining segments are obscure brown, though there are indications of lateral yellow oblong spots on segments three to nine. Appendages as long as nine plus ten, yellow at the basal third, then obscure brown. Vulvar lamina very short, hardly one-tenth the length of nine, rectangularly excised, lateral lobes broadly rounded.

Wings hyaline, the venation brown, yellow near the costa. At the extreme base the wings are blackish in the costal, subcostal and median space. Four basal subcostal antecubitals with a small brown spot surrounding each, the spots not larger than one-sixth of the space between the cross-veins; fifth and sixth antecubitals (subcostal) very narrowly margined with brown. Nodal spot very small, consisting of a narrow internal subcostal streak and a similar narrow postnodal streak. Hind wings similarly marked, with the spots one-third larger. Stigma of all wings brown, membranules white, black at the spical third. Venation:

Fore Wings.	Left Wing.	Right Wing.
Costal antenodals	9	8
Subcostal antenodals	7	8
Postnodals	10	9
Triangle	3-celled	3-celled
Subtriangle	3-celled	3-celled
Post-triangular series	3-2-3-rows	4-2-3-rows
Cubitals	3	3

Hind Wings.

Costal antenodals	5	5
Subcostal antenodals	5	6
Postnodals	10	8
Cubitals	2	2
Triangle	2-celled	2-celled
Post-triangular series	3	3
Apex on loop resting on	1 cell	1 cell

It is worthy of note, that there is a cross-vein in the hypertriangular space in the left fore wing.

Length of abdomen (excel. app.) 35 mm., appendages 25 mm., hind wings 38 mm.

Described from one female labelled Alabama in the Brooklyn Institute. Holotype bearing "Accession No. 11146."

The entire absence of anal spots on all wings will distinguish this species from other *Neurocordulia*. There is not the slightest trace of the anal spots as found in *N. obsoleta* and *yamaskarensis*.

Somatochlora minor Calvert. One male, Saquenay River, Prov. Quebec, July (Brooklyn).

Somatochlora cingulata Selys. One male, Saquenay River, Prov. Quebec, July (Brooklyn).

The appendages of this species have never been figured. In lateral view they appear almost identical with those figured by Williamson for *albicincta* Burmeister. In dorsal view they are likewise similar, except for the acute external basal spine of the superior appendages.

Somatochlora provocans Calvert. Ent. News, 14, p. 39, 1903; male described.

Female (hitherto undescribed)—Dull metallic green, markings yellow.

Face chiefly yellow. Labrum black, the oblique margins of the nasus with a narrow black stripe, which do not touch the frons, their upper ends being one millimeter apart. Frons above and a very little in front very dark metallic green, with a violet tinge. Vertex similar, occiput and back of head black.

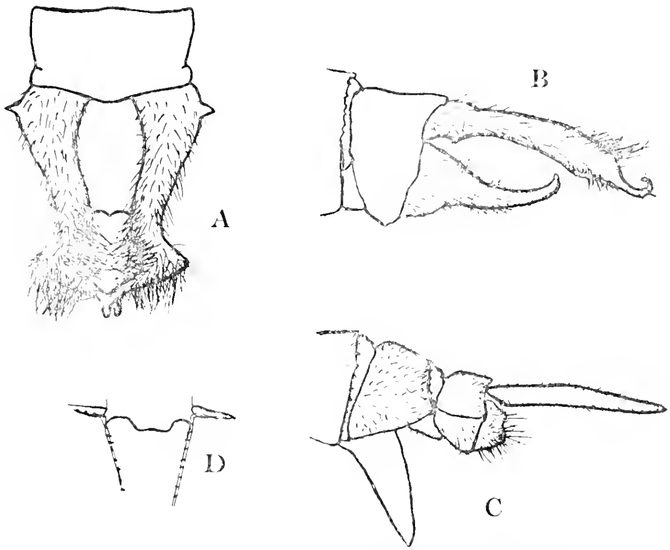

Fig. 2. A, B, appendages of *Somatochlora cingulata*: A, dorsal view, B, lateral view; C, apical segments of *Somatochlora provocans*, female; D, vulvar scale of *Neurocordulia obsoleta clara* n. subsp.

Thorax metallic green, covered with fine white hair, which are thicker and longer on the dorsum. Sides with a rather broad anterior stripe and a smaller metapimeral stripe, which does not reach the metasternum. Yellow between the wings on dorsum. Legs with coxæ and trochanter obscure yellow or brown, fore femora brown beneath, middle femora at base; otherwise black.

Abdomen dark metallic green, an apical dorsal line on one, an oblique latero-inferior triangular stripe on two, yellow; the stripe occupies the basal half, and widens toward the apex of the segment; segment three with a basal ring of yellow, which is interrupted dorsally, and two latero-dorsal triangular basal spots, yellow.

Appendages longer than nine plus ten, straight and acute. Vulvar lamina forming a trough protruding at right angles from the venter, longer than the height of nine.

Wings hyaline, tinged throughout with yellow, the yellow more pronounced in the costal regions of all wings; also intense streaks in the subcostal and cubital spaces of the fore wings and the subcostal spaces of the hind wings. Venation:

Fore Wings.	Left Wing.	Right Wing.
Costal antenodals	9	8
Subcostal antenodals	8	8
Postnodals	5	6
Triangle	3-celled	2-celled
Post-triangular series	3-2-3-rows	3-2-3-rows
Hind Wings.		
Costal antenodals	6	5
Subcostal antenodals	6	5
Postnodals	7	6

Post-triangular series broken, with batches of very minute cells.

Abdomen (excl. appendages) 42 mm., appendages 4 mm., vulvar lamina 3 mm. Hind wings 37 mm., stigma 2.5 mm., hind femora 8 mm.

Described from one female from White Mills., Pa., captured in August (Brooklyn). Allotype in Brooklyn Institute.

The species is close to *tenebrosa*, *filosa* and *linearis*. From the latter it is distinguished by the markings of the abdomen. From *tenebrosa* it can be separated by the longer appendages and the form of the vulvar lamina. These are much like those figured by Martin for *S. filosa* (Cat. Coll. Selys, 9, p. 22, 1908; t. f. 20). Of Martin's figure, however, it must be said that it does not agree with the descriptions of the vulvars "forming a recurved trough reaching the tip of the abdomen," as attested by Needham's figure on page 500 of the Adirondack report (1901). If such be the case, there is the probability of Martin's specimen being a female of *S. provocans*. I have seen a male of *S. filosa* from Lake City, Fla.

LIBELLULINÆ.

Libellula auripennis Burmeister. One male, Florida (Brooklyn).

This specimen has the wings more intensely amber-colored than any that I have ever seen. This coloration is especially strong in the apical half of the wings. Stigma on all wings bright red.

Libellula flavida Rambur. One male, Lakehurst, N. J., June (Brooklyn).

Libellula saturata Uhler. Los Angeles Co., Calif., August; eight males, one female.

Libellula incesta Hagen. One male, Mississippi.

Plathemis subornata Hagen. Two males, two females, Clark Co., Kansas, May (Snow).

Erythrodiplax berenice Drury. Two males and two females, Galveston, Texas, May (Snow).

Sympetrum obtrusum Hagen. One male, Utah (Brooklyn).

Sympetrum scotium Donovan. One male, California (Brooklyn).

Sympetrum madidum Hagen. One male, California (Brooklyn).

Sympetrum corruptum Hagen. One male, Utah (Brooklyn).

Sympetrum semicinctum Say. One male, White Mills, Pa., August (Brooklyn).

This species occurs also in Wisconsin. I have several specimens from Chippewa Falls (Howieson).

Paltothemis lineatipes Karsch. One male, Huachua Mountains, Ariz., (Brooklyn). Three males and two females, Los Angeles Co., June and July. Two males and two females, Baboquivaria Mountains, Ariz., (Snow).

Orthemis ferruginea Fabricus. Male and female, Bill Williams Fork, Ariz., July and two males, Brownsville, Texas (Snow). One male, Guyaquil, Ecuador (Campos).

Pseudoleon superbus Hagen. Two males and two females, Baboquivaria Mountains, Ariz., (Snow).

Milwaukee Public Museum,
Sept. 30, 1910.

THE BROWN BAT IN WISCONSIN.

Eptesicus fuscus fuscus (Beauvois).

By Henry L. Ward.

The earliest mention of this species as an inhabitant of Wisconsin is apparently in Strong's list under the entry "*Scotophilus fuscus Palisot.* Brown Bat." ("Palisot" stands for Palisot de Beauvois, which is properly abbreviated in nomenclature to "Beauvois" or "Beauv."). His only reason given for citing this species is contained in the note prefatory to the bats which begins: "Within the confines of Wisconsin eight species of bats have been observed." None of the species listed are annotated as to locality within the state where observed, by whom, whether or not collected, nor where preserved. Unfortunately the above cited list partakes so largely of hearsay evidence and so completely fails to meet the requirements of modern zoologists that it can not be relied upon as establishing the presence of any considerable number of the mammals therein mentioned. There appears to have existed heretofore no reliable data for the inclusion of this species in a Wisconsin list and therefore we find that Jackson[2] omitted mention of it and that Hollister[3] did not include it in his Check-list proper, though in his "Hypothetical List" following it is given a place with two citations, "*Scotophilus carolinensis*" and "*S. fuscus* Strong 1883." In a note to a species previously cited from Strong's list is the statement apparently warranted and also applicable to other divisions of that list: "Strong listed all the bats known from eastern and northern states, without having local records * * * *."

That the species should belong to our fauna was to be expected, in fact it would be remarkable were it to be absent from

1) Strong, Moses, "List of the Mammals of Wisconsin," in "Geology of Wisconsin, Survey of 1873—1879," 1883, p. 438.

2) Jackson, Hartley H. T., "A Preliminary List of Wisconsin Mammals," Bull. Wis. Nat. Hist. Society, Vol. 6, Nos. 1-2, 1908.

3) Hollister, N., "A Check-List of Wisconsin Mammals," Bull. Wis. Nat. Hist. Society, Vol. 8, No. 1, 1910.

the state as its known range is, according to Miller[4], "Austral, Transition and (lower edge of) Boreal zones throughout the United States and adjoining British provinces."

In the range map (No. 66) of the species published by Seton[5] we find Wisconsin well within the area of the species as depicted but no actual records are plotted for Wisconsin or the surrounding states of Minnesota, Iowa or Michigan. In Illinois there are plotted, near the eastern and western borders of the state, what presumably are Miller's[4] records of Illinois: "Richland County, 1; Warsaw, 4."

Herrick[6] includes the species in his Minnesota list but the nearest that he comes to giving a record is the statement: "The following description will apply to a male captured early in June, and will illustrate the typical condition of the species in Minnesota."

Apparently there are no definite records for Minnesota, Wisconsin or Michigan and with the common knowledge that this bat should occur in Wisconsin it affords pleasure to show by citing seven specimens, six of them mounted and long on exhibition in the Milwaukee Public Museum, but apparently overlooked by both Jackson and Hollister, that there has been no invidious discrimination against this state.

Three specimens, two females and a male, Nos. 93, 94 and 95 of the Museum's collections were taken at the abandoned vaults of the old Falk Brewery in Milwaukee in January, 1897, by Dr. E. H. Neymann, D. Otteson and O. Boscowitz. On Jan. 18, 1898, the same gentlemen also took specimens recorded as Nos. 85 and 86, and on Feb. 6, 1898, a male, No. 84. On Dec. 18, 1907, Mr. A. N. Fairchild presented a specimen to the museum, No. 1450.

I believe that I have several times when collecting seen the species flying in various parts of northern Wisconsin, as well as about the streets of Milwaukee; but have so far failed to collect it.

Seton[5], p. 1182, writes: "In the Museum of the Geological Survey at Ottawa, is a specimen found dormant behind a window of

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4) Miller, Gerrit S., "Revision of the North American Bats of the Family Vespertilionidæ," North American Fauna No. 13, 1897.

5) Seton, Ernest Thompson, "Life Histories of Northern Animals, An Account of the Mammals of Manitoba," Scribner's Sons, 1909.

6) Herrick, C. L., "The Mammals of Minnesota," Bull. No. 17, Geol. and Nat. Hist. Survey of Minn., p. 34.

the building on Dec. 3, 1894. This is the more interesting because it is nearly the northmost record and the species is supposed to be migratory". It will be noticed that the Museum's specimens were taken at a date running from fifteen days later in December up to as late as Feb. 6, indicating that a number of this bat remain and hibernate.

ON HUMMING-BIRD FLOWERS.

By S. Graenicher.

In tropical regions birds figure to a considerable extent as visitors to a great number of flowers. Honeysuckers belonging to the families *Meliphagidæ* and *Nectariniidæ*, and humming-birds (*Trochilidæ*) furnish the best known examples in this respect. In the temperate regions of North America east of the Rocky Mountains the ruby-throated humming-bird, *Trochilus colubris* L. is the only flower-visitor among the birds.

According to numerous observations this bird has been seen at quite a number of flowers of various colors, but the evidence at hand indicates that it is in attendance on red flowers more than on those of any other color. Robertson[1] considers the following four flowers of our surroundings as being especially pollinated by the ruby-throat:

Castilleja coccinea (L.) Spreng. (Scarlet Painted Cup),
Aquilegia canadensis L. (Wild Columbine),
Impatiens biflora Walt. (Spotted Touch-me-not),
Lobelia cardinalis (L.) Juss. (Cardinal-flower).

A fifth species, *Tecoma radicans* (L.) Juss. (Trumpet-creeper), mentioned by Robertson in the same connection does not occur with us. All of these flowers are distinctly red, or possess at least a reddish hue.

Around Milwaukee the ruby-throat has been witnessed as a visitor to the following flowers: *Lonicera Sullivantii* Gray (Sullivants Honeysuckle), *L. tatarica* L. (Tartarian Honeysuckle), *L. dioica* L. (Smooth-leaved Honeysuckle), *L. oblongifolia* (Goldie) Hook. (Swamp Fly Honeysuckle), *Polygonatum biflorum* (Walt.) Ell. (Small Solomon's Seal), *P. commutatum* (R. & S.) Dietr. (Great Solomon's Seal), *Trifolium pratense* L. (Red Clover), *Impatiens biflora* Walt. (Spotted Touch-me-not), and *Lobelia cardinalis* L. (Cardinal-flower).

At Maiden Rock, Pierce Co., Wis., I have seen it at the flowers

1) Chas. Robertson, The Philosophy of Flower Seasons, Etc.; The American Naturalist, Vol. XXIX (1895), p. 113.

of the last named species; at Elkhart Lake, Sheboygan Co., Wis., at those of *Aquilegia canadensis* L. (Wild Columbine); and at Prescott, Pierce Co., Wis., at those of *Oenothera rhombipetala* Nutt. (Rhombic Evening-Primrose).

It will be noted, that in this list only three out of the four flowers of our region referred to above as humming-bird flowers are represented, while for the fourth (*Castilleja coccinea*) no such visits have been seen.

In the following a brief account of the floral characters of these species is given, and a few observations recorded:

Castilleja coccinea (L.) Spreng.—The tubular corolla is pale yellow, but the tips of the floral leaves (bracts) show a bright scarlet coloration, and this imparts to the entire inflorescence the conspicuous glowing color that renders the groups of these plants visible from a great distance. Robertson[2] makes the following statements: "The scarlet color and the absence of a landing-place suggest that the flower is adapted to humming-birds, and the ruby-throat (*Trochilus colubris* L.) is the only visitor I have observed, although bumblebees and butterflies may sometimes occur, since the tube is only about 15 mm. deep." On the prairie, about one and one-half miles east of Corliss, Racine Co., Wis., this plant grows in profusion. On the occasion of four visits to the locality during the blooming period of the scarlet painted cup, viz.: on May 29, 1906, May 19, 1907, May 11, 1910 and May 15, 1910, the bumblebee *Bombus pennsylvanicus* DeG. (female) was seen regularly on these flowers, while not a single humming-bird was in evidence. Since the length of the tongue of this bumblebee amounts to 14 mm., this insect is able to reach the nectar, which is secreted at the bottom of a tube at a depth of 15 mm. From these observations the conclusion may be reached, that in this particular locality the bumblebee *Bombus pennsylvanicus* figures as the principal pollinator of the scarlet painted cup.

Aquilegia canadensis L.—Todd[3] and Trelease[4] have recorded the visits of the humming-bird to these flowers in Iowa, and Schneck[5] has done the same for Illinois. Meehan[6] expressed the

2) Chas. Robertson, *Asclepiadaceæ* to *Scrophulariaceæ*; St. Louis Acad. Sc., Vol. V, p. 598.
3) J. E. Todd, Am. Nat., Vol. XIV (1880), p. 668.
4) W. Trelease, Am. Nat., Vol. XIV (1880), p. 731.
5) J. Schneck, Bot. Gaz., Vol. XXXII (1901), p. 305.
6) T. Meehan, Am. Nat., Vol. XV (1881), pp. 134-135.

opinion that cross-pollination can be brought about by insects only. The very conspicuous flower presents a combination of yellow and scarlet, but the latter being on the outside, and the flower in a pendulous position, scarlet is the color visible from the sides and from above. Each of the five petals is prolonged into a long straight spur, which is directed upward, and in which the nectar is contained. As indicated above, the humming-bird was seen at these flowers on one occasion only, at Elkhart Lake, Sheboygan Co., Wis.

Impatiens biflora Walt.—The ground color of the flower is orange, and this is copiously dotted with reddish-brown. There is a continuation of the broad open corolla into a short bent spur, which secretes the nectar. Judging from various reports the humming-bird seems to be a regular visitor to these flowers —wherever the two occur together; and in the vicinity of Milwaukee such visits have been witnessed by the writer on several occasions. *Impatiens pallida* Nutt. (Pale Touch-me-not), a second species of *Impatiens* of our region, has larger and paler flowers, and no visits of the humming-bird to these have been recorded so far. Robertson[7] compares the flower of *I. biflora* with that of *I. pallida*, and considers in the first named "the red color, the small landing-place, and the longer and narrower posterior sepal" favorable to the visits of humming-birds. Robertson has seen also bees and butterflies on the flowers, and at Milwaukee the following additional visitors have been observed: two bumblebees (*Bombus consimilis* Cr. and *B. separatus* Cr.), another long-tongued bee (*Clisodon terminalis* Cr.), a long-tongued syrphid-fly (*Rhingia nasica* Say), and a short-tongued bee (*Halictus albipennis* Rob.). The latter is not able to reach the nectar on account of the shortness of its tongue and was seen gathering pollen, while all of the other visitors were sucking.

Lobelia cardinalis L.—In referring to the visits of the humming-bird to these intensely red flowers Robertson[8] expresses the view that the bird is especially adapted to these. Furthermore, this author saw the humming-bird fly past the blue flowers of *Lobelia siphilitica* L. without paying any attention to them, and

7) Chas. Robertson, Flowers and Insects, III; Bot. Gaz., Vol. XIV (1889), p. 300.

8) Chas. Robertson, Flowers and Insects, VI; Bot. Gaz., Vol. XVI (1891), pp. 68-69.

visiting those of *L. cardinalis* growing close by, as also the red flowers of a hybrid of these two species of *Lobelia*. At Milwaukee, as also at Maiden Rock, Wis., I have on more than one occasion noticed this visitor at the flowers.

Giving all of these facts due consideration, there is hardly any reason to doubt that red flowers receive more attention on the part of the humming-bird than is the case with flowers otherwise colored. Of the eleven flowers which were seen by the writer to be visited at Milwaukee or at other points in Wisconsin, five are red or reddish, three yellow, two green, and one purple. Blue is not represented in any of them, and a glance at the list of flowers visited by the ruby-throat (Knuth's Handbuch der Bluetenbiologie, Vol. III, part II, pp. 364-365) shows a remarkably small percentage of blue flowers. The behavior of this bird in a locality where red and blue Lobelias were growing together (Robertson) and where preference was given to the red flowers is significant.

In looking for an explanation in this matter my attention was directed to the results obtained by C. Hess[9] in his studies on the light sense and color sense in birds of diurnal habits (chickens and pigeons). Hess has shown that these birds perceive the colors on the red side of the spectrum (the side with long light waves) to the same extent that we do, while on the side corresponding to the short waves their perception of any part of the spectrum beyond green is partly or entirely out of question. The outside world with all its colors appears to them the same as it does to the human eye when the latter sees the objects through red or yellowish-red glasses. The meaning of this is, that such birds are able to perceive red, yellow and green more or less distinctly, but green-blue, blue, and violet to a slight extent only, or not at all. Viewed in the light of these facts the greater percentage of visits to flowers, the colors of which correspond to the red side of the spectrum, and the small percentage of visits to blue or violet flowers is more easily explained.

9) C. Hess, Ueber Lichtsinn und Farbensinn der Tagvoegel: Archiv. f. Augenheilkunde, Vol. 57, No. 4 (1907).

Milwaukee Public Museum,

October 24, 1910.

NEW BIRD RECORDS FOR DELAVAN, WISCONSIN.

By N. Hollister.

During a recent visit to Delavan, Wisconsin, I had the pleasure of examining a small collection of neatly prepared bird skins made at that place during the past few years by Mr. Charles Besecker. The collection was of special interest to me because I found in it eight species not taken by myself during a long period of collecting in the same vicinity. Mr. Besecker began to form his collection about the time my active work in this region terminated. Six of these captures make new records for Walworth County and all seem worthy of publication. The eight species in question are:

Sterna caspia. Pallas. Caspian Tern.

A single adult female shot at Delavan Lake, September 19, 1904. First county record.

Phalaropus fulicarius (Linn.). Red Phalarope.

A single specimen shot by W. Holland at Delavan Lake, October 11, 1902. Sex marked female (?). First county record.

Cathartes aura septentrionalis (Wied). Turkey Vulture.

One specimen, a female, Delavan, September, 1903. Heretofore all Walworth County records have been based upon birds "seen." The species is very rare indeed in this county and this is the first capture to my knowledge.

Astur atricapillus (Wils.). American Goshawk.

A beautiful adult male from Delavan Lake, October 23, 1907. First record for the county.

Aluco pratincola (Bonap.). Barn Owl.

One male from Delavan, April, 1910. Another individual was seen by Mr. Besecker later in the season. Not before recorded from the county.

Cryptoglaux acadica (Gmel.). Acadian Owl.

One specimen, found dead near Delavan, January, 1906. Previously recorded from the county by King[1]. His specimen was also found dead, near Whitewater, December, 1877.

Sturnella neglecta Aud. Western Meadowlark.

Mr. Besecker reports this species as regularly breeding of late years. A single specimen was collected June 21, 1904. Not previously known from the county.

Euphagus cyanocephalus (Wagl.). Brewer's Blackbird.

One pair, collected June 6, 1904, and a single male shot April 14, 1910. These were killed from small flocks which were following the plow and constitute the first county records.

1) Geol. of Wis., Surv. 1873-1879, Vol. 1, p. 582, 1883.

U. S. National Museum.
November 21, 1910.

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OF THE

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RICHARD A. MUTTKOWSKI

ASSOCIATE EDITORS:
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Vol. 9 APRIL, 1911 Nos. 1-2

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OF THE

Wisconsin Natural History Society

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EDITOR: RICHARD A. MUTTKOWSKI.

Associate Editors: DR. P. H. DERNEHL, I. N. MITCHELL, HOWLAND RUSSEL, EDGAR E. TELLER.

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THE EDW. KEOGH PRESS.

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ORGANIZED MAY 6. 1857.

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MEETINGS.

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room at the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 9. APRIL, 1911. Nos. 1-2

PROCEEDINGS.

Milwaukee, October 13, 1910.

Meeting of the combined sections.

President Barth in the chair, 36 people present.

Minutes of the last section meeting read and approved.

The name of Leo Falconer, Public Museum, was presented by Mr. Burrill for active membership; Mr. Falconer was subsequently elected by the Board of Directors.

The subject for the evening was Nature Fakes: Physical and Chemical. Mr. George W. Colles gave a lecture on Perpetual Motion and Other Mechanical Fakes.

Mr. Colles began with a resume of the history of nature-faking, citing a number of instances from scripture, and illustrating by means of black-board diagrams the various contrivances with which the old pagan priests were able to astound the gullible populace. Perpetual motion was defined as "moving a body against resistance." The various types of perpetual motion machines, viz., overbalanced wheels with weights on elbow-levers, self-winding clocks, water-wheels, screw devices, self-filling chalices, compressed air chambers, inclined planes, mercury-weighted balance machines, and in modern times the various electrical contrivances, were copiously illustrated and explained by means of lantern slides and black-board diagrams.

After an announcement by President Barth that Dr. Sommer had requested that his scheduled lecture on Chemical Fakes be postponed until next month, a motion for adjournment was presented and accepted by the members.

Milwaukee, October 27, 1910.

Regular meeting of the Society.

President Barth in the chair. 28 people present.

Minutes of the last regular meeting read and approved.

The name of Mr. Frank E. Tobin, Public Museum, was presented for active membership; Mr. Tobin was subsequently elected by the Board of Directors.

Dr. S. Graenicher gave the evening's lecture on Some Biological Observations made on a Recent Museum's Collecting Expedition to the Mississippi River. Dr. Graenicher confined his observations to two topics: snakes and mollusks. Various types of snakes found in Wisconsin were correlated to the regions in which they are usually met with. Rattlesnakes, blow-adders, blue racers, and black snakes were those chiefly illustrated. A series of specimens of mollusks, all from the Mississippi basin, served the lecturer in a consideration of their distribution and their adaptation as aquatic animals to their habitat. About 18 species of mollusks and a number of lantern slides were shown in the course of the lecture.

A brief discussion followed, in which Messrs. Burrill and Colles and Dr. Graenicher participated.

Upon motion the meeting then adjourned.

Milwaukee, November 10, 1910.

Regular meeting of the Society.

President Barth in the chair. 21 people present.

Minutes of the last section meeting read and approved.

Dr. R. E. W. Sommer gave the evening's lecture on Chemical Fakes. Dr. Sommer stated that the temptation for chemical faking lays in the ignorance of the general public as to chemical elements and properties. This ignorance has at all times been preyed upon by fakers. The characteristic feature of the Greek and Roman eras is a disinclination to experiment; it is only thereby that we can account for the general acceptance of Aristotle's superficial dogmatisms, which later on gave rise to the alchemistic humbug of the middle ages. As interesting examples, Plutarch's and Livy's account of crude vinegar as a solvent of rock as supposedly used by Hannibal when crossing the Alps, and Pliny's tale of pearls dissolved in vinegar by Cleopatra, may be referred to.

Alchemy—the attempt to transform baser metals into gold—prospered under such conditions. It had its origin in Egypt, but its long period of ascendency culminates in the 12th to 14th centuries. In its later days this was coupled with many other theories: such as the four elements theory—fire, water, air, and eaerth, which also gave rise to the elixir theory—that the baser metals were nothing but diseased gold, to be transformed into pure gold by the elixir or the philosopher's stone; the latter is a mixture of astrological and cabalistic nonsense, with a reputed power of transforming mercury into gold, an absurdity seriously considered by many great men, even such as Roger Bacon, who gives a recipe for the transformation.

Yet the true period of chemical faking commences only with the fifteenth century, and the alchemistic swindle has never been wholly eradicated, but is continued to the present day.

Paracelsus, faker and scientist, originated a third period. To this man, a chemist, physician and pharmacist on the one hand, drunkard, charlatan, astrologist and alchemist on the other, modern science owes the origin of three branches, namely chemistry, medicine and pharmacy.

In the 17th century modern chemistry with Lavoissier and the law of the divisibility of matter has its inception. In its early days this was marked by the consideration of fire as a substance. In the recent years faking has assumed the form of food adulterants.

A spirited discussion followed the lecture. Methods of distinguishing adulterations, the nutritive value of adulterants, tabloid food, and the development of synthetic chemistry, were discussed by Messrs. Colles, Barth, Sommer, Russel, Whipple, and Miss Elmer.

Upon motion the meeting then adjourned.

Milwaukee, November 17, 1910.

Regular meeting of the Society.

President Barth in the chair. 51 people present.

Minutes of the last regular meeting read and approved.

Dr. S. A. Barrett gave the evening's lecture on the Menominee and Chippewa Indians of Wisconsin.

Dr. Barrett opened the lecture with a linguistic survey of the tribes of North American Indians, pointing out that the Menominee and Chippewa Indians form a part of the great Alonquin stock, which at one time covered a wide belt of temperate North America, Labrador and North Carolina, marking the eastern extent, and North Dakota and Saskatchewan, the western limits of their haunts. Though now restricted to the reservations the Indians number about the same as they did fifty years ago. Civilization has changed their mode of life and many of their customs; but they retain much of their former culture and observe many of the ceremonies practised previous to the coming of the white man.

In successive order the lecturer illustrated and explained the following phases of Menominee and Chippewa life:

STRUCTURES: In the winter the Indians live in log and frame houses. But for the summer they return to their aboriginal wigwams. The wigwam consists of a domeshaped skeleton of poles thatched on the sides with matting and above with birch or elm bark. Another structure is the medicine lodge, a long and narrow framework of saplings, covered usually with matting.

DRESS: Only on festive occasions is a change made from the white man's dress. At such times great quantities of beadwork in the form of belts, necklaces, bags and beaded skirts are donned by the men. The women wear, in addition to belts and necklaces, elaborately beaded shawls and waists ornamented with silver brooches.

CANOEMAKING: The process of building, sewing and pitching canoes was shown by slides. This is one of the most important industries of these tribes.

RICING: Wild rice forms the main vegetable food. Two methods of stripping are employed, one being to bind the young stalks and strip when ripe, the other to strip the ripe rice into the canoe bottoms without binding.

WEAVING: Two types of mats are made. The one for thatch has its rushes sewed in parallel lines, while the one for table and bed is of a different species of rush and is made by a process of wicker work. In this latter form intricate patterns are frequently employed.

GAMES: *Lacrosse:* A person who has had a vision of a certain kind sends a messenger to the men of the various communities. The messenger distributes tobacco and delivers at the same time an invitation to attend at the games. Upon the appointed day the men assemble and take the side of the locality or faction to which they logically belong. Their racquets are matched on the ground and when all is in readiness they pick them up and move to the center of the field. The ball used is small and is made of buckskin filled with hair.

The goal is a pole at one end of the field, which must be struck by the ball. The racquet used is a stick with a circular net about four inches in diameter at its end. *Moccasin:* This is a guessing contest and is played upon a mat which is placed upon the ground. At one end the two "guessers" are seated, at the other their opponents, one of whom hides four small balls under the same number of moccasins. The object of the game is to guess upon the location of the one marked ball. The guesser strikes his choice with a long stick.

TRIBAL COUNCIL: An annual gathering of the men of the tribe to consider the affairs of the reservation. This is the governing body. Long orations and deliberations are held. One of the main topics is the administration of the Neopit sawmill, the largest in Wisconsin.

MAGIC: The medicine man is still an important factor. Many of the early superstitions exist. Spirit houses and spirit stones can be found quite frequently.

DANCES: The chief of these is the dream dance which lasts several days. The dancers appear in full dance regalia and people assemble from long distances to see them.

MORTUARY CUSTOMS: The dead are interred and a low wooden house is built over the grave. Such a house is provided with a small opening through which food is given the deceased by his relatives, for his journey to the shadow world. During a full year the near relatives must observe strict customs of mourning. One of these is the making of a death bundle to which from time to time clothes, trinkets, etc., are added. After a year the near relatives are released from their mourning obligations and the contents of the bundle are divided among friends and more distant relatives.

Dr. Barrett used a large number of slides in the course of his lecture. A discussion of religious customs followed, in which Dr. Barrett, Dr. Barth and Messrs. Russel and Carpenter participated.

President Barth thanked Dr. Barrett in the name of the Society for the interesting lecture, after which a motion to adjourn was put and carried.

Milwaukee, December 8, 1910.

Meeting of the combined sections.

President Barth in the chair. 22 people present.

Minutes of the last meeting read and approved.

Dr. Barth nominated Mr. Frederick Scheiber, 3007 Cedar St.; Miss

Mary O. Allen, 719 Cass St.; and Mr. Frederick H. Emmerling, 3007 Cedar St., for active membership; the Board of Directors subsequently voted to accept the nominations.

The subject for discussion was: Mammals as Carriers of Disease.

Dr. G. J. Kaumheimer read a paper on The Transmission of Bacterial Diseases of Mammals. Distinguishing between direct transmission and transmission through a medium among humans, and transmission of animal diseases to man, Dr. Kaumheimer enumerated a long series of diseases and their carriers, as far as such are known from the most recent researches.

Dr. R. G. Washburn read a paper on Plant and Animal Parasites as Agencies in the Transmission of Disease. By means of lantern slides the speaker illustrated the methods and ravages of the Ringworm, various *Sarcoptes*, *Tænia saginata* and others of the *Cestodes* group, and *Trichina spiralis*.

Drs. Kaumheimer, Graenicher, Dernehl and Mr. Burrill discussed topics suggested by the lectures.

Mr. Ward announced the death of Dr. Whitman of the University of Chicago and moved that a committee be appointed with Dr. Peckham as chairman to draft a resolution expressing the sympathy of the members to Mrs. Whitman and conveying the compliments of the Society to the University of Chicago. Seconded and carried. President Barth appointed a committee consisting of Dr. Peckham, chairman; Mr. Ward and Dr. Graenicher, members.

Mr. Ward then presented an inquiry made to him by Dr. Wagner and Dr. Beatty, the secretary of the Wisconsin Academy of Sciences, Arts and Letters, as to the attitude of the Society toward a meeting of the Academy in Milwaukee. Dr. Graenicher moved that the Secretary inform the Acamedy that the Wisconsin Natural History Society would welcome a meeting of the Academy in Milwaukee and would co-operate as heretofore to insure the success of the meeting. Seconded and carried.

Upon motion the meeting then adjourned.

Milwaukee, December 29, 1910.

Regular meeting of the Society.

President Barth in the chair. 8 members present.

Minutes of the last meeting read and approved.

Minutes of the last meeting was informal. Mr. Henry L. Ward

The meeting was informal. Mr. Henry L. Ward exhibited some specimens of birds showing remarkable sexual coloration.

Dr. S. Graenicher spoke on the distribution of certain bees and plants.

Mr. R. A. Muttkowski spoke on the preevalence of the Tussock moth and Tomato worm in Milwaukee during the past summer.

All members present joined in the discussion of the topics.

The advisability of the Society's taking action on the appointment of a state game warden by the governor was discussed by the members, no action being taken because of the absence of a quorum.

The meeting then adjourned.

Milwaukee, January 12, 1911.

Meeting of the combined sections.

President Barth in the chair. 43 people present.

Minutes of last meeting read and approved.

Mr. Burrill presented an informal report of a committee on spring shooting. After some discussion on the part of Messrs. Burrill, Barth, Russell, Finger and Gallun, Mr. Finger moved that the committee confine its work to the opposition of spring shooting in Wisconsin. Seconded and carried.

A leaflet entitled "A Sportsman's Platform: fifteen cardinal principles affecting wild game and its pursuit," by W. T. Hornaday, was read by the secretary. Mr. Burrill moved that the Society indorse the principles as read. Seconded by Mr. Doerflinger. Carried.

The evening's symposium on Venomous Snakes and Their Poisons, was opened by Dr. S. Graenicher, who spoke on the Classification and Phylogeny of Snakes. Dr. Graenicher stated that snakes were of comparatively recent origin, remains having been found in the Eocene epoch. Their nearest relatives are the lizards; their classification is based upon the bones of the head and the presence or absence of poison fangs. The speaker accented the fact that there are no reliable means of distinguishing poisonous from harmless snakes at sight except familiarity with the species.

President Barth then announced that owing to the illness of Dr. R. E. W. Sommer, his scheduled lecture would be postponed until February.

Mr. George W. Colles read an illustrated paper on the Pit-vipers. After a brief review of the various species of poisonous snakes in

North America, Mr. Colles stated that snakes may be divided into three classees, according to food habits: (a) those eating cold-blooded animals alive (garter, water snake, etc.); (b) those killing their prey by constriction (boa constrictor) and (c) those killing by their poison (Crotalids, etc.). The speaker illustrated the methods by which the poison enters the fangs from the glands. A consideration of the virulence of the poisons followed together with the statement that it is greatly overestimated. Snake-charming and charmers and some other popular fallacies were ridiculed. The speaker took issue with Dr. Graenicher's statement as to the method of distinguishing poisonous from harmless snakes in the open and cited a number of characteristics, such as the frontal pits, the scutallar arrangement, the carinated dorsal and the single row of ventral scales and greater sluggishness as reliable and ready means for distinction and recognition of poisonous snakes.

In the following discussion Dr. Graenicher suggested that the characteritics cited by Mr. Colles could be seen only upon close examination, which Mr. Colles parried by saying that at least one or two of them were evident even at a distance.

Drs. Sherman and Graenicher and Messrs. Burrill and Colles discussed alcohol as an antidote for snake poisons: alcohol, if applied directly, coagulatess the toxin.

Mr. Mann suggested a correlation of the single row of ventral scales to the sluggishness of poisonous snakes. Messrs. Burrill, Colles and Dr. Graenicher discussed the sense of hearing in snakes.

Upon motion the meeting then adjourned.

Milwaukee, January 26, 1911.

Regular meeting of the Society.

President Barth in the chair. 21 people present.

Minutes of the last regular meeting read and approved.

A communication from W. T. Hornaday, thanking the Society for the indorsement of "Sportsman's Platform," was read by the Secretary.

The evening's talk was on "Parallelism Among Insects," by Mr. R. A. Muttkowski. In the enormous number of living forms of insects it is not surprising that we should find repitition in features of development. Similar stimuli produce similar results, as instanced in the development of jumping legs of *Acridiidæ* and *Pulicidæ*, and of raptorial fore legs in the Orthopteran *Mantis* and the Neuropteran *Mantispa.* The legs of insects show many similar structures, especially in minor features as spines and spurs. A more striking parallelism is found in the antennal features, the simpler types recurring in most insect orders. Along special lines we find remarkable homogeneity in the development of secondary sexual characters in the various orders, especially in pedal structures, blunt spines being the most frequent, though some of the structures, as in the case of Deltoid moths, are very elaborate.

Parallelism in color pattern is the commonest form of parallelism. Fundamentally all color patterns can be analyzed into similar components. The most primitive type of color pattern is found in dragonflies and may be conveniently classed as a one color type (apparent differences in color being an intensification or modification of the pigment). The most primitive expression of color pattern is a basal or apical band on the wing; a further development is the uniform coloring of the wing. The next is a basal, apical or nodal intensification on a uniform background. Always, however, the markings partake of the form of ill-defined spots or blotches; never do they become linear—hence lines and bands. Lines therefore may be assumed to indicate a higher development of pattern.

All color patterns can be reduced to lines and bands. Lines may break up into lunules or dots, bands into spots; or vice versa. Marginal, submarginal, median, and basal rarely, unless coupled with submarginal bands or lines, are the simpler forms of two-color patterns. We find that these patterns follow distinct mechanical rules, as that of bands break up into spots and lines into lunules when the costal or posterior hold is lost, this breaking up being quicker in the former case. A diagonal band wants an inferior brace and a superior fastening, both of which are provided in the striking case of *Papilio thoas.*

There is much similarity in the color patterns of the various orders, as can be shown by a simple method of approximation.. For example, if the wing of *Papilio turnus* be squared (1) according to Mayer's method, this square then depressed (2) and finally equalized (3) with the elytron of a beetle or *Orthopteron* or *Hemipteron*, we find a remarkable similarity of pattern.

A common parallelism within families is the possession of some featuring mark, such as the orbicular and reniform in Noctuid moths, the silver spots on the under sides of *Argynnidæ*, the dorsal stripes of

Odonata, the abdominal transverse stripes of bees, wasps, Syrphid flies, etc..

A final comparison of the wing movement of *Odonata*, bees and butterflies, shows remarkable parallel development. In general insects possess both vertical and horizontal wing movement; the latter being absent in the three types named, and likewise in some moths. These types fold their wings with tip to tip, not in roof fashion over their abdomen, with the under wing covered by the fore wing. As a result, the hind wing is considerably stronger, the venation is well developed and transverse supports strong; while in the other types the horizontal folding of the hind wing under the fore wing necessitates an elongate development of venation with slight transverse supports. When more specially compared, we find that bees and butterflies move all four wings simultaneously, while dragonflies move their wings alternately, the main stress being laid on the hind wings. We may therefore say, vertical wing movement increases speed of flight, while the addition of horizontal movement tends to decrease the speed.

The lecture was illustrated by about fifty colored lantern slides and diagrams.

Dr. Dernehl reported that there was now a sufficient amount in the treasury to enable the committee to secure more popular lectures for the general meetings. The matter was discussed by Messrs. Colles, Barth, Dernehl, Graenicher, Burrill and Russell.

Upon motion the meeting then adjourned.

Milwaukee, February 9, 1911.

Meeting of the combined sections.

President Barth in the chair. 21 people present.

Mr. A. C. Burrill as secretary pro tem.

Minutes of the last section meeting read and approved.

Mr. E. E. Teller read a paper on The Type Fossils From the Paleozoic Formations of Wisconsin. A full abstract of Mr. Teller's paper will be found elsewhere in this volume.

President Barth then announced that the meetings of Wisconsin Academy of Science and allied scientific societies would take place in Madison next week on the 16th and 17h. Suggestions for closer affiliation of the Academy with the local societies were invited.

Dr. R. E. W. Sommer then read a paper on Animal Poisons. Science has demonstrated that the popular view that poisons are derived chiefly from the vegetable and mineral kingdom is quite mistaken, but that on the contrary poisonous snbstances are far more common in animals than in either plants or minerals. It has been shown that the human body contains and secretes a large number of poisons, which are harmful to other individuals or even to the individual himself if injected into his blood. These organic poisons have been placed in three classes, viz., enzymes, alkaloids and toxalbumins, the latter class being the most important. Snake poisons belong to this group.

Dr. Sommer detailed the process by which antiricin and antiabrin serum are derived from plant poisons and then enunciated the fundamental law of all serums: "that an antitoxin is only specific and will neutralize only the specific toxalbumin through the injection of which it was obtained, and no other." Hence immunity from one snake poison will not insure immunity from any other poisonous snake. Snake venoms have been little studied owing to the great danger to the chemist in their study. In general, they belong to the toxalbumins, although always compounded of several substances. Their action upon blood is complimentary, some unknown substance in the latter aiding in the disintegration of the blood corpuscles. The properties of antivenins, alcohol, goldchloride and calciumhypochlorite as antidotes against snake poisons were discussed by the speaker, injection of antivenin being commended as the most potent.

An extended discussion of the paper then took place, in which Drs. Pratt, Dernehl, Sommers, and Messrs. Burrill and Colles participated.

The meeting then adjourned.

Milwaukee, February 23, 1911.

Regular meeting of the Society.

President Barth in the chair. 22 people present.

Minutes of the last regular meeting read and approved.

Dr. Graenicher presented an informal report for the committee on programs for regular meetings, saying that four professors had been engaged from the state university to lecture before the Society.

Mr. Burrill presented some papers for signatures against spring shooting.

Mr. Fred W. Werner gave the evening's lecture on Theories of Protective Coloration, with Special Reference to that of Thayer. The accepted explanation of color phenomena is: Color protection refers to resemblance of animals to their environment, while mimicry refers to the resemblance of one animal to another, the mimicked form being supposed to have some immunizing odor, taste, or defensive apparatus. Thayer's theory may be briefly called a theory of "obliterative" coloration. The lecturer showed a large number of slides in illustrating the effectiveness of dorsal and ventral shadows, of stripes, bands, and other patterns as obliterating the specimens in their proper environment.

The lecture was discussed by Messrs. Burrill, Colles, Russel, and Werner.

Upon motion the meeting then adjourned.

Milwaukee, March 9, 1911.

Meeting of the combined sections.

President Barth in the chair. 34 people present.

Minutes of the last section meeting read and approved.

Dr. Copeland reported on behalf of the committee in charge of opposition to spring shooting that a hearing of the bill would take place on Friday at which Mr. Ward and several other members of the Society would attend. He also requested all members present to write to the representatives of their district to oppose the bill.

Mr. Senn stated that considerable illegal hunting of game and fish was being done in the vicinity of Milwaukee, the proceeds being sold chiefly in Indiana.

Mr. Doerflinger suggested that it would be advisable to prove conditions to the legislative committee by demonstration; that at a recent hearing of some bills presented by the Archaelogocical Society for the preservation of Indian mounds it transpired that five members of the committee had never seen an effigy mound.

Mr. Alfred Senn then gave a talk on Trees and Tree-planting. Mr. Senn deplored the existing individualism of property owners in tree planting, stating that the bad results of indiscriminate planting, overcrowding and neglect could be seen on all streets of the city. The park idea is to preserve and build up the forests; here the asymmetry of the whole is to be preferred to the symmetry of the individual. For street planting individual conditions are to be considered, such as the ornamental qualities, the water supply, methods of planting, soil, etc. The American elm, linden, white ash, and Norway maple are best fitted for street planting, trees of not more than 18 inches circumference to be preferred. In conclusion Mr. Senn stated that the park board had established a tree nursery of 33,000 plants, from which trees would be later supplied for the streets.

Drs. Dorner, Barth, Graenicher, and Mr. Senn discussed the lecture.

Mr. Howland Russel read a paper on Mutations, relating MacDougall's experiments on *Oenothera*, and stating that the matter seemed more theoretical than practical.

Messrs. Ward, Russel and Colles discussed the distinctions between variants and mutants.

Mr. Ward cited a new mammal record for Wisconsin: the Alleghany weasel *(Putorius rixosus allegheniensis)*, specimens of which been secured from three different localities, Burlington, Prairie du Sac, and Prescott, Wis.

Upon motion the meeting then adjourned.

NOTES ON THE NATURAL HISTORY OF *AMBYSTOMA JEFFERSONIANUM, A. PUNCTATUM* AND *A. TIGRINUM.*

By Bertram G. Smith.

In the spring of 1909, while an instructor in Syracuse University, I undertook a comparison of the spawn and larval stages of *Ambystoma jeffersonianum* and *A. punctatum*, with the object of securing data for the identification of species in these stages, and possibly contributing something of value from a biological point of view. Information as to the specific characteristics would at least be of service to any one using the material for embryological or experimental purposes.

After my departure from Syracuse in the early summer of 1909 it became apparent that I would have no opportunity to study these forms again, and since the results of one season's work were necessarily fragmentary and incomplete, the idea of publishing anything on the subject was abandoned. But the recent article of Piersol ('10), dealing with precisely the same problem, studied under remarkably similar faunal conditions, suggests that taken in connection with his paper my own notes may be of some interest, since in many respects the two accounts supplement each other. I have added some observations on the habits of the adults, and a few notes on *A. tigrinum*.

HABITAT.

Ambystoma jeffersonianum was studied exclusively in "Branchipus Pond" and its immediate vicinity, about two miles south of the campus of Syracuse University. *Ambystoma punctatum* was studied in the same habitat, and several years before in various ponds about Ann Arbor, Mich. *Ambystoma tigrinum* has been observed at Ann Arbor; in the pond on the campus of Lake Forest College at Lake Forest, Ill.; and, rarely, in the pond on "Picnic Point," near Madison, Wis.

"Branchipus Pond" is, in the spring, several acres in extent. On one shore is an almost precipitous hillside, sloping gently at the bottom down to the water line. Near the pond is a shallow ditch, extending at right angles from the hillside. The ditch, and the shore of the pond nearest the hill, are favorite spawning grounds for *Ambystoma.*

Besides the two species of *Ambystoma* mentioned, the following other species of amphibia occur in the locality: *Diemyctylus viridescens, Plethodon erythronotus, Rana pipiens, Rana sylvatica, Hyla pickeringii.* In the early spring, just as the ice is melting from the pond, vast numbers of *Branchipus* sometimes make their appearance; hence the name of the pond.

The hillside mentioned is a steep talus, consisting of rock fragments mingled with vegetable mold. This affords a labyrinth of natural cavities, the ordinary terrestrial dwelling-places of the local urodeles. Here they find abundant food: earthworms, etc.

In the vicinity of Ann Arbor, *Ambystoma punctatum* and *A. tigrinum* breed in different ponds, each species occurring to the exclusion of the other. I have noted only a single bunch of eggs in exception to this rule. The cause of this phenomenon is a matter for conjecture; possibly an explanation lies in an adaptation of the structure of the larvæ (e. g., presence or absence of "balancers") to certain factors in the environment (e. g., character of the bottom, whether leaves, pebbles or mud, etc.); or the larvae of one species may devour those of the other, or monopolize the food supply.

THE SPRING MIGRATION.

The fact that *A. punctatum* winters on land and migrates to water after the opening of spring has been established by Wright ('08). The following observations on this point are in complete accord with Wright's account and point to the same phenomenon in *A. jeffersonianum.*

During the fall of 1908 Branchipus Pond was completely dried up. This was noted in the latter part of September. Since dry weather continued until very late in the fall it seems probable that cold weather overtook the *Ambystoma* before they could have made use of the pond as winter quarters, had it been their habit to do so. The fact that they appeared in considerable numbers the next spring shows that the pond was not necessary as a winter's habitat.

On March 31, 1909, the ice had melted about the edges of the pond. Thorough search was made in the exposed water, and every available cover along the shore line was overturned, but no *Ambystoma* were found. The rocks on the hillside were still frozen fast.

On April 2, the ice had just disappeared from the pond, except some very thin ice that had formed along the shore during the night. Two specimens of *A. jeffersonianum* (male and female), were found under stones at the water's edge. One female specimen of *A. punctatum* was found under a stone 100 feet from water and about 10 feet above water level; this specimen was almost rigid from cold. Only the stones on the slope at the foot of the hill, adjacent to the pond, were now thawed out; the steep hillside, which presumably formed the main winter quarters of the urodeles, was still frozen at the surface. A few days later, when this hillside thawed out, specimens of both species were found in greater numbers in all the localities mentioned, and numerous spermatophores of *A. punctatum* (Smith '07 and '10) appeared in the pond. The animals were evidently nocturnal in their activities, since, in the daytime, only one specimen of each species was ever found in the open water.

Concerning the occurrence of a spring migration in *A. tigrinum* I am in doubt. At Lake Forest specimens were found in the open water as soon as the ice had melted from the edges of the pond. The next day a trap, 60 ft. long, was constructed, consisting of a zigzag paling of burlap extending along one side of the pond; pits were dug at the apex of each angle on the landward side. Though this remained in place until late in the spring, no *Ambystoma* were caught in it. If a spring migration occured at all it must have been extremely early in the season. Hay ('91) remarks: "In Indiana this species appears to pass the winter hiding about the margins of ponds, or in some cases, away from the water, under logs and such places. I have received specimens taken under the ice, in company with *A. microstomum*, in January and February." In the vicinity of the pond on Picnic Point, near Madison, Wis., there is very little cover that would serve for

PLATE I.

AMBYSTOMA JEFFERSONIANUM.

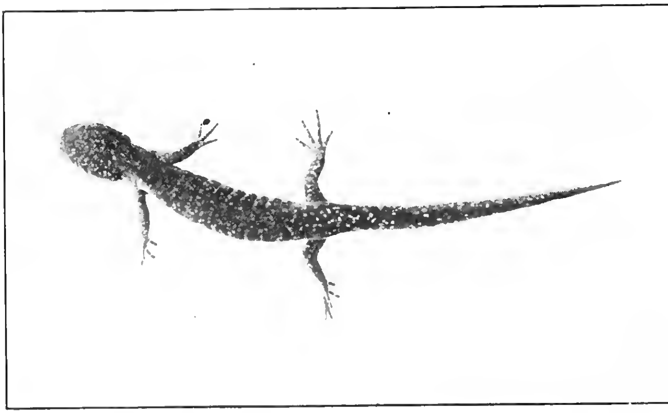

Fig. 1. Adult specimen, living, one-half natural size.

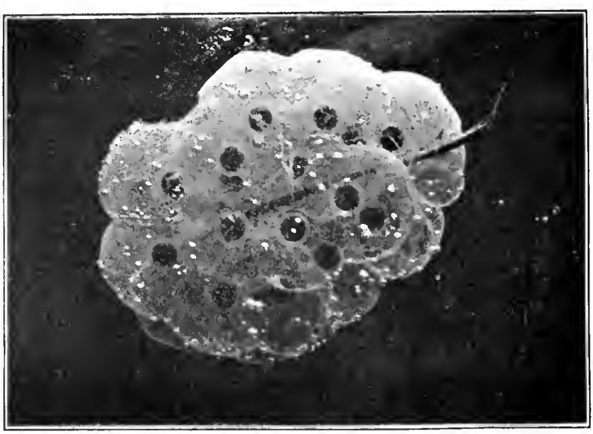

Fig. 2. Egg mass, natural size, living. The light spots are air bubbles which are normally present in the gelatinous envelopes.

protection during the winter, so well as the matted vegetation and deep mud of portions of the pond itself. It seems quite probable that, in the case of *A. tigrinum* at least, migration is an event depending somewhat upon ecological conditions.

THE SPAWNING SEASON.

As shown by the study of the two species of *Ambystoma* occurring together in Branchipus Pond, the spawning season of *A. jeffersonianum* is distinctly earlier than that of *A. punctatum.*

In 1909 the first eggs of *A. jeffersonianum* were found on April 5; the first eggs of *A. punctatum* on April 13. The precise duration of the spawning season was not determined, but no fresh eggs of either species were found after April 16.

At Ann Arbor newly-laid eggs of *A. punctatum* were found on April 1, 1905, and April 9, 1906. I have no records for first appearances of eggs of *A. tiginum* in this locality, but my general impression is that the spawning season is slightly earlier than for *A. punctatum.* At Lake Forest the first record of eggs for *A. tigrinum* in 1907 is March 19, and the last for newly-laid eggs is April 4, the spawning season having been interrupted by a week of cold weather. At Madison in 1910 the first eggs of *A. tigrinum* were found on March 26; they were in early segmentation stages.

THE ADULTS.

Ambystoma jeffersonianum (see Plate I, Fig. 1) is usually covered with small white spots, irregular in size and distribution; in some specimens these are almost entirely absent.

In its natural habitat, *A. punctatum* (see Plate II, Fig. 3) has spots of a brilliant yellow; in captivity, exposed to light, the color fades to a dull yellow; in formalin it is changed to a dull gray.

When captured in the early spring, and kept for a few days in confinement, all three species shed the cuticle, usually intact or nearly so. The most perfect specimens of entire shed cuticles were obtained in 1907 from *A. tigrinum.* Four shed cuticles were obtained from the same number of specimens in captivity, and of these three were intact, one broken into two pieces. All were turned almost completely wrong-side out. The cuticle is first loosened at the lips, and then rolled backward, aided by locomotor movements of the animal; the cuticle of the feet comes off like a glove.

In *A. jeffersonianum* and *A. punctatum* the cuticle was usually broken into two or three pieces. The process of shedding, observed when just begun, was found complete 2-3 hours later. Each specimen evidently sheds the cuticle at intervals of a few days.

When handled, individuals of both *A. jeffersonianum* and *A. punctatum* often become immovable. Two one-year-old specimens of *A. punctatum* (see Plate 2, Fig. 3), active when captured, were brought to the laboratory and placed in water in a finger-bowl at room temperature; so far as could be judged from repeated though not continuous observation, they kept the same position for 24 hours. When first handled at the expiration of this time, they were thought to be dead; after being handled for several minutes, they slowly showed signs of life and normal activity. Perhaps this was a "death feint" or hypnotic state.

By daylight, in the aquaria, *A. jeffersonianum* was more active than *A. punctatum*. When watched at night by electric light *A. punctatum* was more active, seemingly in efforts to escape.

In captivity both species will eat earthworms. *A. jeffersonianum* will eat readily even when newly captured; recently captured specimens of *A. punctatum* refused this food.

SPERMATOPHORES, AND THE TIME OF FERTILIZATION

The distribution and structure of the spermatophores of *A. punctatum* have already been adequately described (Smith '07 and '10), except for the trifling correction that the spermatophores are sometimes deposited on a vertical as well as a horizontal surface. The breeding behavior of *A. punctatum* has been described by Wright and Allen ('09).

The deposition of spermatophores by *A. punctatum* precedes egg-laying by several days. In 1909 the first spermatophores were found on April 5, the first eggs of *A. punctatum* on April 13.

In Branchipus Pond all the spermatophores studied were identified as belonging to *A. punctatum*. In ponds inhabited by *A. tigrinum* I have been unable to find spermatophores of *Ambystoma;* observations have been confined to the spring. The extremely early spawning season of *A. jeffersonianum* and *A.*

Plate II.

AMBYSTOMA PUNCTATUM.

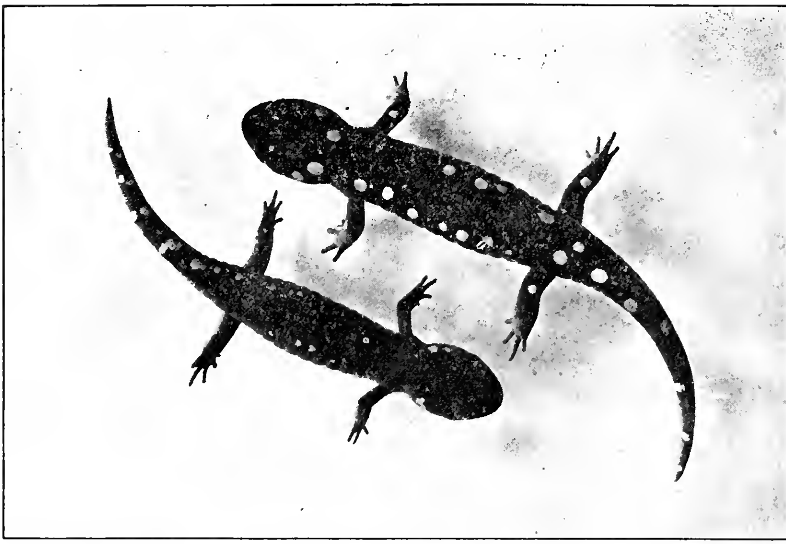

Fig. 3. One-year-old young, natural size, formalin specimens.

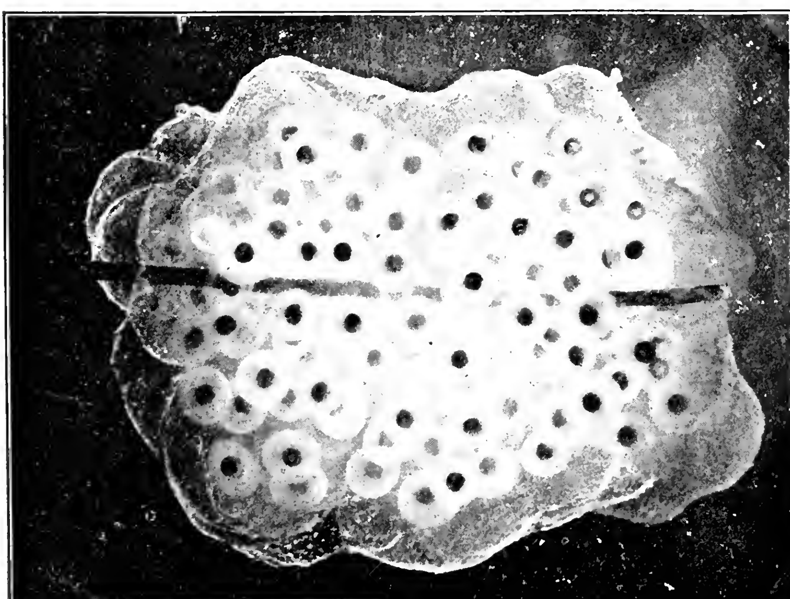

Fig. 4. **Egg mass, natural size, preserved in formalin.**

tigrinum suggests the possibility of an autumnal fertilization. In this connection it may be mentioned that the testes of an adult *A. tigrinum,* preserved Sept. 21, 1907, were very large and swollen with ripe or nearly ripe spermatozoa, while an adult of the same species, taken March 24, 1910, contained no sperm that could be obtained by stripping, and when preserved April 3, 1910, the testes were extremely small as is usual in urodeles after the breeding season. Sections showed the testes of the latter specimen to contain very few spermatozoa, and those in a state of degeneration.

THE EGGS AND THEIR ENVELOPES.

In all three species the eggs, with their individual gelatinous envelopes, are aggregated in masses by means of a common jelly envelope, which varies greatly in thickness in the different species.

I have identified the eggs of *A. punctatum* by obtaining them from a female in captivity; eggs of *A. tigrinum* through the exclusive occurrence of this species at Lake Forest; and eggs of *A. jeffersonianum* through a process of exclusion.

In twelve clusters of eggs of *A. punctatum* the average number of eggs in a cluster was found to be 56, the range 30-95. Clarke ('79) states that the masses "vary in size from a small bunch of three or four eggs to a large mass containing two hundreds eggs and weighing sixteen ounces." According to Wright and Allen ('09), the number of eggs in a complement varies from 130 to 225; these may be deposited in one to ten bunches, two or three per female being a fair average.

In 52 egg masses of *A. jeffersonianum* the average number of eggs was found to be 14, the range 1-35. Piersol ('10) states: "The typical spawn mass of *A. jeffersonianum* is a small one, the number of eggs being usually about twenty; the extremes encountered have been small masses of jelly without any eggs, and a mass containing forty-one. The complement of ripe ovarian eggs carried by two females of average size was 128 and 161."

My notes contain only two records of the number of eggs in the egg masses of *A. tigrinum*—bunches of 53 and 75 eggs respectively.

The egg masses of *A. punctatum* (see Plate II, Fig. 4) average much larger in size than those of either *jeffersonianum*

(Plate I, Fig. 2) or *tigrinum*. This greater size is due not so much to the number of eggs present—for this may be as great in *tigrinum* as in *punctatum*—as to the greater thickness of the common jelly mass. The photograph does not differentiate the common gelatinous envelope of *A. jeffersonianum,* which is extremely thin.

As a result of these differences in the thickness of the common gelatinous envelope we find decided differences in the contour of the egg masses of the three species. In *A. punctatum* the outlines of the individual egg envelopes are obliterated in the general contour; in *A. jeffersonianum* they are almost perfectly preserved, the entire cluster bearing some resemblance to a bunch of grapes. In other words, the eggs of *A. jeffersonianum* form a much *looser* cluster than those of *A. punctatum*. The egg masses of *A. tigrinum* occupy in this respect an intermediate position.

A further distinction between species is that the egg masses of *A. punctatum* possess in general a greater degree of rigidity and firmness, due perhaps to a denser consistency, perhaps to the greater bulk, of the jelly. In this respect also, *A. jeffersonianum* presents the opposite extreme, *A. tigrinum* occupies an intermediate position.

The eggs of *A. punctatum* and *A. tigrinum* are aggregated more closely, forming a more compact group, than those of *A. jeffersonianum*.

The eggs of *A. punctatum* average slightly larger than those of *A. jeffersonianum*. There seems to be greater variation in the size of the latter. The range of the diameter of the two species apparently overlaps. Accurate measurements are desirable as a basis for the comparison.

In the egg masses of *A. jeffersonianum* there is often observable an arrangement of the eggs in from two to three spirally arranged parallel rows. In *punctatum* I have found no such tendency.

The eggs of all three species are invariably attached to some object—the stems of plants, leaves, twigs, etc. In the natural environment the presence of air bubbless in the jelly mass is a normal occurrence; they are shown in the photograph of the egg mass of *A. jeffersonianum*.

HISTORY OF THE EGGS BEFORE HATCHING.

During the early stages of development the space filled with liquid surrounding the individual egg is small, but in the later stages it enlarges to keep pace with the growth of the embryo.

I have searched in vain for spermatozoa imbedded in the egg envelopes of *A. jeffersonianum* and *A. punctatum*.. Clarke ('79) says of *A. punctatum* breeding in captivity: "The eggs were found to have adhering to their outer shells a considerable number of these male elements, but I could not find, after trying a great many times, any spermatozoa within even the outer shell." So far as this evidence goes, it would seem that in the process of internal fertilization the spermatozoa ascend the oviducts and reach the eggs before the envelopes are laid down. But Kingsbury ('95, p. 290) says: "I have never seen zoosperms in the oviducts of any species sectioned by me, in almost all of which the lower portion of the oviduct was examined." In *Cryptobranchus,* in which fertilization is external, spermatozoa are always to be found imbedded in the egg capsule and floating in the fluid-filled space within.

I have found polyspermy occurring in the eggs of *A. tigrinum.* This point will be discussed in a later paper. I have not yet studied the fertilization stages of the other species.

The low vitality in the eggs of *A. jeffersonianum* reported by Piersol ('10), resulting in the loss of about three-fourths of the eggs before gastrulation, has not been evident in the material studied by me.

The approximate time record, not quite complete, for the two species, follows:

Stage.	*A. jeffersonianum.*	*A. punctatum.*
Crescentic blastopore ..	....	50 hrs. after fertilization.
Neural groove	22 hrs. after crescentic blastopore.	30 hrs.
Closing neural folds...	16 hrs.	20 hrs.
External gill rudiments	33 hrs.	....
Hatching	7—13 days.	12—22 days after closing neural folds.
Total time to hatching.	**10—16 days after crescentic blastopore.**	**16—26 days after fertilization.**

From this table it will be seen that the time required for development to hatching is greater in the case of *A. punctatum,* and that even in the early stages the development is slower. Hence the longer time in the case of *A. punctatum* is not due entirely, if at all, to the greater thickness of the gelatinous envelopes.

Embryos of *A. tigrinum* reared at Lake Forest required for hatching a period of from 18 to 20 days.

LARVAL HISTORY.

Larvae of *A. tigrinum* were reared at Ann Arbor in 1906 and at Lake Forest in 1907; *A. punctatum* was reared at Ann Arbor in 1906 and at Syracuse in 1909; *A. jeffersonianum* was reared at Syracuse in 1909. In each case the larvæ were kept in good condition for a little over a month after hatching, circumstances preventing my caring for them for a longer period. The larvae were studied in the living conditon and series preserved for future reference. The following account deals more particularly with the larvae studied at Syracuse.

An effort was made to keep the conditions for the two species, *jeffersonianum* and *punctatum*, practically alike, in order to avoid possible errors of comparison from the occurrence of modifications due to environment, such as are recorded by Powers ('07). The larvae of both species were fed at first on entomostraca—chiefly *Cyclops* and *Daphnia*.. But soon after *A. punctatum* hatched the supply of entomostracans failed almost entirely. This diet was then supplemented by scraped raw beef fed every two or three days to those larvae that would take it. In all cases the larvae took no notice of the meat unless it was moved. *A. jeffersonianum* readily ate the meat, and not satisfied with this, about eight days after hatching commenced to eat each other; the unequal rate of growth facilitated this cannibalistic practice. Ordinarily, one larva partly swallows another nearly as large as himself, digests a portion of the body, then regurgitates the rest. One larva was found swallowed, tail first, nearly to the eyes, by another less than twice his size. The result of this practice is that in time usually only one larva is left in each aquarium.

For a long time *A. punctatum* refused meat and apparently ate nothing, except perhaps the scanty supply of entomostracans. Cannibalism was not noted in *A. punctatum* during the five

PLATE III.

A. JEFFERSONIANUM. A. PUNCTATUM.

Fig. 5. Newly hatched, living. X4

Fig. 9. Newly hatched, living. X4

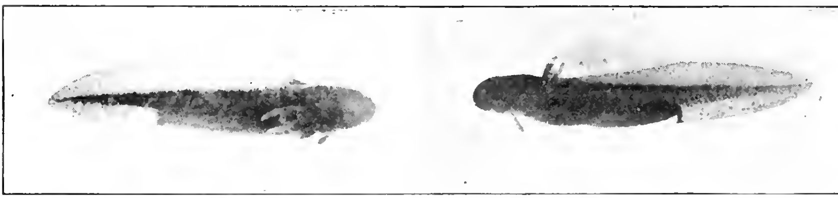

Fig. 6. Newly hatched, formalin specimen, X4.

Fig. 10. Newly hatched, living. X4.

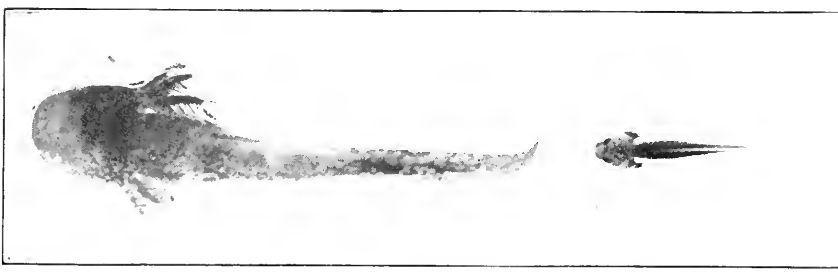

Fig. 7. Eight days after hatching, formalin, X4.

Fig. 12. One month after hatching, life size, living.

Fig. 8. One month after hatching, natural size, living.

Fig. 11. Eight days after hatching, living, X4.

weeks they were kept under observation. At the end of five weeks only the largest specimens would take meat.

A striking morphological feature common to the early larvae of both *jeffersonianum* and *punctatum*, but absent in *tigrinum*, is the presence of "balancers" at the sides of the head (see Plate III, Figs. 5, 6, 7, 9, 10, 11). These balancers are sticky at the tips, and serve to keep the larva erect while resting on a solid surface. About two weeks after hatching the balancers degenerate and disappear; by this time the broadening of the head, and growth of the anterior limb rudiments, makes them unnecessary. Hay ('91) cites Hoy ('71) to the effect that at the time of hatching the larvae of the "tiger salamander" possess short "holders," which are lost ten days later. This would seem to be a mistake in the identity of the species. The absence of balancers is a characteristic sufficient to distinguish the larvae of *tigrinum* from those of *jeffersonianum* and *punctatum*.

The most marked difference between the newly hatched larvae of *jeffersonianum* and *punctatum* is in the color pattern. Yellow and black pigment are present in both species, and in *A. jeffersonianum* there is a tendency toward the segregation of the black pigment along the sides into a row of 4-6 large black spots, shown but faintly in the photographs (see Plate III, Figs. 6 and 7). These spots vary greatly in distinctness in different specimens, but are always present in a considerable proportion of them, and since they are absent in *punctatum*, afford a convenient character for differentiating the species. The spots sometimes persist for a month after hatching.

The newly-hatched larva of *A. Jeffersonianum* is slightly stouter in body form than that of *A. punctatum*. The latter is hatched in a slightly more advanced stage of development.

A synoptic comparison of the larvae of the two species follows (see also Plate III). The body length after hatching is a character too variable for consideration in this connection.

A. CONDITION AT TIME OF HATCHING.

Characters.	*A. jeffersonianum.*	*A. punctatum.*
Length	11 mm.	12-13 mm.
Form of body.........	Stout.	More slender than in *A. jeffersonianum* and tail forms a greater proportion of the entire length of the body.
Balancers	Sometimes not well developed at the time of hatching, but elongate very rapidly and in a day or two attain their full development.	Well developed at the time of hatching.
Eyes	Sometimes covered with opaque integument, but this disappears in a day or two.	Usually functional.
Color and color pattern	Yellow and black pigment, the latter often segregated along the sides to form 4-6 large dark spots.	Both yellow and black pigment, but no marked grouping to form large spots.
Front limb rudiment...	Slightly developed.	Well developed, two digits.

B. EIGHT DAYS AFTER HATCHING.

Characters.	*A. jeffersonianum.*	*A. punctatum.*
Balancers	Present.	Present.
Color pattern	Usually spots, as described.	No spots.
Front limb rudiment...	Elongated, sometimes two digits.	With two digits.

C. SEVENTEEN DAYS AFTER HATCHING.

Characters.	*A. jeffersonianum.*	*A. punctatum.*
Balancers	Lost (about 14 days after hatching).	Lost (15-18 days).
Color pattern	Spots sometimes present.	No spots.
Front limb rudiment...	With three digits.	With four digits.
Hind limb rudiment...	Beginning, no digits.	Beginning.

D. ONE MONTH AFTER HATCHING.

Characters.	*A. jeffersonianum.*	*A. punctatum.*
Form of body.........	Usually stouter than *punctatum.*	Usually more slender than *jeffersonianum.*
Color pattern	Spots sometimes persist.	No spots.
Front limbs	Well developed.	Well developed.
Hind limb rudiments...	Much variation in size and degree of development.	Much variation as in *jeffersonianum.*

Month-old specimens taken from their natural environment are usually much further advanced than those of the same age reared in the laboratory.

I have had no opportunity to rear larvae to a greater age than five weeks, but have captured specimens from the aquatic habitats of all three species at various dates during the summer. I feel confident that, in the light of the experience gained with earlier stages, these larvae can easily be assigned to their proper species.

The late larval stages of *A. tigrinum* have been described and figured by Powers ('07), with particular attention to the variation in form due to different environments. All the larvae that I have classified as *A. tigrinum* show a characteristic tadpole-like form of body, with large broad head and rapidly tapering body. In some cases there can be no doubt as to the species, there being no other in the locality. *A. punctatum*, on the contrary, has a narrow head and long slender body, more like the adult. Some of the variations of *A. tigrinum* figured by Powers look to me almost exactly like normal specimens of *A. punctatum*. With respect to body form, *A. jeffersonianum* is intermediate between *A. tigrinum* and *A. punctatum*.

The color of *A. punctatum* larvae varies considerably with the habitat, being very dark in shaded pools containing dead leaves and much organic matter in solution; lighter in more open situations. In a larval specimen, presumably *A. punctatum*, captured August 2, 1906, a row of sharply defined small light spots occurs along the upper part of the sides of the body, very much as in the adult though situated not quite so far dorsally. In a larval specimen, presumably *A. jeffersonianum*, taken from Branchipus Pond on June 14, 1909, the row of four or five large dark spots on the sides of the body, noted in the earlier stages, was still clearly defined.

In all the late larval stages examined the external gills were in a well-developed condition, showing no signs of the degeneration accompanying the metamorphosis. Some young post-larval specimens of *A. punctatum* (see Plate II, Fig. 3), captured in April, 1909, were not much larger than the largest larvae observed in August, hence were probably one year old.

I have refrained from figuring these later stages, since their identity has not been established beyond the possibility of a doubt by rearing them from the egg.

Zoological Laboratory, University of Wisconsin.

January, 1911.

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NEW RECORDS OF WISCONSIN DRAGONFLIES (*ODONATA.*) II.

By Richard A. Muttkowski.

The following records are largely from specimens taken by the Museum Expedition of 1910 along the Mississippi river, from N. Hudson, St. Croix Co. to Fountain City, Buffalo Co., Wis.

The chiefest element of interest in the expedition was the influx of western forms, less noticeable in *Odonata* than in other orders, whose distribution is more dependent on extraneous factors. This was one of the most noticeable features of the collections.

Several extraneous records are included in this paper, chiefly for the purpose of figuring the characters of the species, hitherto not figured. It is well to note that I am obliged to Mr. E. B. Williamson for the loan of specimens to illustrate *Cœnagrion resolutum* and *Ischnura prognatha.* The remaining figured species are mentioned in the text.

AGRIONINÆ.

Agrion æquabile (Say).

In the material collected along the St. Croix river[1], a large variation in markings is perceptible. The largest of the series agree perfectly with Hagen's description of the race *hudsonica*[2], while the smallest are identical with specimens taken at Milwaukee and at points farther south.

On comparing a series from Milwaukee with a similar series from the St. Croix region, it is possible to note several differences, which, however, are probably of local origin.

The differences cited by Hagen, namely "more bulky in head, thorax and abdomen," hold good for the St. Croix specimens. Another difference, "wings more strongly tinged," also applies to the St. Croix material. It likewise applies to specimens from Washington and Chippewa counties.

1) See the Bulletin of this Society, Vol. 8, p. 54, 1910.

2) Psyche, Vol. 5, p. 247, 1889.

In checking material from Chippewa county and the St. Croix river, I note that there are some differences in coloration between these and southern forms. These differences may be summarized, as follows:

1. St. Croix and Chippewa Counties.—Males with dorsum of thorax dark metallic green, sides with coppery reflections below, abdomen dark metallic green, from base to apex. Rarely a coppery or dark blue (violet) reflection on dorsum of thorax or abdouen when viewed from above. Females all with a distinct coppery reflection on dorsum and lateral sutures of thorax.

2. Milwaukee and Washington Counties.—Males with distinct dark blue or violet reflection on dorsum of thorax and basal segments of abdomen, sides of thorax dark metallic green, not coppery at sutures. Females metallic green on thorax, but without coppery or violet lustre.

3. Northern females with apices of wings decidedly more strongly tinged with brown than Milwaukee females.

Intermediates between these two groups are found in specimens from Divide, Vilas county, and others from Cedar Lake and Oostburg, in Washington county.

If not identical with Hagen's *hudsonica* the northern specimens will at least furnish a transitional stage between the southern *apicalis* and the Lake Superior specimens from which Hagen made his diagnosis. In view of this bridging of forms it is questionable if *hudsonica* can maintain its nomenclatural status, even as a subspecies.

LESTINÆ.

Lestes rectangularis Say.

Taken at Maiden Rock, Pierce Co., Wis., July 27-Aug. 3, 1910, one male and five females; Aug. 4-10, two males and four females.

These specimens were taken in a region north of the city of Maiden Rock, on the shore of Lake Pepin, which, at the ordinary summer depth of the Mississippi, is said to be very swampy. But owing to the extraordinary drouth of the past summer the river was very low and the swamp consequently high and dry, although in places the bottoms were quite wet, as the members of the expedition found through experience. The myriads of midges abiding in the extensive fields of wild rice formed an excellent feast for the many *Lestes, Aeschna, Anax* and *Sympetrum* frequenting the swamp.

Lestes disjunctus Selys.

Maiden Rock, Pierce Co., July 27-Aug. 3, one female; Aug. 4-10, one male.

Lestes vigilax Hagen.

Golden Lake, Waukesha Co., July 7, 1910. Male and female collected by Mr. L. Falconer of the Museum.

The measurements of the specimens: Abd. male 37, female 37, hind wing male 25, female 28, are unusually large, especially for the female, which is the largest I have thus far seen recorded. The clear green of the thorax and abodmen, and yellow of the apical segments, as also the yellow or brown stigma, render this species easy of determination.

Lestes eurinus Say.

North Hudson, St. Croix Co., July 6-12, one female.

While normally the wings are infumated, this specimen is clear winged.

CŒNAGRIONINÆ.

Argia apicalis (Say).

North Hudson, St. Croix Co., July 6-12, male and female.

Argia tibialis (Rambur).

North Hudson, St. Croix Co., July 6-12, one female.

Enallagma carunculatum Morse.

North Hudson, St. Croix Co., July 6-12, seven males and ten females. Prescott, Pierce Co., July 12-19, two females. Maiden Rock, Pierce Co., July 27-Aug. 3, seventeen males and two females.

The range in size is very considerable. In most of the specimens, the black on segments three to five of the abdomen occupies a trifle more than half of each segment.

Enallagma ebrium (Hagen).

North Hudson, St. Croix Co., July 6-12, three males and one female. Prescott, Pierce Co., July 13-19, four males and six females.

Enallagma hageni (Walsh).

North Hudson, St. Croix Co., July 6-12, twenty-four males and eight females. Prescott, Pierce Co., July 13-19, five males and two females. Maiden Rock, Pierce Co., July 27-Aug. 3, three males.

Here also the range in size is considerable. In an attempt to correlate the females of *hageni* and *ebrium* with their respective males, I find distinct color differences, which may be of service in the determination of mutilated specimens.

1. The orbicular spot on segment two of the abdomen is mushroomed in *hageni;* always with a special point directed basally in *ebrium*. Rarely pointed in *hageni*.

2. The apical rings on segments three to six are rarely pointed dorsally in *hageni*, nearly always in *ebrium*. Furthermore, when viewed through a lense, *ebrium* nearly always (two partial, one entire exception among twelve males) has a very fine dorsal line leading from the dorsal point of the apical ring to the base of the segment.

3. Females of *ebrium* and *hageni* are said to be well-nigh indistinguishable. In the material before me the two species seem to be distinct. Yet the distinctions are so trifling that I doubt whether they are reliable. Besides, in the mass of material I have only three undoubted pairs of *hageni,* and but one of *ebrium*, so that the identity of the females referred to each species must be regarded as tentative.

I do not doubt that a correlation of the mesothoracic lamina of the female to the form of the superior anal appendages of the male will ultimately be discovered. Indeed, it would be surprising if such were not the case. Mr. Williamson[3] has already suggested as much. I have repeatedly tried to ascertain the exact position of the male superior appendage on the female mesothorax, but such copulating pairs as I obtained thus far, had always separated in the net before I could examine them more carefully.

Viewed from the mechanical standpoint, it would seem that the male *ebrium* used its deeply bifid superior appendage as a vise, or, at least, as a double lever which is much more effective than the simple cylindrical process of *hageni*.

4. In looking for venational differences between these two species I was greatly surprised by the approximation of *hageni* toward *Ischnura*.. For example, if we disregard the stigmal difference, *Ischnura* is distinguished from *Enallagma* chiefly by the origin of vein M_2—four cells beyond the nodus in the fore wing, three cells in the hind wing, while in *Enallagma* vein M_2 arises at five and four cells, respectively, beyond the nodus, or more.

3) Ent. News, Vol. 17, p. 144, 1906, ¶ D.

Taking 25 random males of *hageni* I find the following:

4 specimens with typical *Ischnura* venation on all wings.						
6	"	"	both hind wings *Ischnura*-form.			
7	"	"	one	"	"	" "
1	"	"	both fore wings			" "
2	"	"	one	"	"	" "

Summarizing:

All wings,	4 specimens	=	16	wings.
Both hind wings,	6 "	=	12	"
One hind wing,	7 "	=	7	"
Both fore wings,	1 "	=	2	"
One fore wing,	2 "	=	2	"

Total: 39 wings of 100 = 39%, *Ischnura*-form.

If it were not for the color and markings and the form of the appendages, some *hageni* might easily be referred to *Ischnura*, especially as the number of postnodals is a variable quantity. But if we correlate the females of *Ischnura verticalis*, for example, and those of *Enallagma hageni* with *Ischnura* venation, we find generic distinctions failing us. This dilemma is aggravated if the females be pruinose or blackened, as most *hageni* and *verticalis* females are.

The variation or approximation just noted may even exceed the 39% given, especially as the disparity of the number of *hageni* females to the males, and of *verticalis* males to females, becomes apparent when comparing the figures here listed. These are:

Enallagma hageni—males 32, females 10.

Ischnura verticalis—males 28, females 53.

Using the ratio of 39%, twenty females of *I. verticalis* would be referred to *hageni*, the result being 30 and 33 females respectively, which seems a much fairer ratio than the listed figures. It would seem, therefore, that a number of the females here listed as *I. verticalis* are really *E. hageni*, especially so in view of the unreliability of the generic character, as cited above. Thus far when collecting I have noted a slight preponderance of *Ischnura* females over the males, but no excess as the listed figures indicate. (See also *E. walkeri*, postea).

*__Enallagma geminatum__ Kellicott. (Plate IV, figs. 3, 4 and 5.)

North Hudson, St. Croix Co., July 6-12, one male.

Enallagma diragans Muttk., Bull. Wis. N. H. Soc., (2) 8, p. 55, 1910; female from St. Croix Dam, Douglas Co., July 17-22, 1910.

This species establishes a new record for the state. At first glance I took the male for *E. piscinarium* Williamson, until a subsequent more careful examination of the markings and form of the appendages proved it to be *geminatum*. The apical segment and the appendages are malformed, with the result that we have two differing forms of appendages, as figured on the accompanying plate. The coloration on the whole agrees very well with Kellicott's description, except that the lateral thoracic markings are intermediate between those given for *geminatum* and Williamson's *piscinarium*.

Enallagma walkeri n. sp. (Plate IV, figs. 1 and 2.)

Male.—Black and dull metallic green; pale markings of delicate pale green and blue.

Face pale green, labrum bluish, a narrow black line and median spot at its upper end; rhinarium and frons yellow, nasus dull metallic green. Vertex black, with obscure coppery lustre, yellow of frons extending farther back in a point at the eyes. Back of eyes yellow, but middle third of head surrounding the foramen black. Occiput with large pale spots, the posterior edge of which bear two or three denticulations.

Hind margin of prothorax generally rounded, produced medially in a small obtuse point, which is slightly depressed; in oblique view the lobe, therefore, seems indistinctly bilobed. Rear margin with a yellow stripe on each side narrowing toward the dorsum; the stripes are separated by the middle fifth of black. Prothorax otherwise black; the paratype with two small dorso-lateral spots of blue.

Thorax black, with a faint bronze lustre; antehumeral stripes and sides pale green. Antehumeral narrowed at the upper third (broken into an inverted !-spot in the paratype on the left side), the black fine line from base of fore wing to base of hind wings; at its anterior humeral correspondingly widened at the same point. Sides with a end a brief line 1 mm. in length, and somewhat lower at the middle of the first suture a small round spot. A similar, heavier line widened below on the second suture. Wing sutures pale green.

All legs yellow beneath, green at the sides with black as follows: femora above with a broad stripe, tibiæ with a latero-external narrow stripe, tarsal joints ringed and tips of claws; all spines of the legs.

Abdomen dark metallic green and pale yellow, segments 8-9 pale blue. Base of 1 with a quadrangular black spot; sides subapically with a small elongated spot, and the suture laterally with a fine black line to the sternum. A diamond-shaped spot occupies the apical half of 2; at its lateral points a long lateral stripe extends toward the base of the segment, but does not reach the suture; (this stripe is broad and connected with the dorsal spot on the right side of the paratype, slender and broken on the left side; disconnected in the holotype). 3-5 with apical half black, truncated, briefly tridentate toward the base, dorsally and laterally. A very narrow basal ring of pale green, interrupted dorsally on 6 and 7. 8-9 pale blue. Dorsum of 10, superior appendages and apices of inferior appendages black.

Superior appendages hardly one-fourth as long as 10, conical when viewed laterally. Inferior appendages longer, half as high as 10, at the upper end a short apical, rounded lobe.

Wings hyaline, stigma buff-colored. Vein M_2 arising at the fifth postnodal in the fore wings, at the third in both hind wings of the holotype. In the paratype the venation of the hind wing is normal.

Female unknown.

Abdomen male 23-24 mm., hind wing 15-16.5 mm.

Described from male holotype (cat. no. 27699) and one broken male paratype (cat. no. 27696), both in the collection of the Milwaukee Public Museum. Collected May 27, 1908, in a swampy depression in Johnson's Woods, Milwaukee, Wis.*

Ordinarily I should have placed this species with *Cœnagrion;* because of its close adherence to the description of *C. resolutum* Hagen I suspected an identity with that species until an examination of the appendages of several specimens of *resolutum* sent me by Mr. Williamson proved its distinctness. Because of the analogies of color pattern and form of appendages this species is placed in *Enallagma*, although the female is not known at present.

The species will fall close to *Enallagma carunculatum* and *durum*, but the coloration and form of appendages will easily distinguish it.

* Also 29 males collected May 26, 1911, in the same locality. Since the female lacks the sternal spine, this species must be placed in *Cœnagrion.*—May 29, 1911.

With great pleasure I dedicate this species to Dr. E. M. Walker, to whose careful and thorough labors Entomology, and especially Odonatology, owes so much .

***Enallagma signatum** (Hagen).

North Hudson, St. Croix Co., July 6-12, two males, one female. Fountain City, Buffalo Co., Aug. 11-17, one male. Golden Lake, Waukesha Co., July 7, one male.

Enallagma pollutum (Hagen).

North Hudson, St. Croix Co., July 7-12, one male.

Nehallenia irene Hagen.

North Hudson, St. Croix Co., July 6-12, one male, three females.

Amphiagrion saucium (Burmeister).

Prescott, Pierce Co., July 23, one male.

Ischnura verticalis (Say) .

North Hudson, St. Croix Co., July 6-12, twelve males, forty-four females. Prescott, Pierce Co., July 20-26, one male. Maiden Rock, July 27-Aug. 3, one male. Fountain City, Buffalo Co., Aug. 12-17, fourteen males, nine females.

There appear to be two forms of this species, a smaller one in which the abdomen measures 20-21 mm., and a larger form in which the abdomen measures 25-27 mm. Except for the size of the latter I am unable to find any differences, save that the lateral sutures of the thorax have more black. The remainder of such differences as I found are all covered by the great variation of *verticalis*. Forms having the anteumeral stripe changed in a ! spot are not at all rare. One male from North Hudson has the thorax entirely black on the dorsum. The larger forms appear to have different appendages, but the range of variation in the smaller forms is so great that it would be difficult to establish an identity on that basis.

These larger forms likewise occur at the same time and the same places as the smaller forms and are associated with them throughout their period of flight. For a time I thought that this might be a geographiccal variation of *verticalis*, as only larger forms were represented in the material taken along the St. Croix river in 1909. But I captured several specimens at North Hudson in 1910, and also found them in Milwaukee county though never so numerous as the small form. In all cases, except at the St. Croix river, they associated with the small typical form.

Mr. Wiliamson writes me that he has taken both forms at Bluffton, Ind., and that they occurred at the same time and in the same places with the others. These experiences are identical with my own observations.

GOMPHINÆ.

Gomphus fraternus (Say).

Prescott, Pierce Co., July 13-19, eight males, ten females.

Gomphus ventricosus Walsh.

Prescott, Pierce Co., July 13-19, one male.

Gomphus vastus Walsh.

Prescott, Pierce Co., July 13-19, one female.

Gomphus externus Hagen.

Prescott, Pierce Co., July 13-19, two males and three females.

All the *Gomphinæ* were taken on the sand flats in the Mississippi river below Prescott. The dams erected by the government to correct the basin of the river have caused large deposits of sand between these dams. In times of high water the dams, as well as the flats between them, are covered by the water, but in the summer drouth these flats were exposed to a great extent. They were frequented by the *Gomphinæ*, *Libellula pulchella* and *Sympetrum corruptum*, the latter two species flying around and over the stagnant pools left by the withdrawal of the river. I also saw a lonely *Perithemis tenera* male, which was too wary to permit its capture. *G. fraternus* was most common, although I rarely saw more than two or three specimens at a time. The *Gomphinæ* were very curious and would fly near me, at length settling down on the sand a short distance away, usually within ten feet. After trying at various times to sweep them in my net I found that by simply covering them with the net as they rested on the sand I could obtain better resuls.

I was rather surprised that *G. fraternus* did not hunt the vegetation of the shore line as is the case along the Milwaukee river, where I have taken it and also *quadricolor* from the flowers and in the reeds growing within ten feet of the water. *G. externus* usually hunted such resting places where the sand was sufficiently mixed with loam to permit the growth of a scanty vegetation. But *fraternus* invariably hunted the naked sands near the immediate edge of the water.

Gomphus lentulus Needham. (Plate IV, figs. 14, 15 and 16).

Needham's description[4] was made from a single, somewhat faded male. Through the courtesy of Mr. Charles Schaeffer, I was recently enabled to examine a male in the collection of the Brooklyn Institute Museum, which shows some marked differences from Needham's type. The Brooklyn male is fully matured and in good coloration, except for segments 4-9 of the abdomen which are deplorably discolored.

Following are the chief differences, or additions:

1. Ground color olivaceous green, as found in *Ophiogomphus*.

2. Prothorax with a double median spot of yellow on the dorsum, and a larger yellow spot each side, this spot probably a continuation of the yellow area of the anterior legs.

3. Thorax olivaceous green, sides more distinctly green in the region beneath the wing bases; no indication of dorsal stripes beside the carina, except in very strong light, in which case a very delicate and fine line seems faintly penciled on each side.

4. Antehumeral of brown present and of usual type, 1 mm. wide. Humeral suture with a brown line, .5 mm. wide, reaching from the base of fore wing to anterior coxa.

5. Antecubitals of fore wings: left 13, right 12; of hind wings: left 9, right 9. Postcubitals 8-9 on all wings.

6. The anal segments seem capable of considerable distension, as segment 8 is 4 mm. high and 2.5 mm. wide, whereas 6 is only 1.7 mm. high and wide.

7. Length 54 mm., abdomen 39.5 mm., hind wing 31 mm., which in each case exceeds the measurements given by Needham.

The appendages agree very well with Needham's description. A single male in the Brooklyn Museum, locality unknown.

Gomphus cavillaris Needham. (Plate IV. figs.. 10, 11, 12 and 13).

Turkey Lake, Florida, March 28, 1908, male and female.

A figure of the appendages and genitalia of the male is here given. The vulvar scale of the female is slightly overdrawn, as its true length is hardly one-tenth of segment nine.

ÆSCHNINÆ.

Aeschna canadensis Walker.

Prescott, Pierce Co., July 13-19, one female.

Caught in the woods above the Pine Coulee where the expedition camped.

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4) Can. Ent., Vol. 34, p. 275, 1902.

*Aeschna interrupta** Walker.

North Hudson, St. Croix Co., July 6-12, one female.

This was taken at the bluffs of Lower St. Croix lake, where I watched it playing for some time with *Epicordulia princeps.*

***Aeschna lineata** Walker.

Maiden Rock, Pierce Co., Aug. 4-11, one male. Hastings, Minn., July 12, one female.

The male was taken in the wild rice in the bottoms left by Lake Pepin, where it associated with *Anax junius* and *Aeschna constricta.* The female I found in the depot at Hastings, Minn., while en route to Prescott. It was lying on the floor, totally spent but still alive. It was fortunate that the specimen had escaped being mashed by the feet of the various people crowding the station.

Aeschna constricta Say.

Maiden Rock, Pierce Co., July 27-Aug. 4, one male.

CORDULIINÆ.

Epicordulia princeps (Hagen).

North Hudson, St. Croix Co., July 6-12, nine males.

Though this species was extremely wary, I succeeded in obtaining nine males. I looked in vain for females. Such males that I caught were betrayed by their curiosity. They would fly very close and, notwithstanding my repeated attempts to get them into the net, return after circling over a short patrol of about 75 feet length. This flight back and forth was kept up by them for an appreciable length of time, after which they would dodge over the bluff with a speed that I was unable to follow with the eye. I did not see any of them enter the woods nearby; all stayed in the open strip along the bluff, refusing to interrupt their play and preying even while I disturbed them. In this they acted differently from *Leucorrhinia glacialis,* which frequented the same locality and would dodge into the woods upon my approach, to be lost in the shadows.

Although I watched them carefully, I did not see whether they rested. Only on the 11th day of July, when we collected on the shores of the Willow river pond, did I observe them resting on the tips of the various *Potamogeton* (pondweed) which were just then appearing above the water surface. They were in less numbers there than at the bluffs of Lower St. Croix lake. Where I saw them they usually flew over the water or along the banks near the trees at places conspicuous through the absence of shore vegetation. Over the water they played with *Libellula pulchella* and *luctuosa*, at the shore they flew alone..

This species, although not seen in large number at any time, is probably very common in that locality. I have a note of having seen two crushed specimens on the day of arrival at Hudson and several more in the course of the week. The strangest is the apparent dearth of females.

***Tetragoneuria canis** MacLachlan.

The correction published on page 169, Vol. 6 of this Bulletin was based on a misdetermination. The male in question is not *spinosa*, but clearly *canis*. At the time I was not familiar with the form of appendages of *canis*, which species I did not expect here, and therefore inferred its identity. *T. spinosa* should now be struck from the state list and *canis* entered in its place.

LIBELLULINÆ.

***Sympetrum semicinctum** (Say).

Chippewa Falls, Chippewa Co., Aug. 21, 1900, three males.

A new state record.

***Sympetrum costiferum** (Hagen).

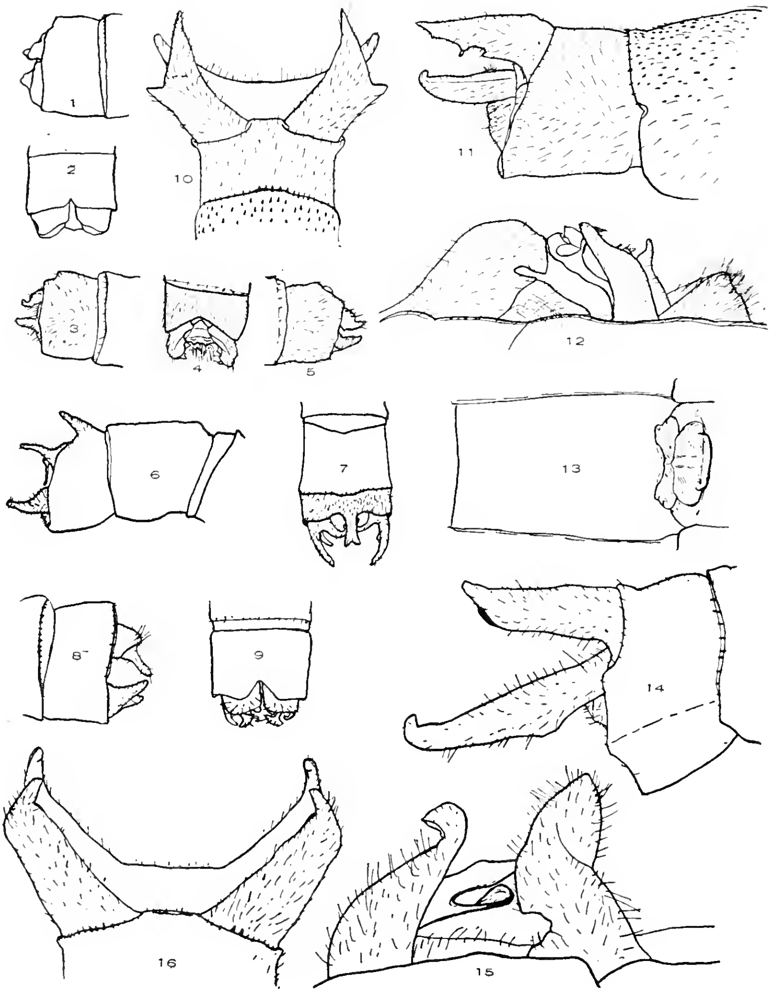
Sympetrum sp. Muttkowski, Bull. Wis. N. H. Soc., (2) 6, p. 167; (2) 8, p. 58.

North Hudson, St. Croix Co., July 6-12, one female. Maiden Rock, Pierce Co., July 27-Aug. 4, one male.

With three males and one female of this form at hand I cannot doubt their identity any longer, though the species remains an interesting local variation. The unusual number of denticles on the superior appendage of the male is the only feature distinguishing the Wisconsin forms from eastern specimens. In the three males thus far captured this number is constant in the main, four appendages having nine denticles, one appendage with eight and the sixth with ten denticles on the inferior surface. Coloration and genitalia render its identity with *costiferum* certain.

Leucorrhinia hudsonica (Selys).

A female from Milwaukee county was collected by one of the members of the Museum staff. This is a typical case of the in-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trusion of a boreal element into the generally Austral region about Milwaukee, and offers an interesting parallel to the frequent occurrence of boreal *Hymenoptera, Diptera and Lepidoptera* in this region.

Milwaukee Public Museum.

January 13, 1911.

EXPLANATION OF PLATE IV.

All figures are drawn with the camera lucida.

Figs. 1 and 2, *Enallagma walkeri* n. sp. Fig. 1 showing lateral view, fig. 2 showing dorsal view.

Figs. 3, 4 and 5, *Enallagma geminatum* Kellicott. Fig. 3 showing male appendages viewed from the right, fig. 5 from the left, fig. 4, dorsal view.

Figs. 6 and 7, *Ischnura prognatha* Hagen. Fig. 6 lateral view, fig. 7 dorsal view.

Figs. 8 and 9, *Cœnagrion resolutum* Hagen. Fig. 8 lateral view of male appendages, fig. 9 dorsal view.

Figs. 10, 11, 12 and 13, *Gomphus cavillaris* Needham. Fig. 10 showing dorsal view of male appendages, fig. 11 lateral view, fig. 12 the male genitalia, fig. 13 the female vulvar scale.

Figs. 14, 15 and 16, *Gomphus lentulus* Needham. Figs. 14 and 16 showing dorsal and lateral view of anal appendages, fig. 15 the genitalia.

A TREMATODE PARASITE OF THE ENGLISH SPARROW IN THE UNITED STATES.

By Leon J. Cole.

UNIVERSITY OF WISCONSIN.

In early June, 1910, young sparrows (*Passer domesticus*) were abundant about the barns and poultry plant of the College of Agriculture of the University of Wisconsin, and it was observed that occasionally certain individuals in the flocks appeared reluctant to take flight, and when they did so their flight was heavy, as if the birds were in some way weighted down. Such individuals frequently lagged somewhat behind the others, and it was often with difficulty that they managed to alight even so high as the top of a fence. On closer approach it was observed that these birds were hampered by some sort of growth or tumor in the region of the anus, of such size that it was often plainly discernible at a distance of several feet.

Specimens of these sparrows were finally secured, when it was seen that what had appeared to be a single tumor, was in reality made up of a number of aggregated vesicles or cysts, the largest of which were about 5 mm. in diameter. Upon opening these vesicles, they were found each to contain two, or sometimes more, broadly ovate trematode worms, which were provisionally identified as *Monostoma faba* Bremser.[1] Figures 1 and 2 show ventral views of two infected sparrows. It will be noted that in Figure 1 the vesicles form a grape-like cluster on the lower abdomen;[2] in Figure 2 there is a similar bunch in the same relative position, but in addition this bird has a rosette-like cluster of five cysts just below the sternum. The photographs also show on

1) Professor H. B. Ward of the University of Illinois kindly agreed to examine this parasite, and accordingly specimens were submitted to him. In return he writes: "I think you have the form indicated, but it would be hazardous to make a positive statement without giving more time to the study of the structure than is possible for me at the present moment."

2) Some of the feathers have been plucked away on both these birds in order that they might not obstruct the view of the cysts.

PLATE V.

Fig. 1.

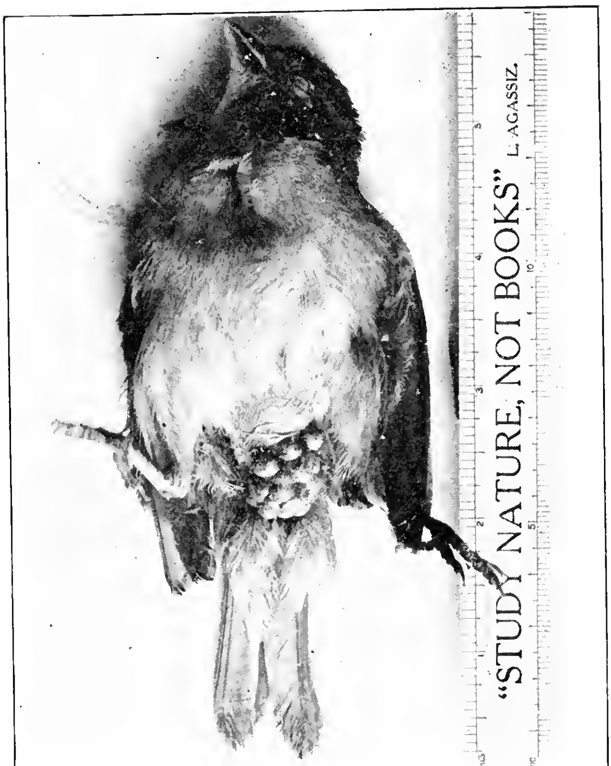

Fig. 2.

many of the cysts an interesting structure which was common to all of them, namely, a small black spot, which is in reality a minute opening communicating with the interior of the cyst. That this was in reality such an opening was made evident in the case of one specimen which was laid in the ice box over night. When this specimen was examined the folowing morning a small quantity of a dark, almost black fluid was observed oozing from these pores on many of the cysts. Under the microscope this was plainly revealed to be a rather scanty serous fluid crammed with the dark brown eggs of the parasite.

Monostama faba has been known in Europe for more than three-quarters of a century, but has been reported only at irregular intervals, and apparently has never been found with much frequency. It was first described and figured by Bremser (**1831**) in the *Tabulæ anatomiam cutozoorum illustrantes* of Schmalz from specimens found in the skin of a titmouse *(Parus major)* by S. Th. v. Sömmerring, while later Bremser obtained it from one of the Old World warblers *(Ficedula (Sylvia) sibiliatrix Bechst.)*. He apparently described it also, in the same volume, as *Monostoma geminum*, from the wag-tail *(Motacilla boarula* L.).[3] A few years later Miescher (**1838**) reported the species as "tolerably frequent" on the domestic sparrow *(Passer domesticus* L.) at Basel.[4] At about the same time Creplin (**1839**) reported it from Germany on another of the *Sylviidæ*. These two authors did much toward clearing up the understanding of the anatomy of the parasite, especially of the digestive and excretory systems, but mistook the yolk glands for the ovaries and were in disagreement as to the male reproductive organs. From this time little was added to the knowledge of this form till Willemoes-Suhm (**1873**), more than 30 years later, obtained it on the wheat-ear *(Saxicola œnanthe)* in Germany. This writer gives the first hint, so far as I can find, of the possible life cycle of *Monstoma faba*. He confirms the earlier observations, that the parasites usually occur two together in the cysts, with their ventral sides opposed, and states that the small pore through the cyst wall

3) *Teste* Creplin (**1839**). I have not had access to the original descriptions in Schmalz.

4) Dr. S. Graenicher of the Milwaukee Public Museum informs me that at Basel, in 1885 (nearly 50 years after Miescher's observations), his attention was called to the frequency of what was apparently this same parasite on the sparrows of that city.

serves for the extrusion of the eggs and excretory products. He furthermore suggests that the eggs may then be eaten by the feather lice *(Mallophaga)* which infest all birds, or by some of the insects which live parasitically in the birds' nests, and that it is among these that the intermediate host should be sought. So far as I am able to learn, nothing more definite than this pertaining to the life history of this organism occurs in the literature.

If the life history of the species involves only the possible intermediate hosts mentioned above, the parasite going directly from its primary host to the intermediate and back again, it would seem that its life cycle were fairly safeguarded, and that the species should be more common. Willemoes-Suhm (1873, p. 335) recognized this fact and remarked on the infrequent and sporadic appearance of the adult parasite. His specimens, as stated above, were obtained on a wheatear, which he procured in the bird market of Genoa, and although this dealer handled and examined daily a large number of small birds, in no other case was the parasite found. A taxidermist in Munich, whom Willemoes-Suhm interested in the matter, examined many birds during three years with no better success.

Railliet (1898) gives a list of ten passerine birds from which the species has been recorded, all of them of small size. The list includes representatives of the families *Fringillidæ* (including the canary), *Turidæ, Sylviidæ, Motacillidæ, Paridæ* and *Sturnidæ* (the starling). To these he adds an eleventh,[5] a jay *(Garrulus glandularis* Vieill.) belonging to the *Corvidæ*. Including his record, the parasite was then known from Austria, Switzerland, Germany, Italy and France. It has apparently not, previously to the present, been reported from the United States,[6] and its

5) Braun (1893, p. 877) gives *Monostoma faba* as occurring on 13 species of birds and when synonyms are eliminated it leaves about the same number cited by Stiles and Hassall (**1908**).

6) Stiles and Hassell (**1908**, p. 312) include in their list of the hosts of *Monostoma faba* the bluejay (*Cyanocitta cristata*), which is a strictly American bird. Since, however, they have not included the French jay (*Garrulus glandularis*) reported by Raillet, it is possible that this is a slip.

[Since the foregoing was written, I have learned that Dr. Hassell found *Monostoma faba* on a specimen of *Cyanocitta cristata* collected in Maryland in 1908. The record was published nowhere except in Stiles and Hassell (**1908**) as mentioned above.

Through the kindness of Dr. B. H. Ransom, Chief of the Zoological Division of the U. S. Bureau of Animal Industry, I am, furthermore, able to report that the Bureau has a hitherto unpublished record of *Monostoma faba* on an English Sparrow sent in from Ripon, Wisconsin, by Prof. C. S. Millliken, in August, 1907.—L. J. C.]

appearance at this time at a point so far inland, presents certain interesting questions. If the parasite came to this country with the English sparrow, why has it not been observed before this, and why did it not appear first in the New England states or at least along the Atlantic seaboard?[7]
and it is not likely to have been introduced by the starlings since it has not been reported on them in this country, and, moreover, this species is still confined to a small territory along the Atlantic coast. The possibility remains, of course, that it may have been introduced on canaries and so have infected the sparrows in this locality.

Such data as were accumulated on the prevalence and effects of the epidemic of last June may not be without some value. For the observations on which the accompanying table is based, I am indebted to Prof. J. G. Halpin of the Poultry Department, who, at my request, examined such sparrows as came into his hands. It will be noted that in all 64 young sparrows were examined during the period between June 15 and July 24, and that of these 20, or a little more than 31 per cent., harbored the parasite. All of these except eleven were old enough to fly; of the eleven young taken from nests four were already parasitized. In no case examined were the parasites present on adult birds. Furthermore as the table shows, all young examined after July 14 were also free from infection, although young birds were present about the poultry yards even in August and occasional ones, not represented in the table, after July 24, were examined.

There have probably been no recent importations of sparrows,

7) Prof. Ward (*in litt.*) mentions a newspaper account of a sparrow epidemic in the East which was apparently similar to the one here reported, but he had no definite reference to the same.

Table of sparrows examined for *Monostoma* by Professor Halpin, June 15 to July 24, 1910:

Date	Number Examined	Age	Number Parasitized	Severity of Infection
June 15	3	young	2	moderate
" 18	4	"*	2	slight
			1	severe
" 18	3	"	2	"
" 20	2	"	0	
" 24	5	"	2	slight
" 30	1	"	1	severe
July 2	4	"	2	"
" 4	2	"	0	
" 6	6	"	1	slight
" 7	2	adult	0	
" 7	7	young*	1	
" 8	3	"	1	severe
" 10	9	"	0	
" 10	1	adult male	0	
" 12	3	young	3	moderate
" 14	6	"	2	"
" 17	2	adult	0	
" 18	1	young	0	
" 20	3	"	0	
" 24	2	"	0	
Total	64	young	20	
	5	adult	0	

It is interesting in this relation to consider the weather conditions during the season in question. In general it may be said that there was a protracted dry period, virtually a drought, from the second week in June until the middle of August. The following more definite statement regarding the rainfall has kindly been furnished me by Mr. E. R. Miller of the local Weather Bureau

* Taken from nest; too young to fly.

office: There was a rainy spell from May 15 to May 23, and a smaller one June 2-6; the conditions thereafter were generally dry, with light falls of rain on the 18th, 26th and 27th. July was also predominatingly dry, with light rains on the 11th, 12th, 14th, 17th and 24th. Thereafter there was no rain to speak of till a wet spell of a week or so which began August 13. From the above it will be observed that the cessation of the finding of the parasite, on June 14, followed very closely the beginning of the dry period, on June 7. From this it might be inferred that the accession of the parasite to its final host is in some way dependent on moist conditions, and that conditions of dryness cause a break in the life cycle. Those sparrows found parasitized after June 7 might very well have received their infection prior to that date.

As regards the seriousness of the infection to the sparrow host, some evidence has accumulated suggesting that it may in certain cases, at least, prove fatal. During the period of the epidemic of infection several sparrows were found dead near the barns and poultry yards, and the majority of these showed severe *Monostoma* infection. This is, of course, only presumptive proof that death was due to the parasite, but as such it is fairly strong.

Finally, the points which have been learned from the epidemic under discussion may be summed up as follows:

1. Only young sparrows were affected; in no case were the parasites found on the adults.

2. Young sparrows were infected even before leaving the nest. This would seem to lend some support to the suggestion of Willemoes-Suhm (1873) that some one of the sparrow's insect parasites may serve as the intermediate host.

3. Infected sparrows were found only during and for a short time subsequent to wet weather; the epidemic apparently ended with the advent of dry conditions. It is difficult to see why the parasite should be influenced in this way if its life cycle is so simple as suggested in the paragraph above.

4. The sparrows may still fly about and feed, even when severely infected with the parasites, but they are hampered in their flight, and probably in some proportion of cases, at least, a fatal result ensues.

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INCIDENTAL OBSERVATIONS ON A QUEEN OF *POLISTES PALLIPES* LEPELLETIER DE SAINT FARGEAU WHILE FOUNDING A COLONY, INCLUDING FRAGMENTARY BIOLOGICAL NOTES.

By A. A. Girault.

Observations such as the following are not of much value because of their fragmentary nature; nevertheless, they may serve to confirm others made previously and, doubtless, will add one or two facts that are both novel and useful. If this is so, they are placed on record without hesitation. These notes will be of most importance from the biological standpoint. They record the following important facts: (1). Duration of the egg, larval and pupal stages. (2). Disappearance of the queen before emergence of any workers, spoils the colony. (3). Activity of the mother wasp up to the time of the appearance of the first workers. (4). The larvæ of the first workers, at least, cap their own cells and emerge from them without assistance.

The observations were made quite incidentally while stationed in the field at Centralia, Illinois. The field station consisted of an ordinary one-story frame cottage situated in the rear of a farm and it was on this building that the queens of *pallipes* established their nests. Four of them were built on various parts of the cottage and one other—a fifth—was easily accessible, situated as it was on the under ledge of a low window of an adjoining outhouse. One of the first four nests was in direct view from the interior of the building and it is upon this nest that the observations were made, the others serving as controls. The nest was hanging mouth down from the upper side of the principal doorway (west side), its attachment consisting of a flat flange or pad adhering to the door sill and a short perpendicular petiole leading from it and opening into the first cell. The pad and petiole were of the same substance as the cells.

The observations were commenced on the 17 of May, the nest being well established; the queen was then watched daily until the first workers appeared. On this date, all five nests were approximately in the same stage of construction, consisting of ten completed cells, each cell containing a single egg. They varied, however, in general appearance, in shape and relative size, and in situation, being from three to twenty feet up from the ground but all were hanging downward and all were under cover, under the eaves or in the doorway, so as to be more or less protected from the weather. The observations follow as recorded from May 20, 1909:

May 20, 1909:—The female remained on top of the small nest throughout the previous night, up until 10:30 a. m. today when she left, not returning until afternoon; she was present again at 1:20 p. m., but so far as could be told, she had not altered anything about the nest nor did she appear to be engaged in any particular operations. She left again at 1:44 p. m., returning at 2:10 p. m., apparently carrying nothing and she made three more similar trips away during the afternoon. The rest of the time she remained at rest on top of the nest. Day cloudy and cool until 11 a. m., then fair and warmer. The female remained on the nest during the night.

May 21:—Observing from 6 a. m., she remained on the nest until 5:30 p. m., and from then throughout the coming night; at 5:35 p. m. she made a careful examination of the nest, for this purpose inserting her head entirely within some of the cells, feeling upward with the extended antennæ. During most of the day she was at rest in her usual position on top of the nest beside the petiole. Fair and cool, gradually clearing after 3 p. m.

May 22:—The queen left the nest the first time today at 10:45 a. m. and made occasional trips away during the entire day. Beginning a new cell. Fair and slightly warmer.

May 23:—At 10:47 a. m. today she left for the first time, after carefully examining each of the cells. By 5 p. m. the new (11th) cell was about five-sixths completed, that is, about five-sixths the present size of the others, and an egg had been deposited about a third the distance down from its apex in the usual position, that is, in the crease or angle between two sides of the cell. The queen did not leave after 5 p. m. and so far its working day has been between the hours of about 11 a. m. and 4:30 p. m., or about five and one-half hours.

The new cell is now about 6 mm. deep by about 5 mm. wide across its open mouth and is bellshaped. The newly deposited egg is attached to one side of the cell's interior in an angle as mentioned, and is fastened by the anterior end, which tapers somewhat. It is creamy white, 2.1 mm. long, ovate, the cephalic end slenderer, 1 mm. in greatest width, hence twice as long as wide, its surface to the eye smooth and opaque, but in reality (⅔-inch objective, 1-inch optic, Bausch and Lomb) it is uniformly roughened like the surface of leather. The attachment at the cephalic end is formed by a short membranous petiole; cephalic end translucent; micropyle inconspicuous; chorion yielding, egg easily crushed, plump. Day fair, slightly warmer.

May 24:—The queen wasp did not leave her nest at all today: at rest in her usual position. Day cloudy; dropping rain at 7 a. m., becoming steady and harder at 9 a. m. and so through the day.

At 10:20 a. m. in the rain, a nest of one of the four other queens, mentioned previously, was taken after capturing the queen and liberating her in one of the empty, unused rooms of the cottage with another nestless queen (captured in a room at 4 p. m., May 22; captured in the attic of a farm house). The two wasps were supplied with water and a partly decayed banana for food.* The nest taken was the one fastened to the lower ledge of a window of an outhouse, three feet up from the ground; it was in the same stage of construction as the one under direct observation. Hence, it was of nearly the same general size and shape, the differences between them not easily observable, but many of a detailed character. The nest contained eleven cells, the eleventh about three-fourths completed (in relation to the average size of the others); all cells contained a single egg. The nest measured three-quarters of an inch long (seven-sixteenths inch being the distance from base or attachment to petiole to apex of central cell) and one-half inch wide, the petiole itself three-sixteenths of an inch long. The individual cells varied in depth from the center outward, the three central cells (leading down directly

* The nestless queen disappeared. The other fed sometimes on the banana and was once observed resting on her old nest, but she never showed any signs of adopting it, probably because ants very soon carried off the eggs within the cells and also the food droplets. She was not further observed.

from the petiole, being without doubt the oldest or first three) measuring 11 mm. in length, the last (11th) but 4 mm.; the cells also varied in shape, the two central interior cells being hexagonal, each side forming within the cell an obtuse angle with the others, while the eight exterior cells, which have at least one side free, are either quadrilateral or pentagonal; but the last (11th) cell has the outline of its mouth semicircular or rather U-shaped, the remaining side being straight.

The egg in each cell was deposited in all cases at the crease or angle between two of the sides of the cell, and on its side, hence perpendicular to the horizon. The side of the cell upon which it was deposited varied somewhat but none were deposited on those sides away from the center of the nest, but in all of these cases the egg had been fastened on that side of each cell that was nearest to an imaginary center of the nest; also each cell—excepting the smallest and last and one of the deepest and oldest—contained a single drop (or several) of a clear honey-yellow, mucilaginous substance, resembling clear gum, but which was thin in consistency and had a sweet taste like the nectar of honeysuckle. This substance adhered to a side of the cell, appearing like a drop of water on a horizontal surface, did not run and was situated in these cases always on that side of any cell which was opposite to the egg; the droplets varied in size from 1.20 to 2.25 mm. diameter, were round in outline from above and convex. They were also usually placed in the crease between two sides of a cell and in relation to the egg were either above or below it, the majority in these cases being below the egg (natural position of nest). Three of the cells of this nest contained two of these droplets each, both side by side. No eggs had hatched; their relative distance from the apex of each cell also varies. At 9 a. m., May 25, the nest was placed in the room with the two females and pinned to the wall in its usual position.

The nest under direct observation does now also contain the food droplets not noticed previously, though not as many cells contain them as with the other nest. They have been recently added.

May 25:—The queen remained on top of the nest all of the morning; in the afternoon she made several trips away, starting another (twelfth) cell against the eleventh; she returned for the night at 5:30 p. m. Raining until 9 a. m.; fair to cloudy and warmer by 9:40 a. m. and so through the day.

May 26:—The female left the nest for the first trip abroad at 9:15 a. m. and by 11:30 a. m. had "half" constructed the twelfth cell: at noon, an egg was deposited into it, in that crease of its sides nearest to the nest center. The twelfth cell was merely formed by arching against the eleventh one, and like it with the built side U-shaped. Day clear and warm to fair; thunder shower 1:30 to 2:30 p. m., then cloudy.

May 27:—The twelfth cell was "completed" today, the queen being active during all of the warmer portions of the day. Clear and warm.

May 28:—The queen was active throughout today, patching the nest in various places. No eggs have as yet hatched. Clear and warm.

May 29:—Again active; by 4 p. m. had completed a thirteenth cell, adjoining and against the twelfth, but the egg was not deposited into it today. Clear and warm.

May 30:—The nest was left for the first time today at 10:30 a. m., but the female was present the entire afternoon, during which time she occasionally visited each of the cells for examination. Cloudy early a. m.; severe thunder showers up to 6 a. m., windy; fair to cloudy after 11 a. m. Moderate

May 31:—Between 7 and 8 a. m. the queen spent the entire hour in making a careful examination of each cell, putting her antennæ, head and fore legs entirely within the cell for this purpose, sensing with the former. With her head within a cell she nevertheless remained alert and was visibly disturbed if anyone passed under the nest, darting then quickly backwards out of the cell and facing about, suddenly assuming a defensive attitude, the antennæ waving, and usually one of the fore legs upraised, its tarsus in rapid, intermittent, nervous, up-and-down motion. Such actions, not previously noticed, were given significance when it was discovered that the eggs in three of the oldest, hence central, cells had hatched, all very recently. These eggs have been under observation for nearly two weeks, since May 17; as there were on that date ten cells, taking at least eight days to construct, the duration of the period of embryonic development in these three cases must have averaged about twenty-two days, or even longer. A fourth egg in a cell adjoining the other three hatched about noon today. The remaining eggs have not changed. No food droplets are now to be observed in any of the cells and the thirteenth cell has not as yet received an egg.

During the whole day up to 4 p. m., the queen remained on the nest, seemingly very solicitous about her young, as inferred from her actions. At 4:30 p. m., she was observed making a careful examination of the fastening and the petiole of the nest, gently biting with her mandibles the petiole from all sides, as well as sensing it with the antennae and apparently adding some saliva to it as a kind of varnish, though this could not be ascertained with certainty. Her actions, during this examination, indicated anxiety. The sun appearing at 5:30 p. m., she made the only trip abroad, not having returned up to 6 p. m. Day cloudy, cool, threatening; slight shower at 8:30 a. m. and a hard one between 11 a. m. and 12:20 p. m., then fair, clearing at 5 p. m.

June 1:—Up to 6:30 a. m., the female remained at rest on top of the nest; at 6:50 a. m., she became active and made a careful examination of the whole nest for ten consecutive minutes, then returning to her former station on top. At 7:55 a. m., she made her first trip abroad, the earliest trip so far recorded. She returned at 8:57 a. m., being away slightly over an hour; so far as could be told she brought nothing to the nest; the trip may have been for nectar upon which she fed. Immediately after her return she visited each cell again and then went abroad at 9:02 a. m. A careful examination of the nest just after she departed failed to reveal that anything had been added to the cells. She returned from this second trip at 9:51 a. m. She then examined all of the cells over and over again until 10:10 a. m., or for about nineteen minutes, when she retired to the top of the nest and began to examine that portion of it, including the petiole and fastening, continuing for three minutes. During the entire day she continued her visits from cell to cell. Day clear and warmer.

June 2:—For the first time today the queen left the nest at 8 a. m. Four of the eggs are now hatched; by 10 a. m., besides feeding the larvae, the female had lengthened one of the central cells containing a larva, it being 1.25 mm. longer. Raining early a. m.; then cloudy and sultry.

June 3:—The female was observed to return to the nest at 10:35 a. m., holding in her fore legs a morsel of what appeared to be the flesh of some lepidopterous or other larva. Clinging downward from the nest by her other pairs of feet, she continued to reduce this morsel to a homogeneous and well kneaded mass by revolving it about with her fore feet and chewing and biting it with her mandibles. This continued for several minutes, when the motion was stopped and the morsel held in her "'chin' or between the breast and the under side of her head and the mandibles, the fore feet assisting; this allowed exploration of the cells with the antennæ. The right cell found in this way, the morsel of food was again revolved and chewed for another minute and then placed into the cell decided upon. The queen then thoroughly cleaned her fore feet, antennæ and mandibles, the former by drawing them through the mandibles, the antennæ by drawing them through the fore tarsal strigils and the mandibles by working them. She then inspected the nest again. Day cloudy, windy.

June 6:—The past few days have been rainy and warm. This morning it was found that two of the larvæ in the nest have reached a very large size, nearly filling their respective cells, which have been considerably lengthened. The queen is now kept constantly engaged in feeding. The eggs in the eleventh, twelfth and thirteenth cells remain unhatched.

At 5:16 p. m., the mother wasp was observed to return to the nest holding in her mandibles a pellet of soluted paper, which after a minute, was added to one of the cells; for this purpose, the substance being still held in the mandibles, it was simply applied to a spot on the edge of the cell and then pinched with the jaws which at the same time were drawn along the cell's edge, thus distributing the matter, which upon being thinned out, dried and hardened; the mandibles alone were used in this operation. While thus engaged, she was much irritated by the approach of another wasp *(Sceliphron)* which happened to fly in toward the nest; she suddenly darted out at it and drove it off. Then she kept on the alert, constantly facing the observer. At 5:27 she left again, returning at 5:32 with the same kind of material, which was placed around the edges of another cell. Again a trip was made at 5:52 p. m., returning at 5:58 with a food morsel, which was held as previously described; after chewing this for about a minute, she visited in turn each larva, holding the morsel out to them in her mandibles (head and fore legs hidden within the cells each time); the food quickly disappeared. After this the queen did not leave the nest again, remaining throughout the night. Day fair, warm, sultry.

One of the other nests under observation was taken at 6:45 p. m. today, during the absence of the mother wasp. This description of it will apply equally as well to the one under direct observation, at this time, insofar as the development of the eggs and larvae are concerned. The whole nest, however, was not obtained, the middle cell having remained behind attached to the petiole which was out of reach. The mother wasp returned twenty minutes later and made an examination of the remains of the nest upon which she passed the night. The nest was not rebuilt and as far as could be ascertained no new nest was strated. This nest was composed of eleven cells, ten of which were occupied—four by half-grown larvæ, six by eggs and one empty (injured when taking the nest). The larvæ were all erect in their cells and with a forceps one was easily removed by gently grasping it and pulling. It was found to be attached to the apex of the cell by means of a short, pallid nipple-like petiole which is sticky, secreting a colorless, sticky fluid which adheres to the skin (the larva could be lifted bodily by applying the tip of the finger to this viscous projection). The nipple-like petiole just described is white, the remainder of the body being soiled greyish, tinged with pinkish. The larva is fusiform, smooth and shining, unarmed at any part, the nipple less smooth, opaque. Its head is blunt, the mouth parts fleshy, the mandibles well developed, acute, yellowish, fleshy proximad, all of the organs prehensible, sucker-like and the mouth is central in relation to the mouth of the cell. The cervical shield is narrow, transversely roughened, minutely papillate; head dusky, from dorsal aspect with a median longitudinal white dash and one of similar appearance laterad, which is oblique and farther cephalad, pointing cephalo-laterad, all three lines broader at base; mesad of the tips of each of the oblique lateral stripes is an ocellate white round spot, conspicuous, apparently setigerous but bearing no visible seta; antennæ not visible. On the head, farther cephalad, near the large labrum are two transverse white stripes, one across the cephalic edge of the clypeus and the other along the cephalic edge of the labrum; two pairs of short fleshy appendages—the upper pair being maxillæ—armed with two short, black hooks at apex, are also visible. From the dorsal aspect the head is seen to be finely papillate, scatteringly so, roughened less than the cervical shield. The mouth is continually in motion and is very sensitive. The spiracles are minute.

When the larvæ are removed from the cells the egg-shells from which they have hatched are still found adhering to the cell walls, where the egg was deposited. The six eggs in the nest under consideration were pale, normal.

Looking directly into a cell containing a half-grown larva, the sensitive head is seen, the sensitive mouth working. If the point of a needle is allowed to touch the mouth lightly, a bubble or small drop of a clear, odorless fluid is excreted.

The cells are perfectly clean. Each of the larvæ of this nest were fed at 8:15 a. m. (June 7), by holding a small portion of well-ripened orange in a pair of forceps, the fruit being brought in turn against the mouth of each larva, all feeding from it as it was presented to them.

Later, these larvæ were fed similarly on small bits of crushed caterpillars. They remind one of hungry nestlings and it is surprising to see what large quantities they can ingest. One of them for instance swallowed the whole body—minus head—of a crushed *Mineola* larva, which if pulled upon during the last of the process of swallowing came out whole, showing that the flesh was but little chewed before ingested. On June 8 the larvæ were fed at 7 a. m., 2 p. m. and 5 p. m., but afterwards irregularly, usually once in the morning and once in the afternoon. On the morning of June 9, it was found that another egg had hatched, almost imperceptibly, no swelling occurring until the larva was fed. The hatched larva is difficult to distinguish from the egg, being of about the same size, shape and color; it is firmly attached to the cell, apparently at the same place where the egg was attached; portions of the egg-shell remaining standing after hatching, erect, uneven and membraneous. The hatched egg was in the smallest, outside cell, which was not half as long as any of the others. The larva was left unfed and died within four days (noon, June 10, 1909).

June 7:—The female was on her nest at 7 a. m. She left for abroad for the first time at 7:31 to 7:45 a. m. and again, 7:56 to 8:02 a. m., bringing material for the purpose of enlarging the cells. The latter are now very uneven, shadowing the uneven development of the larvæ. For the same purpose she left again at 8:24 to 8:30 a. m. Then she remained home for an hour or more, leaving for nearly the same period of time, returning at 10:12 a. m., with a large morsel of macerated flesh (4 mm.). After chewing this for about four and one-half minutes, holding it between the fore legs, she took the morsel in her mandibles, placed her head within a cell and touching the larva with her extended antennæ, placed the morsel before its mouth; the larva also reached forward and its mouth quickly enclosed a portion of the morsel and ingested it. The female then visited four or five of the largest larvæ in apparently random order, the morsel lasting for thirteen separate ingestions for these larvæ (10:21 a. m.); the mother wasp placed no food within any of the cells but it was passed directly from the mother to the young; for each ingestion, the morsel was held to a larva for about ten seconds. After the morsel of food was exhausted, the female carefully cleaned her fore legs by drawing them through the mouth; and also her antennæ by drawing them through a portion of the fore leg as previously described (through the strigil).

After exploring the nest and (apparently) resting, she left again at 10:49 a. m., returning at 10:56 a. m. with material for enlarging a cell. Abroad again at 11:03 to 11:13 a. m. and 11:37 to 11:39, bringing the same material in her mandibles, which, each time, was distributed along the edges of some of the shorter cells. At 2 p. m. she fed the larvæ again and she was observed at 5:09 to 5:42 p. m., to make a trip abroad for food. Day warm, cloudy to fair, sultry.

June 8:—The mother wasp was observed to return with a morsel of food (2.25 mm.) at 6:30 a. m.; and after the usual preparation of it, she presented it in turn to six of the larvæ; it sufficed for eight ingestions. She was occupied thus a total of two and one-half minutes; this morsel, as the ones of the preceding day, appeared to be composed of macerated caterpillar flesh. She left again at 6:46 a. m., returning at 6:58 a. m., apparently with food, as each larva was visited in the usual way; this time, the food must have been liquid, perhaps nectar, for it was not bulky enough to be seen. Left again at 7:01 a. m., returning at 7:29 with building material.

At 5:41 p. m. the wasp returned to the nest with a large rounded mass (3½ mm.) of macerated caterpillar flesh, which she held, revolved and chewed in the usual way for five minutes; during this process only the outer layer of the mass was pinched by the mandibles. Then the larvæ were visited in turn, the morsel held to them as previously described, and all of it had disappeared after one and one-half minutes. Day clear, warm.

June 9:—The nest was first seen at 6:28 a. m., when the mother wasp was absent. She returned after six minutes, carrying a large food morsel. This was prepared in the usual manner—chewing it with the mandibles—and it served for nine ingestions (the morsel was prepared for three minutes and fed for two and one-fourth minutes);

it was 3.1 mm. in diameter. The queen left the nest again at 6:51 a. m., returning at 7:01 a. m. with another smaller food morsel. This she fed to the larvæ and then left again at 7:08 a. m., returning at 7:29, apparently with a small amount of food. Abroad again at 7:32 a. m., returning at 8:36; again at 8:41, coming back at 8:56 with food; at 8:59, returning with a large morsel of food (3.3 mm.) at 9:24, which was prepared and offered in the usual way; it was given to the largest larvæ only. At 9:43 she left again, returning with food at 10:07½. After feeding this, and as usual cleaning herself, she went abroad at 10:10, reappearing at 10:38 with a very large food morsel—apparently the flesh of some green caterpillar, as usual already macerated to some extent; this ball of food measured about 3.75 mm. and was heavy enough to interfere seriously with her flight, causing her to miss the nest for the first time since her movements have been observed. This was fed to the larvæ, after which the nest was explored and its security tested (apparently)) by a peculiar scraping movement of the abdomen, done while the female is on top of the nest; clinging with her feet, she switched the abdomen several times rapidly over the top of the nest, a movement previously observed, before any of the eggs had hatched. Then abroad at 11:20 a. m., returning at 11:32½ with building material. Day clear and warm; cool early morning, clouding at 8 a. m.

June 10:—The mother wasp left the nest later this morning than usual (9 o'clock). One of the larvæ began to cap its cell at 11 a. m. (larva No. 1). Egg in cell No. 11 deposited at 2:30 p. m., May 23, hatched at noon, June 8; that in cell No. 12, deposited at noon, May 26, hatched at 11 p. m., June 9; and that in cell No. 13, deposited on June 3, hatched on June 14, showing gradually decreasing egg-stages. Two new cells (14 and 15) were commenced about noon today. The wasp was observed to return to the nest at 5:15 p. m., carrying a morsel of food. Cloudy early a. m.; afterwards fair and warm.

June 11:—The mother wasp remained on the nest, mostly inactive, occasionally inspecting it, until 8:50 a. m., when she went abroad, returning with food for the larvæ at 8:58 a. m. During this whole forenoon she was constantly busy about the nest, running over the cells and feeding the larvæ. Also the fourteenth and fifteenth cells were slightly lengthened and at 1:35 p. m. the petiole of the nest was being strengthened. At 5 p. m. an egg was deposited below the mouth of the fourteenth cell, which adjoins the fifteenth. Day clear and warm.

June 12:—By 6. a. m., two more larvæ had nearly completed the caps of their cells, which must have been commenced during the night: these two cells adjoin the first, one on each side of it, and are undoubedly the next two oldest. The mother wasp was absent at 6:20 a. m., returning at 6:43, apparently without anything. She was busy at the nest and abroad, through the day. At 1:30 p. m. an egg was deposited in the fifteenth cell and adjoining the fourteenth cell, a sixteenth cell was commenced, which received an egg on the following day (thirteenth). Day cloudy, cooler; clear and warm by noon.

June 16:—By this date, two more larvæ had prepared for pupation by capping their cells; all of the capped cells are comparatively very long, measuring 20 mm. During severe showers at 3:30 p. m., the mother wasp remained away from the nest, having been overtaken by the storm. She did not return immediately after the storm, not until 5 p. m.

June 17:—At 4 p. m. today a sixth larva had completed the silken cap to its cell. At 2:50 p. m., the female commenced a new (seventeenth) cell, against the south of the fifteenth; she deposited an egg into it at 5 p. m Earlier, at 11:30 a. m., she was observed to go to a cell, scrape against its mouth with her mandibles and, having in this manner attracted the larva's attention, her head was extended to meet that of the larva, and the latter's head then grasped with the mandibles, bringing the two mouths together; this was repeated at all cells containing large larvæ. Food was probably regurgitated to each, though the actual process could not be seen.

June 18:—An eighteenth cell was commenced today against the seventeenth, but no egg was deposited into it. The mother wasp was absent from 7 to 8:15 p. m., or up to darkness and she did appear during the night. She was still absent at 6 a. m., June 19. At 7 p. m. today, the following:

Number of cells	18
Number of cells capped	6
Number cells with eggs	4
Number cells with larvæ	6
Number empty cells	2

One of the empty cells is a large central one.

June 19:—At 6 o'clock this morning the female was still absent from the nest and a little later she was accidentally found crawling over the grass beneath the nest in a manner suggesting weakness and unhealth.* She continued thus through the day. At 5 p. m. she was induced to crawl upon a twig and by this means was transferred to the top of the nest. She appeared to recognize the nest at once and almost immediately she placed her head and antennæ into the first open cell in front of her and sensed the interior, afterward proceeding to the other cells. A quarter of an hour later she was visiting the larvæ feeding them (apparently) in the manner mentioned under date of June 17, namely by regurgitation. After reaching the nest her manner changed visibly—from passiveness to activity and interestedness—and an approach to the nest on the part of the observer would incite an attitude of defense. Thus, after a very short period of time, apparently, she had completely recovered her normal condition. She did not leave the nest at all today. Day clear and pleasant.

June 20:—The mother wasp hung from the bottom of her nest all through the morning and afternoon, though it was light and warm and other queens are actively engaged. After it began to rain she moved from the bottom of the nest to its top. Clear and warm, cloudy at 3 p. m., showers at 4:15 p. m.

June 21:—At 1:40 p. m., though present previously, the female was noticed to be absent from her nest and she was not seen up to 3 p. m., when the observations were discontinued until June 23. The egg in cell seventeen was noticed to have disappeared at 2 p. m. today.

June 28:—Apparently the queen has disappeared entirely. She did not appear on the nest today and no trace of her could be found in the immediate vicinity of the nest.

June 24:—The egg in cell fourteen, deposited at 5 p. m., June 11, hatched at 9 p. m., June 23; that in cell fifteen, deposited at 1:30 p. m., June 12, hatched at noon, June 24; and that of cell sixteen, deposited on June 13, hatched on June 25.

June 27:—The queen has disappeared altogether. At 2:15 p. m. today the worker adult from cell No. 1 emerged, after neatly removing the cap to its cell.

June 28:—At 10 a. m. the worker adult from cell No. 2, adjoining cell No. 1 on the south, emerged; the first worker is still present on the nest and the behavior of both gives the impression that they are uncertain just what to do with themselves; they have a lost appearance.

* Apparently not parasitized.

June 30:—A third worker adult emerged at about noon from the cell adjoining cell No. 1 on the north: the other two workers were absent and during the warm afternoon this third worker occupied itself by occasionally twirling its wings as if to strengthen them for flight. By 6. m. a fourth worker adult had emerged: the first two continue absent. The young larvæ of cells fourteen, fifteeen and sixteen have perished of starvation but the large larvæ are still alive. What is to become of this queenless nest? Clear and warm.

July 1:—A fifth worker adult emerged at 3 p. m. and remained on the nest, the others (third and fourth) being absent; apparently, judging by their actions, these workers are not paying any attention to the nest though they do examine the cells, but apparently from curiosity. The fifth, newly emerged worker was still present at 7:30 p. m., when it was occupied in strengthening its wings by twirling them as in actual flight; this was done by hanging from the bottom of the nest with the two posterior pairs of legs, then going through the motions of actual flight. The four other workers remain absent and were absent during the night and early the following morning.

July 2:—At 10:50 a. m. the fifth worker was observed going over the cells of the nest in a manner similar to that followed by the queen; she was still alone and continued present, occasionally examining the cells, until about 4:30 p. m., when she deserted, remaining away through the night following.

July 3:—The nest was deserted all day. The workers apparently were ignorant of their functions in the absence of the queen.

July 4:—All the larvæ in the nest are now dead.

July 5:—The worker adult from cell No. 6 emerged at 6 a. m. It in turn disappeared after about twenty-four hours and the nest was again deserted. Another nest in the same relative position in a closed doorway, facing south, and of an age similar to this one, prospered and by August 15 was large and thickly populated. The queen remained present in this case.

Summing up, the following significant facts were observed:

(1). In the immediate locality of the nest under direct observation, other nests were about the same age, hence in the same locality the hibernated queens have a tendency to commence activity at about the same time.

(2.) All nests observed were under shelter.

(3.) In regard to the activity of the queen wasp. Of the month of actual observation of the queen, it was observed that at first—for the first ten days—she did not leave the nest until late in the forenoon, about 10:30 a. m., but after June 1, as it became warmer she commenced trips abroad much earlier until about the middle of June, she was leaving as early as 6:30 a. m. Correspondingly, she began to work until later in the afternoon so that her working-day which at first was about five and one-half hours, or from about 11 a. m. to 4:30 p. m., became gradually lengthened to nearly eleven (or more) hours, or from about 6:30 a. m. to about 6 p. m. Of the twenty-four days of actual observation, she made trips abroad on twenty-one of them, three of which were cloudy. Of the three days which she remained upon the nest, two were rainy and one was fair. She passed the nights upon the nest. During the month she constructed eight new cells, or one about every four days.

(4). The duration of the egg stadium gradually decreased in length as it became warmer, from about twenty-two plus days on May 31 to fifteen and one-eighth days on June 8, fourteen and one-half days June 9 eleven days on June 14, to twelve and one-sixth days on June 24 and twelve days on June 25.

(5). The duration of the larval stadium was approximately eleven days (May 31 to June 11) for the first three larvæ to come to full growth; for the fourth larva about fourteen, and for the fifth and sixth, about a day less. The duration of the pupal stadium for the first larva to hatch was about seventeen days, three hours; for the second about a day less and for the third a day more than the first; the fourth and fifth individuals were about the same as the second, while the sixth required nineteen days.

(6). The larvæ capped their cells for pupation without assistance and the resulting adults emerged through their own efforts.

(7). Newly emerged workers appear to be without social instincts and to require education before assuming any relation to the nest. Those observed in the absence of the queen, appeared to be totally unaware that they were in any way related to the nest from which they emerged, though they did occasionally explore it.

(8). The queen wasp, when deprived of its nest, apparently loses all ambition and soon dies.

Urbana, Ill., February, 1911.

A CASE OF DEFENSIVE SELF-MUTILATION IN *CRYPTOBRANCHUS*.

BERTRAM G. SMITH.

One of the worst enemies of aquatic vertebrates in captivity is the water-mold, *Saprolegnia.*. Recovery from a severe infection is so rare that this alone would attract attention; but recovery by means of the automatic amputation of infected members is a phenomenon that I have never seen described, and have recently observed for the first time.

During the latter part of November, 1909, seven hellbenders of various sizes were shipped from their native habitat in northwestern Pennsylvania to the Zoological Laboratory of the University of Wisconsin. Placed in an aquarium with shallow running water pumped from Lake Mendota, all but one were promptly attacked with the "nitrogen disease" familiar to fish culturists, and five of them quickly died. The remaining affected specimen displayed remarkable powers of resistance to the disease and, though swollen with bubbles almost past recognition, after three months entirely recovered from this attack.

This specimen, a young adult 35 cm. long, is the subject of the present note. Perhaps because rendered vnunerable by the bursting of the epidermis by nitrogen bubbles, it became infected with *Saprolegnia.* The fungus completely covered the toes of the hind legs, and the last two inches of the tail, but seemed to be confined to these regions.

A crack or fissure, accurately separating the infected from the uninfected portions of the integument, soon appeared; this deepened until it reached the bone, after which the infected extremities of .the limbs and tail dangled for several weeks connected with the animal only by the bone. The fissures appeared as sharp and clean as if cut with a knife; on one side was healthy living tissue, on the other tissue which seemed insensitive, since the animal did not respond when the affected regions were stimulated with forceps.

On March 15, 1910, the digits of one hind foot had been entirely cast off, and the wound had begun to heal over. The other hind foot had lost the integument and flesh of the first phalanges, and the latter projected as naked bones. The posterior two inches of the tail were still connected with the body by the vertebral column.

About March 30, the infected portion of the tail dropped off, one vertebra being left bare with conspicuously projecting transverse processes.

About three months later (July 7) it was observed that the stumps of the tail and hind feet had entirely healed over, so that the bones were no longer exposed. No signs of infection were visible on any part of the body of the animal. That it had quite recovered its vitality is evidenced by the fact that while handling it I received a bite on the fingers sufficient to draw blood—the only time I have ever been bitten by a hellbender.

About a month later the animal died, apparently from a fresh attack of the nitrogen disease, so that I was unable to observe to what extent regeneration might take place.

The sloughing off of injured or infected tissue is not uncommon in vertebrates but in such cases the tissue is usually gotten rid of piecemeal. In the case described in *Cryptobranchus* the affected portions remained intact until dropped off entire, and this was accomplished by a break in the tissue bordering the region of infection. When we remember that the skin of *Cryptobranchus is* tough and flexible, almost as far removed from being brittle as it is possible to imagine, we find it impossible to explain its breaking at this point as due to purely mechanical factors. Pathological changes in the tissues, proceeding in advance of the actual infection, must so alter their physical properties that a break occurs in precisely the region that is most advantageous to the animal in getting rid of the infection.

Zoological Laboratory, University of Wisconsin.

January, 1911.

WISCONSIN *DIPTERA*. A SUPPLEMENT TO THE PRELIMINARY LIST OF *BOMBYLIIDÆ, SYRPHIDÆ* AND *CONOPIDÆ*.

By S. Graenicher.

About a year ago (this bulletin, vol. VIII, pp. 32-44) the writer published a preliminary list of the flies of Wisconsin belonging to these families. An account is herewith given of the species collected in the summer of 1910 by the expedition of the Public Museum of Milwaukee, at Hudson, in St. Croix County, situated on the lower St. Croix river (July 6th to 12th), and along the Mississippi river at Prescott in Pierce County (July 13th to 26th). Maiden Rock in Pierce County (July 27th to August 10th), and Fountain City in Buffalo County (August 11th to 17th). Of the species considered the following four are new to the state: *Pipiza festiva*, *Conops bulbirostris*, *Conops fronto* and *Zodion obliquefasciatum*. A fifth species: *Systœchus candidulus* met with at Prescott (Pierce County) was originally described from material collected in Wisconsin (exact locality not mentioned), but has not been reported from this state ever since.

BOMBYLIIDÆ.

Spogostylum.

S. albofasciatum Macqart. Two specimens from Prescott (Pierce Co.), two from Maiden Rock (Pierce Co.), and one from Fountain City (Buffalo Co.).

S. pauper Loew. Two specimens from Maiden Rock (Pierce Co.).

Exoprosopa.

E. decora Loew. Common at Hudson (St. Croix Co.), Prescott (Pierce Co.), and Maiden Rock (Pierce Co.).

E. fascipennis Say. Our collection contains nine specimens from Hudson (St. Croix Co.), seven from Prescott (Pierce Co.), and one from Maiden Rock (Pierce Co.). This material shows, as is often the case in parasitic insects an enormous variation in size, the length of the specimens ranging from six to fourteen mm.

Anthrax.

A. alternata Say. Two specimens from Hudson (St. Croix Co.), three from Prescott (Pierce Co.), and one from Maiden Rock (Pierce Co.).

A. fulvohirta Wiedemann. Not at all rare at Hudson (St. Croix Co.), and Prescott (Pierce Co.), where altogether eighteen specimens were obtained. Only one specimen has been taken in eastern Wisconsin (Milwaukee), so far. This is a species of southern distribution, and in Wisconsin it has not been met with farther north than Hudson. It has been reported from Minnesota (*Diptera* of Minnesota, Tenth Annual Report of the State Entomologist of Minnesota, 1905), but no locality given.

A. halcyon Say. Two specimens from Maiden Rock (Pierce Co.) are the only ones on record from western Wisconsin.

A. lateralis Say, var. **gracilis** Johnson. A rather common Bombylid along the Mississippi river. Specimens from St. Croix (Hudson) and Pierce Cos., (Prescott and Maiden Rock).

A. morio Linné. Two from Hudson (St. Croix Co.) and three from Prescott (Pierce Co.).

A. nemakagonensis Graenicher. Seven specimens from Hudson (St. Croix Co.) and ten from Prescott (Pierce Co.) agree in detail with the type and cotypes from the St. Croix region.

A. sinuosa Wiedemann. Four from Hudson (St. Croix Co.) and five from Prescott (Pierce Co.).

Bombylius.

B. fulvibasis Macquart. Fairly common at Hudson (St. Croix Co.) and Prescott (Pierce Co.). No specimens were taken farther south, undoubtedly on account of the lateness of the season. All of those collected at Prescott around July 20th bore the marks of old age (torn wings, and most of the pubescence of the body rubbed off).

Systœchus.

S. candidulus Loew. This species was described by Loew (Centur. IV, 51) from a specimen from Wisconsin. Later Osten-Sacken (Western *Diptera*, p. 253) reported it from Illinois and Kansas, but since that time nothing has been heard of it, so far as our knowedge goes. One male taken at Prescott (in Pierce Co.) has the scutellum more or less red throughout, while in the type the scutellum is red at the apex only, according to the description. This specimen is the only representative of the species in the Public Museum at Milwaukee.

S. vulgaris Loew. Five from Maiden Rock (Pierce Co.).

Phthiria.

P. aldrichi Johnson. Last year this species was reported from the eastern part of this state (Can. Ent. 1910, pp. 26-29), two specimen having been taken in Washington Co. Thirteen specimens from Maiden Rock (Pierce Co.), and one from Fountain City (Buffalo Co.) represent a considerable degree of variation, both in size and coloration. In length they run from two to four mm. On legs and abdomen either the yellow or the black predominates. In some of the specimens the scutellum is entirely yellow, in others partly or entirely black. In the female the front may be very light or very dark; in the latter case there is a yellow line along the anterior orbits.

P. punctipennis Walker. Two specimens from Hudson (St. Croix Co.) and two from Prescott (Pierce Co.).

Geron.

G. calvus Loew. Ten specimens from Maiden Rock (Pierce Co.).

G. subauratus Loew. Fairly common throughout the region under consideration. Numerous specimens from St. Croix (Hudson), Pierce (Prescott and Maiden Rock) and Buffalo Cos. (Fountain City).

SYRPHIDÆ.

Chrysogaster.

C. pulchella Williston. Two males from Fountain City (Buffalo Co.).

Pipiza.

P. festiva Meigen. One female from Maiden Rock (Pierce Co.). Length nine mm. This species has been reported from Nebraska by Jones (Jour. N. Y. Ent. Soc. XV, p. 89, 1907), and from Massachusetts and Maine by Johnson (Psyche. XIV, p. 76, 1907). Our specimen answers the description in all respects, except that the legs are dark and show a very small amount of light color.

P. pistica Williston. One female from Prescott (Pierce Co.).

Paragus.

P. bicolor Fabricius. Three males and one female from Prescott (Pierce Co.) Williston (Syn. N. Am. *Syrphidæ*, p. 19) refers to the variability of this species. The color of the abdomen in the female from Prescott is slightly red on the fifth segment only. Of the three males one has the abdomen distinctly red from the second segment on; the second is only faintly red on these parts; the third has the abdomen black, with a reddish tint on the sides near the apex.

P. tibialis Fallen. Two males and one female from Hudson (St. Croix Co.), one male and two females from Prescott (Pierce Co.). This species is just as variable as the preceding one. In all three males the abdomen is red from the third segment on. One of the females (Hudson) has an entirely black abdomen, and in the other two some red is visible on segments three and four.

Platychirus.

P. hyperboreus Staeger. One specimen from Prescott (Pierce Co.).

P. quadratus Say. Specimens from Hudson (St. Croix Co.), Maiden Rock (Pierce Co.) and Fountain City (Buffalo Co.).

Melanostoma.

M. mellinum Linné. One from Hudson (St. Croix Co.), two from Maiden Rock (Pierce Co.), and one from Fountain City (Buffalo Co.). In all of these the legs are yellow, and have a very faint brownish ring on the hind femora only.

Eupeodes.

E. volucris Osten-Sacken. One from Hudson (St. Croix Co.).

Syrphus.

S. americanus Wiedemann. Specimens from St. Croix, Pierce and Buffalo Cos. This and the following species are common, and probably of general occurrence throughout Wisconsin.

A. ribesii Linné. Specimens from Pierce and Buffalo Cos.

Allograpta.

A. obliqua Say. Common everywhere. Specimens from St. Croix and Pierce Cos.

Mesogramma.

M. geminata Say. Prescott and Maiden Rock, both in Pierce Co.

M. marginata Say. Extremely abundant. Specimens from St. Croix, Pierce and Buffalo Cos.

Sphærophoria.

S. cylindrica Say. Numerous specimens from St. Croix and Pierce Cos.

Neoascia.

N. globosa Walker. One female from Maiden Rock (Pierce Co.) belongs to Williston's "third variety".

Rhingia.

R. nasica Say. Seven specimens from Maiden Rock (Pierce Co.).

Eristalis.

E. bastardi Macquart. Maiden Rock (Pierce Co.).

E. meigenii Wiedemann. Two males and one female from Maiden Rock (Pierce Co.).

E. tenax Linné. Specimens from Maiden Rock (Pierce Co.).

Tropidia.

T. quadrata Say. Two males from Fountain City (Buffalo Co.).

Syritta.

S. pipiens Linné. Prescott and Maiden Rock (both in Pierce Co.).

Xylota.

X. fraudulosa Loew. A male from Hudson (St. Croix Co.) and a female from Maiden Rock (Pierce Co.).

CONOPIDÆ.

Conops.

C. bulbirostris Loew. Three specimens from Prescott, Pierce Co. (two males and a female), evidently belong here. In all of these the front and vertex are evenly black, the dust markings of the thorax are golden yellow, and the pleural stripe is entirely absent on the upper half of the pleura. In the female the process on the underside of the fifth abdominal segment is exceedingly long; it is considerably longer than in any other species of *Conops* or *Physocephala* known from Wisconsin.

C. fronto Williston. One female from Prescott (Pierce Co.). Disk of metanotum only slightly black. Metasternum, as also the disks of the third and fourth abdominal segments without any black whatever. Otherwise as in the description. This species was described from western Kansas, and it has been reported by Jones (preliminary list of the Conopids of Nebraska, Can. Ent. Vol. XXXIX, pp. 250-252) from various points in Nebraska.

C. sylvosus Williston. A specimen taken at Hudson (St. Croix Co.) has the second abdominal segment red at apex, and is in this respect somewhat distinct from the Burnett county specimen referred to in the preliminary list of Wisconsin Bombylids, Syrphids and Conopids published last year.

C. xanthopareus Williston. Three males and two females from Prescott (Pierce Co.). In the specimens from this state much variation in the color of the abdomen is noticeable. In those from Prescott the color runs from black throughout to black combined with red on first and basal portion of second segments, and in the specimens from other regions (St. Croix and Milwaukee Cos.) the abdomen shows still more red.

Physocephala.

P. affinis Williston. A male from Prescott (Pierce Co.) has the frontal median stripe very distinct, and the facial grooves very dark. The three stripes of the thoracic dorsum are confluent. This specimen unites the characters of *P. affinis* with those of *P. marginata* (facial grooves and frontal stripe black).

In Nebraska this species is very variable according to Jones (Loc. cit. p. 250).

P. furcillata Williston. Five specimens from Maiden Rock (Pierce Co.). In all of these the scutellum is black with no trace of red. The same is the case with the majority of the specimens from the St. Croix region, but a few of them have the scutellum reddish.

P. tibialis Say. Two from Maiden Rock (Pierce Co.) and one from Fountain City (Buffalo Co.). The process of the second joint of the style projects rather distinctly; in all other points these specimens answer the description.

Zodion.

Z. fulvifrons Say. Numerous specimens from St. Croix, Pierce and Buffalo Cos. This is the most common Conopid found in Wisconsin.

Z. obliquefasciatum Macquart. A male from Maiden Rock (Pierce Co.). In this specimen the thorax is darker than in one from Meredosia, Ill., contained in the collection of the Public Museum of Milwaukee: as regards the color of the thorax this Illinois specimen agrees better with the description than the specimen from Maiden Rock. The latter is the only one recorded from Wisconsin, so far.

Z. pygmæum Williston. Nine specimens from Pierce Co. (Prescott and Maiden Rock) and one from Buffalo Co. (Fountain City).

Eccemyia.

E. abbreviata Loew. Altogether twenty-eight specimens were taken in St. Croix, Pierce and Buffalo Cos.

THE CISCO OF GREEN LAKE, WISCONSIN.

By George Wagner.

(**Leucichthys birgei**, n. sp.).

Type, No. 1709i, Wisconsin Geological and Natural History Survey; a female specimen, 280 mm. long, taken from 28 meters below surface in Green lake, Green Lake County, Wisconsin, August 3, 1909, by means of gill nets. Co-types, thirty-six other specimens recorded under No. 1709. Collector, H. H. T. Jackson.

Length 280 mm.; head in length 3.9; depth of body in length 3.6; eye 6 in head; maxillary 2.7 in head; height of dorsal 1.6 in head; distance from snout to dorsal 1.8 in total length; depth of caudal peduncle 3.3 in head; gillrakers 15x28; longest gillraker 1.2 in eye; dorsal rays 9; anal rays 11, scales 8-70-8.

Body elongate, moderately compressed; dorsal and ventral outline about equal; greatest depth in front of dorsal. Dorsal outline of head straight, premaxillaries at a slight angle with it; maxillaries not quite reaching center of eye; lower jaw included, the whole head having a sharp, smooth, wedge-shaped outline. Dorsal fin large, its height .67 in its base, the longest ray extending beyond the last one when folded. Pectoral fins reaching slightly over half way to ventrals. Pectorals and ventrals both large; adipose fin large, its length .63 in eye; caudal broad, widely forked. Lateral line straight, somewhat nearer back than belly. Scales firmly attached, fairly uniform in size.

Color (in formalin), as a whole rather light, darker only above lateral outline; head without black; dorsal and caudal fins with edges somewhat dark; other fins light.

The above description is drawn up from the type-specimen. The form, even as represented by the individuals of what was probably a single school, is quite variable; I therefore add here the principal measurements of all the specimens at present available, the specimens being arranged in the order of their size.

No.	Sex.	Length mm.	Head in Length.	Depth in Length.	Eye in Head.	Maxillary in Head.	Dorsal Height in Head.	Snout to Dorsal in Length.	Depth of Caudal Peduncle in Head.	Longest Gill-raker in eye.	Gillrakers.	Dorsal Rays.	Anal Rays.	Scales.
1709 O	Female	150	3.7	5.0	5.1	2.9	1.5	2.0	4.1	0.9	17+32	10	11	8-72-7
1709 N	Female	232	4.0	4.1	5.3	2.6	1.5	1.8	3.6	1.4	15+26	10	11	8-70-7
1709 M	Male	241	4.1	4.3	5.9	3.0	1.4	1.9	3.5	1.1	16+30	10	12	9-75-7
1709 K	Male	243	4.1	4.4	5.9	2.6	1.5	1.9	3.3	1.1	16+28	10	11	9-73-8
1709 y	Male	246	4.0	4.1	5.2	2.8	1.6	1.9	3.4	1.2	15+25	10	12	8-75-7
1709 m	Female	247	4.2	4.4	5.4	2.6	1.5	1.9	3.9	1.4	14+24	10	10	8-77-7
1709 s	Male	248	3.9	3.6	5.8	2.7	1.6	1.9	3.4	1.2	16+28	10	10	9-73-8
1709 g	Male	250	4.0	3.8	5.3	2.9	1.7	1.8	3.2	1.2	14+27	9	12	9-78-7
1709 L	Female	250	3.9	3.6	5.8	2.6	1.5	1.9	3.6	1.2	16+28	10	11	9-75-7
1709 I	Female	251	4.2	3.9	5.0	2.9	1.6	1.9	3.3	1.1	16+29	9	11	9-73-7
1709 q	Female	251	4.3	4.3	5.3	2.8	1.3	1.9	3.2	1.2	15+27	10	12	9-76-8
1709 p	Male	260	3.8	4.0	5.7	2.7	1.7	1.9	3.4	1.3	15+26	11	12	9-69-8
1709 h	Male	262	4.1	3.5	5.8	2.7	1.5	1.8	3.2	1.2	16+27	10	12	9-76-7
1709 b	Male	264	3.9	3.9	5.6	2.7	1.7	1.9	3.4	1.2	16+28	10	12	9-73-7
1709 o	Female	264	4.1	4.3	5.3	2.8	1.5	1.8	3.3	1.2	15+28	10	11	9-77-8
1709 a	Female	266	4.0	3.6	5.6	2.9	1.6	1.8	3.3	1.5	15+27	9	11	8-71-7
1709 r	Male	266	4.3	4.4	5.6	2.8	1.6	1.9	3.3	1.2	14+27	11	12	8-70-7
1709	Female	268	4.2	3.9	5.8	2.7	1.6	1.8	3.4	1.2	14+25	9	11	8-76-7
1709 K	Male	269	4.1	4.5	5.5	2.7	1.5	1.9	3.3	1.3	17+27	10	11	9-77-7
1709 C	Female	270	4.4	4.0	5.6	3.0	1.5	1.9	3.4	1.2	16+28	9	11	9-67-8

1709 G	Female	270	4.1	3.6	6.0	2.8	1.5	1.9	3.3	1.2	15+30	10	12	8-77-7
1709 f	Female	271	4.2	4.2	5.3	2.9	1.6	1.9	3.2	1.5	15+27	10	12	9-74-7
1709 E	Male	271	4.2	4.0	6.4	2.8	1.5	1.9	3.2	0.9	15+28	9	11	9-73-7
1709 g	Female	271	4.1	3.6	5.5	2.6	1.6	1.9	3.3	1.2	16+26	9	12	9-72-8
1709 H	Female	276	4.1	3.7	5.6	2.6	1.6	1.8	3.3	1.1	15+26	10	10	9-80-8
1709 w	Female	277	4.0	3.9	5.7	2.8	1.6	1.8	3.3	1.1	16+26	10	11	8-74-7
1709 n	Female	277	4.2	4.2	5.5	2.6	1.7	1.9	3.3	1.3	15+25	9	12	9-73-7
1709 i	Female	280	3.9	3.6	6.0	2.7	1.6	1.8	3.3	1.2	15+28	9	11	8-70-8
1709 d	Male	280	3.6	3.5	6.0	3.1	1.7	1.9	3.5	1.3	16+27	10	10	9-71-7
1709 D	Male	280	4.4	3.9	5.3	2.6	1.4	1.9	3.0	1.2	14+27	9	13	8-72-7
1709 J	Female	281	4.2	4.1	6.1	2.9	1.5	2.0	3.5	1.2	15+28	9	12	9-78-8
1709 e	Female	281	4.1	3.8	6.2	2.7	1.6	1.9	3.4	1.1	15+28	10	11	9-73-8
1709 A	Female	283	3.9	3.8	5.6	2.8	1.6	1.9	3.5	1.2	15+27	9	11	9-75-8
1709 x	Female	284	4.2	4.0	5.1	2.9	1.4	1.9	3.2	1.6	15+27	10	11	8-77-7
1709 c		287	4.2	4.2	5.3	2.6	1.5	1.9	3.4	1.2	15+27	10	12	8-71-7
1709 B	Female	288	4.1	3.5	5.8	2.7	1.5	1.9	3.0	1.3	15+29	9	11	9-72-8
1709 F	Female	292	4.1	3.7	5.9	2.7	1.5	1.8	3.4	1.2	16+27	10	11	9-78-7
1709 t	Female	345	4.1	4.1	7.0	2.7	1.6	1.9	3.5	?	16+28	10	12	9-73-8

Green lake is the deepest inland lake of Wisconsin, having a maximum depth of 237 feet, and measuring over 100 feet deep over the greater part of its area. Its waters are remarkably clear. It harbors "a true abyssal fauna, organisms which can exist only in the peculiar environment of uniform low temperature and little or no light." (Marsh, Bulletin No. 12, Wisconsin Geological and Natural History Survey). Prominent in this fauna are the two remarkable crustacea, *Pontoporeia Hoyi* and *Mysis relicta.* It has also long been known that a cisco *(Leucichthys)* forms a part of this fauna.

It seems to have been common practice among ichthyologists to consider this form conspecific with *Leucichthys (Argyrosomus) nigripinnis* as found in Lake Michigan. An examination of our specimens, however, makes it very plain that this can not be true. Jordan and Evermann have recently made a careful review of the salmonoid fishes of the Great Lakes. (Bulletin U. S. Bureau of Fisheries, Vol. 29, pp. 1-41, Plates I-VII). A detailed comparison of the Green lake specimens with the species therein mentioned, shows it to be very evidently distinct. It shows undoubted relationship to the two Lake Superior deep water forms, *supernas* and *zenithicus*, and especially to the latter. But it is clearly distinct from both by its smaller eye. From *supernas* it is further to be distinguished by its more slender caudal peduncle, its non-projecting lower jaw, and its shorter gill rakers. The number of scales along the lateral line is distinctly smaller than in *zenithicus.*

I am indebted especially to Mr. A. E. Gurdy of Green Lake, Wisconsin, for information concerning the habits of this form. It is very markedly a deep water fish, practically never appearing near the surface except to spawn. Only rarely do they appear near the surface in spring (June) and then probably while pursuing some swarm of aquatic insect larvæ.

Some of the specimens in our collection have the stomachs crammed with food, and in every case this proved to consist entirely of *Pontoporcia Hoyi.* In winter, however, they are found frequently with remains of small fishes.

The spawning season comes in November, being at its height about the middle of the month. Local fishermen generally believe that the spawning takes place at a depth of about seventy feet, on marly bottom, but this is somewhat doubtful.

The fish is taken only by hook and line from November to the breaking up of the ice in spring, in from fifty to seventy-five feet of water. Minnows, especially shiners, from two to two and a half inches in length are used as bait, also pork rind and white-bait. They take only a moving bait. As an article of food, this fish ranks with the very best, but owing to the large amount of fat, must be used fresh, not standing storage very well.

As to its name: Jordan and Evermann (l. c.) have shown that the generic name *Argyrosomus* is preoccupied, and have employed *Leucichthys* (a name given in 1874 by Dybowski to some Siberian forms) instead. It has seemed to me to be peculiarly fitting that the form here considered should bear as a specific name, that of my friend and chief, Professor E. A. Birge, the foremost student of the physical and faunal phenomena of North American lakes.

Wisconsin Geological and Natural History Survey.

March 25, 1911.

SOME RECORDS OF WISCONSIN LIZARDS.

By S. Graenicher.

The main object of this paper is to report the occurrence of a lizard: *Cnemidophorus sexlineatus* (Linn.) within the confines of our state. At the same time a few records are given for two of the species, that have figured in the previous lists of the reptiles of Wisconsin.

In Dr. Hoy's list[1], published in 1883, the following three species of lizards: *Eumeces septentrionalis* (Baird), *Sceloporus undulatus* (Latreille), and *Ophisaurus ventralis* (Linn.) were considered as members of our fauna, and in 1889 Prof Higley[2] added a fourth species: *Eumeces quinquelineatus* (Linn.) to the list.

Cnemidophorus sexlineatus (Linn.), the "Race Runner," represents the fifth species of lizard found in Wisconsin. A specimen in the collection of the Public Museum in Milwaukee (No. 1110) was taken by a member of the museum collecting expedition at Prescott, Pierce Co., Wis., July 8, 1910. Several specimens were seen in the same locality, (about two miles south of Prescott, near a picturesque deep ravine, which is known by the name of "Pine Coulee"), but owing to their swiftness, all but one escaped. As to the distribution of this species Cope[3] states that "it covers the Austroriparian region of the Nearctic realm and the Eastern as far as the range of the Carolinian district, extending to Maryland and Delaware, but not New Jersey. In the Central region it reaches north to the Sand Hills of the Loup Fork river of Nebraska." Ditmars[4], in 1907 likewise refers to northern Ne-

1. P. R. Hoy. Catalogue of the cold-blooded vertebrates of Wisconsin. I. Reptiles. Geology of Wisconsin Vol. I, pp. 422-425.

2. W. K. Higley Reptilia and Batrachia of Wisconsin. Trans. Wis. Ac. Sc. A. & L. Vol. VII, pp. 155-176.

3 E. D. Cope. The Crocodilians, lizards and snakes of North America. Rept. U. S. Nat. Mus. 1898.

4. Raymond Lee Ditmars. The Reptile book, 1907.

braska as the northern limit of its distribution in the Central Region. It is therefore surprising to find in the seventh (1894) and eighth (1899) editions of Jordan's Manual of Vertebrates Wisconsin included in the range of the species ("Conn. to Va., Wis. and Mexico"). On what authority this statement is made I am unable to say, and neither Cope nor Ditmars uphold it. Hart and Gleason* have reported it from Henry and Ottawa on the Illinois river. The presence of this lizard as far north as Prescott (near the juncture of the Mississippi and St. Croix rivers) is a further evidence of the importance of the Mississippi valley as a pathway along which southern forms are enabled to travel northward. The specimen from Prescott has a length of six and a quarter inches; in color and markings it agrees quite well with a speecimen in the collection of the Milwaukee Public Museum from Gotha, Florida.

Eumeces septentrionalis (Baird). Black-banded skink. According to Hoy (Loc. cit. p. 423) this species is not "uncommon as far north as Lake Winnebago," but no particular localities are given. Higley (Loc. Cit. p. 160) gives Walworth Co., and makes the additional statement, that he has examined several specimens from the western part of the state. Cope (Loc. cit. p. 658) informs us that "this is another species of the plains of the Central region, and it ranges farther north than any species of the genus, that is, to the northern part of Minnesota." Among the specimens seen by Cope there are five from Minnesota: three from Fort Ripley, and two from the Red river of the North.

The writer has before him the following eight specimens, all of them from the northwestern part of the state:

I. Two young specimens from Washburn Co., (T. 42 N.-R. 13 W.) from the collection of Dr. H. V. Ogden of Milwaukee. They were taken by Dr. Ogden on the 5th of October, 1902, on a sandy hill side under a board exposed to the sun. My thanks are due to Dr. Ogden for the kind loan of the specimens for study, as also for the accompanying data.

II. Six specimens in the collection of the Public Museum of Milwaukee, taken by the Museum Expedition along the S t.Croix river in the summer of 1909 at the following points:

* C. A. Hart & H. A. Gleason, Ph. D., On the Biology of the San Areas of Illinois; Bull. Ill. State Lab., Vol. VII, Article VII, January 1907, p. 257.

1. One specimen (No. 1103) from the mouth of the Yellow river in Burnett Co., July 28th, 1909.

2. One specimen (No. 1104) from the same locality, July 30th, 1909.

3. One specimen (No. 1105) from the same locality, August 1st, 1909.

4. One specimen (No. 1107) from Randall, Burnett Co., August 5th, 1909.

5. One specimen (No. 1108) from the same locality, August 6th, 1909.

6. One specimen (No. 1109) from Never's Dam, Polk Co., August 9th, 1909.

On the same occasion a specimen (No. 1106) was obtained opposite Randall in Chisago Co., Minn., (near Rush City Bridge).

All of these were met with in dry soil, either sand or gravel. This species is apparently not uncommon in Burnett Co. in the sandy areas along the St. Croix river, that are so characteristic of that region, the so-called "Pine Barrens."

Eumeces quinquelineatus (Linn.). Blue-tailed skink. Higley (Loc. cit. p. 160) reported it from Walworth Co., and expressed the belief that it would be met with in all the southern counties. According to this author "it may be found to the best advantage in May, in dampish unfrequented woods under bark."

In Cope's list of specimens in the U. S. Nat. Mus. (Loc. cit. p. 639) we find one, for which the locality Aux Plains, Wis., is given. No such locality can be made out on any of the maps at our disposal, and possibly the Eau Pleine river in Marathon county, a tributary of the Wisconsin river is meant.

This is probably the lizard usually met with in the eastern and central states. Garman[5], writing in 1892, considers it common in the southern counties of Illinois, rare in other parts of that state, and extinct in northern Illinois.

There are four specimens in the collection of the Public Museum of Milwaukee from the following localities: two specimens from New Coeln, Milwaukee Co. (Nos. 488 and 491), donated by the Wisconsin Natural History Society (no date given, but to my

5. H. Garman. A Synopsis of the reptiles and amphibians of Illinois. Bull. Ill. State Lab., Vol. III, Article XIII, 1892.

knowledge collected prior to 1890); two specimens from Cedar Lake, Washington Co., Wis. (Nos. 489 and 490), collected July 22nd, 1888, by Prof Wm. M. Wheeler, at that time custodian of the Public Museum of Milwaukee, now of Harvard University. Specimen No. 488 from New Coeln is in the juvenile stage, and shows the stripes very plainly; the three remaining specimens are adults, in which the stripes are more or less indistinct.

All of these were collected over twenty years ago, at a time when this lizard was undoubtedly more common in the two counties (Milwaukee and Washington), than at present. The four specimens referred to above are the only ones which I have seen from Wisconsin, but information received from various sources leads me to believe, that this species is still present in one or more of the counties north of us, Sheboygan Co., for example.

Concerning the occurrence of the two remaining species of the list: *Sceloporus undulatus* (Latreille), and *Ophisaurus ventralis* (Linn.), the writer has no evidence to offer. Hoy had received a specimen of *Sceloporus undulatus* (Fence Lizard) from Lafayette county in 1850, and this was the only one he had seen from the state up to 1883, the year in which his list was published. In 1879 Higley (Rept. and Batr. of Wis.) wrote that a few specimens had been reported from this state (no particulars given), but that he had not seen a specimen himself. In Cope's list of specimens in the collection of the U. S. Nat. Mus. specimens from Ohio, Indiana, and Illinois are referred to, but none from Michigan, Wisconsin, or Minnesota. The information regarding the presence of this lizard in our state is extremely meager, and we are therefore inclined to consider it very rare, if it occurs at all.

Ophisaurus ventralis (Linn.) Glass Snake. This was, according to Hoy (Loc. cit. p. 423) in early days not uncommon near Kenosha, and occurred as far north as La Crosse. Higley's list does not add anything to Hoy's information. Cope (Loc. cit. p. 500) has seen a specimen from Baraboo, Wis. This large and conspicuous reptile (a limbless lizard) has evidently disappeared from southeastern Wisconsin, as a result of the combined activities of man and some of the domestic animals. As to its occurrence in other parts of the state at the present time, nothing has been heard whatever.

Milwaukee Public Museum,
March 24, 1911.

ADDITIONAL WISCONSIN RECORD OF ALLEGHENY LEAST WEASEL.

(*Putorius rixosus allegheniensis* Rhoads.)

By Henry L. Ward.

In two previous communications in this Bulletin* I have noted the presence of this interesting weasel in Wisconsin, at Burlington and at Prairie du Sac; the former established by one specimen, the latter by two.

On March 6th, 1911, Mr. John J. Eling, at Prescott, on the western border of the state, at the confluence of the St. Croix with the Mississippi River and midway between the northern and southern confines of the state, obtained a specimen which he presented to the Public Museum. This is a female measuring in the flesh 180 mm. in length, tail 38 mm., hind foot 21 mm. Except for a small, partially concealed chestnut spot on the right shoulder and narrow, symmetrical, crescentic lines, 12 mm. in length, curving backward from the anterior corners of the eyes, the chords of their arch forming angles of about 45 degrees with the axes of the eyes, also of chestnut color, it is in winter pelage, that is, pure white with a very sparse, scarcely noticeable caudal pencil of chestnut.

These three localities now known for the species in Wisconsin happen to have an almost perfect alignment extending from near the S. E. corner of the state N. W. to the middle of its western border.

Not unlikely its apparent rarity in Wisconsin is due, to a considerable extent, to its inconspicuousness; and further search will probably prove its presence in many other localities; but until this is established, individual records are of sufficient interest to warrant publication.

Public Museum, Milwaukee.

April 11th, 1911.

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* Bull. Wis. Nat'l Hist. Soc'y, Vol. V, No. 1, and Vol. VII, Nos. 1 and 2.

THE STATUS OF HOY'S SHREW IN WISCONSIN.

Microsorex hoyi (Baird).

By Henry L. Ward.

In 1857 Baird[1] described this species from two specimens taken at Racine, Wis. When in 1895 Merriam[2] reviewed *Sorex* he had but 23 specimens of this species for examination and was able to state the range as "from British Columbia on the west almost to Lebrador on the east." The type specimens from Racine, Wis., marked the southern limit of the species as then known, and are the only specimens from Wisconsin recorded by Merriam.

For many years the Public Museum has exhibited a mounted shrew labeled as this species, collected by T. Kumlien in Busseyville, Wis., January 30th, 1884, and by him sold to the Museum on October 21st, 1884. This has acquired a place in the literature of *hoyi* due to Jackson's[3] citation of it, which is qualified by the statement: "this specimen, a female, bears the label *hoyi*, but I have been unable to examine it critically, and, being mounted with the skull inside, the species has not been positively determined by the author."

In March of this year Dr. Charles B. Corey, while examining the Museum's mammals for data for his forthcoming work on the mammals of Illinois and Wisconsin, requested that an examination of the teeth of this specimen be made in order to set at rest its specific identity. Accordingly I caused its lips to be softened so that the teeth were visible, and an examination by Dr. Corey and myself showed the skull to be that of a *personatus*,

1) Baird, Spencer F. General Report on North American Mammals, pp. 32-33 (1857).
2) Merriam, C. Hart. Revision of the American Shrews of the genus *Sorex*. North American Fauna, No. 10, p. 90 (Dec. 1895).
3) Jackson, Hartley H. T. A Preliminary List of Wisconsin Mammals. Bull. Wis. Nat'l Hist. Soc'y, Vol. 6, Nos. 1 and 2 (1908).

and as the skull is still membraneously attached to the skin at the nasal region, all possibility of any substitution by the taxidermist is precluded. The error of identification was presumably made by T. Kumlien in 1884; the Museum possesses no specimen of *Microsorex hoyi*, and there seems to be no published records of the species in Wisconsin elsewhere than at Racine.

Public Museum, Milwaukee.

April 11th, 1911.

PRICE LIST OF PUBLICATIONS.

Orders and remittances should be addressed to the General Secretary, Public Museum, Milwaukee, Wis.

Numbers not included in the following list are out print and can no longer be obtained.

Bericht des Naturhistorischen Vereins von Wisconsin, 1871, 1873, 1874, 1876, each .... 10 cents

Jahresbericht des Naturhistorischen Vereins von Wisconsin, 1876-77, 1877-78, 1879-80, 1880-81, each .... 10 cents

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Proceedings of the Natural History Society of Wisconsin, Apl 6, '85, to Dec. 7, '85; Jan. 11, '86, to Dec. 13, '86; Mar. 14, '87, to Dec. 19, '87; Jan. 23, '88, to Dec. 17, '88, each .... 15 cents

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Bulletin of the Wisconsin Natural History Society (New Series).

Vol. III, Triple Number, January, April and July, 1903.... $1.00

Vol. III, No. 4, November, 1905.......................... $ .50

Vol. IV, Nos. 1-2, April, 1906; No. 3, July, 1906; No. 4, Oct., 1906; Vol. V, No. 1, Jan., 1907; No. 2, April, 1907; No. 3, July, 1907; No. 4, Dec., 1907; each................. $ .50

Vol. VI, Nos. 1--2, April, 1908; Nos. 3-4, Oct., 1908; each.. $1.00

Vol. VII, Nos. 1-2, April, 1909; Nos. 3-4, Oct., 1909; each.. $1.00

Vol. VIII, No. 1, Jan., 1910; No. 2, April, 1910; No. 3, July, 1910; No. 4, October, 1910; each......................... $ .50

The following Occasional Papers published by the Society may be had for seventy-five cents apiece:

Vol. 2, No. 1, "Ant-like Spiders of the Family Attidæ," G. W. & E. G. Peckham, 1892.

Vol. 2, No. 2, "Spiders of the Marptusa Group of the Family Attidæ," G. W. & E. G. Peckham, Nov., 1894.

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 Mxico," G. W. & E. G. Peckham, April, 1896.

"The Wisconsin Archeologist," Vol. I, No. 1, Oct., 1901; Vol. I, No. 2, Jan., 1902; Vol. I, No. 3, Apr., 1902; Vol. I, No. 4, July, 1902; Vol. II, No. 1, Oct., 1902, each................ 25 cents

This publication is now issued by the Wisconsin Archeological Society of Milwaukee, from whom the later volumes may be obtained.

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Actual date of publication, June 22, 1911

Vol. 9 JULY, 1911 No. 3

BULLETIN

OF THE

Wisconsin Natural History Society

PUBLISHED WITH THE
COOPERATION OF THE

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The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6. 1857.

OFFICERS AND DIRECTORS.

PUBLICATION.

The "Bulletin of the Wisconsin Natural History Society."

Matter intended for publication should be sent to the editor of the Bulletin, who will transmit it to the associate editor of the proper department for consideration.

EDITORS.

MEETINGS.

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room at the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

MEMBERSHIP DUES.

Active Members, $3.00 per annum; Junior Members, $1.00 per annum; Corresponding Members, $2.00 per annum; Life Members, one payment of fifty dollars.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 9. JULY, 1911. No. 3

PROCEEDINGS.

Milwaukee, March 30, 1911.

Regular meeting of the Society.

Mr. Teller in the chair. 16 people present.

Minutes of the last regular meeting read and approved.

The name of Mr. Alfred Senn, City Park Board, was submitted by Dr. Barth for membership; Mr. Senn was subsequently elected to active membership by the board of directors.

Mr. George W. Colles gave the evening's talk on The Glacial Topography of Eastern Wisconsin, With Particular Reference to the Duration of Postglacial Times. The speaker discussed the various glacial landmarks found in eastern Wisconsin, especially those found in Milwaukee county, showing them on the screen by means of slides and diagrams. By analogy the speaker attempted to show that the glacial period could not have been less than a hundred thousand years ago.

The lecture was discussed by Dr. Graenicher and Messrs. Scheiber, Teller, Colles and Russel.

The meeting then adjourned.

Milwaukee, April 13, 1911.

Meeting of the combined sections.

President Barth in the chair. 37 people present.

Minutes of the last sections meeting read and approved.

Mr. Henry L. Ward presented the nomination of Mr. Harry F. Buenger, 931 Ninth street, for active membership; Mr. Burrill presented the name of Mrs. Adela Maud Anderson. Both were subsequently elected active members by the board of directors.

Prof. George Wagner of the University of Wisconsin, gave the evening's lecture: The Voyage of the Challenger: A Story of the Deep Sea. Our knowledge of the life of the deep sea is quite recent, the fact that the ocean covered the greater part of the earth's surface dating only from the time of Columbus. The first investigator was Magellan. More recently the laying of the first Atlantic cable disproved Sir Forbes' assumption that life became extinct beyond a depth of 2,000 feet. The expedition of the Challenger, begun December. 1873, and lasting three years and four months, during which over 63,000 miles were covered, was the first attempt on a large scale to determine the depth of the ocean and the occurence of life at the various depths. The United States now keeps a boat, the Albatross, constantly in commission for the same purpose.

By means of lantern slides the lecturer showed the various methods employed by the expedition in sounding—the old method of using ropes, then piano wire and the modern cables; the ascertainment of the ocean temperature at various depths and the forms of dredges developed formed interesting mechanical problems for the audience.

Some of the general physical results obtained by the Challenger expedition are: The deepest place in the ocean is 31,000 feet below sea level, the average depth 12,000 feet. The water pressure being sixteen pounds to the square inch for every thirty feet, it is easy to figure out the water pressure at any depth. Oxygen is found everywhere, carbon dioxide practically absent.

Plant life is found to a depth of about 2,000 feet. After that for many thousand feet we find oozes, the globigerina ooze in the Atlantic, and the infusorian ooze in the Pacific ocean. Among general characteristics may be mentioned that contrary to the expectation that organisms at great depths would be colorless owing to absence of light, as in the case of cave animals, it was found that fishes were mostly black, while crustaceans exhibited beautiful shades of red and blue. Oddness of forms, enormous development of the tactile organs, and phosphorescence, especially among the fishes, are found to be the general attributes of the deep sea fauna.

A large series of slides were used to illustrate the lecture. Messrs. Russel, Dernehl, and others discussed the lecture. Mr. Burrill proposed a vote of thanks. Seconded and carried. Dr. Barth extended the thanks of the Society to the lecturer.

A communication was then read from the Hon. Emil Seidel, Mayor of Milwaukee requesting that the Society submit several names of members to be considered in the selection of a trustee for the Public Museum. After some discussion the names of Mr. Edgar E. Teller and Mr. Gardner P. Stickney were proposed. Dr. McGovern then moved that the President of the Society select the names of three members and submit these to the mayor. Seconded and carried.

The question whether the Society should assume the partial payment of the printing of a pamphlet entitled "The Genesis and Early History of the Wisconsin Natural History Society," by C. Doerflinger, was then brought up for discussion. Messrs. Dernehl, Barth, Colles, Barrett, and Russel spoke on the matter. Mr. Colles moved that since the Society had not ordered the printing it should not assume any portion of the expense of the pamphlet. Seconded. The motion was lost. Mr. Russel then moved that the chairman appoint a committee of three to inquire into the matter. Seconded and carried.

Upon motion the meeting adjourned.

Milwaukee, Wis., April 27, 1911.

Annual meeting of the Society.

President Barth in the chair. 47 people present.

Minutes of the last regular meeting read and approved.

The order of business was reversed.

Dr. C. E. Allen of the University of Wisconsin, gave the evening's lecture on "The Physical Basis of Inheritance," a general summary of Mendelism and its bearing on inherited characters.

The lecture was discussed by Drs. Dernehl, Allen, Graenicher and Mr. Burrill.

Dr. Graenicher proposed a vote of thanks to the lecturer. Seconded by Dr. Sommer and carried. President Barth extended the thanks of the Society to the lecturer, who voiced his appreciation of the Society's action.

After a brief intermission the business was taken up. The printing of a pamphlet by Mr. Doerflinger, for which the Society was requested to assume partial payment, was discussed and a committee appointed to report at the next meeting: Mr. E. E. Teller, chairman; Howland Russel and C. Carpenter, members.

Committee reports: Dr. Graenicher reported in behalf of the Committee for Regular meetings. The Committee for Resolutions on the death of Dr. Whitman of Chicago, and the Botanical Committee; Mr. G. W. Colles reported for the Committee for Section Meetings.

The General Secretary and Treasurer read their reports, both of which were accepted by vote of the Society. An Auditing Committee consisting of Mr. Teller and Dr. Barrett was appointed to audit the treasurer's accounts. This committee subsequently reported that it had found everything in order.

The names of Mr. Charles McDermond, John Meyers and John G. Gross, all of Green Bay, Wis., were presented by Mr. A. Schoenebeck for corresponding membership. The directors subsequently voted favorably on the nominations.

The nomination of officers was then taken up. Dr. Barth, Dr. Dernehl and Mr. Muttkowski signified their intention to withdraw from their respective offices. Dr. Graenicher moved that the Secretary cast one ballot for the incumbent officers. Seconded by Mr. Russel. After protest on the part of Dr. Barth, Dr. Dernehl and Mr. Muttkowski, and some discussion by Messrs. Scheiber, Colles, Russel and Dr. Graenicher the motion was declared void. Mr. Russel then moved that the election be postponed until the next meeting and that the chairman appoint a committee of three to prepare a ticket for the officers, this ticket to be presented at the next meeting. Seconded and carried.

Mr. Colles then brought up the question of summer meetings. After discussion by Dr. Graenicher, Messrs. Russel, Colles, Barth and Muttkowski, it was moved that a committee be appointed to consider the matter and to report at the next meeting. Seconded and carried.

Upon motion the meeting then adjourned.

Milwaukee, May 11, 1911.

The annual banquet of the Society was held at the Republican House and was attended by 34 people.

Milwaukee, May 25, 1911.

Regular meeting of the Society. 13 people present.

Minutes of the annual meeting read and approved.

The order of busines was reversed.

Dr. A. B. Plowman of Carroll College, Waukesha, gave the evening's lecture on The Public Museum as a Factor in Popular Education.

Because of the lack of a quorum no business could be transacted. But owing to the necessity of having a Treasurer for the Society, as urged by Dr. Dernehl, Dr. Barth and Mr. Muttkowski, President Barth appointed Mr. Herman B. Beckmann as Treasurer pro tem, until a Treasurer could be elected in the regular way prescribed by the by-laws.

President Barth then thanked the lecturer for his interesting paper.

The resignation of Mr. Colles as Chairman for the Committee on Programs for Section Meetings was submitted. President Barth appointed Dr. Robert G. Washburn to fill this place on the committee for the present.

Upon motion the meeting then adjourned.

Milwaukee, June 8, 1911.

Meeting of the combined sections.

Mr. Teller in the chair. Mr. Burrill as Secretary pro tem.

Minutes of the last section meeting read and approved.

Dr. R. G. Washburn gave a demonstration of the hookworm and a review of its life history with notes on its ravages in man. Dr. C. W. Stiles brought the matter to public attention by his publication in 1902. This lazy-worm disease is prevalent in rural districts only. Infestation is by embryos getting through the skin, not by the mouth in drinking water as once thought. It comes to infest all people having to do with the soil. General debility follows. Worms are not fixed like tape-worms but move about, biting holes here and there, giving anaemia. Also they may give off a poison in the blood, increasing debility. There may be a few or thousands of worms in one person. Thus has been produced the class of the south called "poor white trash". The hookworm is a member of the Nematode family *Strongilidae*. It differs from its European relative *Ancylostoma duodenata* by the lack of holding hooks and fleshy lips.

The paper was discussed by Messrs. Burrill, Monroe, Washburn and Miss Elmer.

Mr. Burrill read a paper on the "Lake Flies *(Chironomus plumosus)* and their August Swarming About Lake Winnebago". This paper was discussed by Miss Elmer, Mr. Teller and Mr. Ralph.

Mr. E. E. Teller spoke on the new Bull. 21 of the Wis. Geol. and Nat. Hist. Survey, and the Milwaukee members who contributed new species.

The meeting then adjourned.

Milwaukee, June 29, 1911.

Regular meeting of the Society.

President Barth in the chair. 16 people present.

Minutes of the last regular meeting read and approved.

The order of business was reversed. Mr. R. A. Muttkowski gave an illustrated talk on The Gypsy Moth: An Account of the New Remedy.' Mr. Muttkowski gave a brief narrative of the rcent application of Flacherie, or "Wilt", a caterpillar disease, in Massachusetts in the fight on the gipsy moth and discussed its advantages as compared to the parasitic method.

The talk was discussed by Dr. Graenicher and Mr. Burrill.

Dr. Dernehl suggested that the committee send an invitation to Mr. Henry Severin to give a lecture in September.

The election committee then submitted the following ticket for the officers of the Society:

President—Dr. George P. Barth.

Vice-President—Dr. P. H. Dernehl.

Secretary—Dr. Robert G. Washburn.

Treasurer—Herman B. Beckmann.

Additional Director—Henry L. Ward.

Mr. Muttkowski moved that the nominations be closed. Seconded and accepted. Mr. Russel moved that the Secretary cast one vote for each candidate. Seconded and carried.

Dr. Barth then thanked the members for the confidence placed in him and discussed the policy for the coming year.

Dr. Washburn then reported for the committee on summer meetings, saying that the committee thought it advisable to discontinue the meetings during the summer months. The report was accepted by regular vote.

Mr. Teller reported for the committee on the Doerflinger matter, stating that in view of the small sum entailed the committee felt that the Society ought to pay the bill. The report was accepted by regular vote.

Upon motion the meeting then adjourned.

STUDIES IN *TETRAGONEURIA (ODONATA)*.

By Richard A. Muttkowski.

A revision of the genus *Tetragoneuria* presents a series of difficulties which fully equal those of other genera of *Odonata*, such as *Argia*, *Neurothemis*, *Erythrodiplax*, *Perithemis*, *etc.* The close resemblance of the species, the generalized genitals and but little specialized anal appendages, and the variability of wing markings and wing venation are factors which tend to make a mechanical separation of the species difficult, if not impossible on occasion.

The genus *Tetragoneuria* has always, more or less, belonged to the category of "Splitters' and Lumpers' Paradise". The tendency to regard color extremes as indicating specific validity, as also the other extreme—to regard them as a series showing the gradual development of one species—is well marked in the writings on the subject. Either tendency seems to have been based on the amount of material available to the respective author.

The present study had its origin in 1909, when the Milwaukee Museum expedition to the St. Croix river furnished a series of about thirty specimens. Coincident with this material some specimens were received from Florida for determination, a fair share of which fell to the Museum. This together with material already on hand formed the nucleus of a brief study, in which the following conclusions were reached:

(a) The T-spot, as far as *cynosura* is concerned, is an unreliable character. For the material showed all gradations from a rudiment of the T-stem to the fullest development of the T-cross.

(b) The specimens from Florida are not identical with those from northern states.

(c) A query. What is the distinction between *cynosura*, *basiguttata*, *semiaquea* and *indistincta* (*semiaquea* as interpreted by recent authors)? Dr. Martin's table (Cordulines, p. 45, 1908) offered no help in this matter. Strictly taken, over half of the specimens on hand would be referable to *indistincta* Morse; on the other hand, the identity of the specimens of the St. Croix series was unmistakable.

This was as far as I went at the time. Later, in 1910, when rearranging the collections, a more careful examination of the material was made with a view toward the discovery of constant specific characters. One result was the discovery of *T. morio* n. sp., whose color resemblance to the other specimens had caused me to overlook it previously. Characters seemed plentiful and were fairly constant in most cases. Yet since the material was regional, it could be assumed that at least some of the characters were likewise regional. Eventually this proved to be the case.

Before attempting to describe *T. morio* I found it imperative to ascertain the exact values of existing species. The various descriptions seemed confusing, and in a number of cases did not agree at all with the original descriptions.

It was necessary to obtain additional material, especially from the Austral region. Such was kindly supplied by Dr. Philip P. Calvert of Philadelphia, Mr. E. B. Williamson of Bluffton, Ind., Dr. E. M. Walker of Toronto, Ont., Messrs. C. S. Brimley and F. Sherman, Raleigh, N C., and the U. S. National Museum.

Dr. Calvert's material showed a number of interesting forms from diverse and widely separate localities. Mr. Brimley's and Mr. Sherman's material was entirely from North Carolina and was for that reason especially welcome. As usual, Mr. Williamson furnished the richest material, rich in number, variety and localities. That of Dr. Walker was regional. The National Museum specimens covered several regions untouched by the remaining lots.

Characters.

The characters considered in this study may be conveniently classed into venational, structural and color characters.

Venation.—A comparison of the tables will show that there is a very gradual increase in the venation, with *cynosura* and *canis* as the two extremes. Yet this increase is so gradual and the amount of variability from the mean is so great that the venation cannot enter as a factor in the determination of the more nearly related species. The antenodals increase from six to ten in the fore wings and from four to six in the hind wings. The postnodals increase in a less striking manner. Co-ordinate with the increase of the latter we find the postnodal-radial space (Williamson) lenghtening and the substigmal series of two to four veins retreating from the third to the fifth postnodal.

The origin of the cubito-anal crossvein—coincident with A_4 or distal thereto—seemed a constant factor in Wisconsin material; the tables showed otherwise for other regions.

The crossing of the triangle of the forewings may be set down as a generic feature, for it is constant, with rare exceptions, in all specimens seen by me. Only in *spinigera* and *canis* are the triangles of the hind wings found crossed, but this is the case in only 50% of the specimens so that no specific value can be attached to this character.

Structure.—The form of the abdomen is an uncertain feature. Here also a progression from parallel to broadly spindle-shaped abdomens takes place, with *stella* and *spinigera* at the two extremes. As a rule, the constriction of segment three is fairly well pronounced and segments nine and ten are markedly narrower than the preceding ones, and the species so labeled (as spindle-shaped) are therefore easily recognizable.

The form of the male appendages is the chief character of distinction, though subject to some variation, at least in the *cynosura* series. The female appendages show little variation in a species and this character has formed the chief distinction between females of the various species. If taken in conjunction with other characters, I believe, a species cannot be easily mistaken.

Colors.—The general color is subject to little variation. All have practically only one type of color pattern, with slight individual variation. The chief feature is the T-spot, which apparently is constant in most species by its presence or absence, though extremely variable in *cynosura.*

The question of wing coloration is taken up more fully under *cynosura* and *semiaquea.*

Distribution.—The genus *Tetragoneuria* covers a greater portion of North America. Few specimens have been collected in the west, though the species undoubtedly occurs in the western states, as proven by material obtained by Dr. Osborn and others in Washington and Britsh Columbia.

Species.—The present study has occasioned the naming of several new species, while at the same time a number of others have been relegated to the synonmy. The number of species of *Tetragoneuria* is therefore hardly increased. A list of the species and their synonymy is given at the end of this paper.

Acknowledgements.—I have already stated from whom specimens were received. To these gentlemen I wish to express my thanks and sincere appreciation of their kindness. To Mr. Williamson and through him to Dr. Ris I am indebted for the use of the notes of the latter on the types in the de Selys collection at Brussels. Had it not been for the careful notes of Dr. Ris, a solution of the synonymy would have been impossible. Through his notes I have been enabled to ascertain the exact values of such forms as *complanata, basiguttata* and *costalis*, though in the latter case Dr. Ris has expressed his doubt of the specimens under that name in the de Selys collection.

Dr. Walker has sent me notes on several specimens of *canis* in his collection and also some suggestions on the color variation of *T. cynosura.*

Dr. Calvert's paper on Burmeister's types of Odonata has been very useful. Owing to his exact description of the type of *semiaquca* it is possible to refer *semiaquca* to the position it should properly occupy.

Of all the species described only *costalis* and *spinosa* have not been seen by me. The latter is very rare in collection and has been confounded with *canis* by most recent writers. *Spinosa* is probably a southern species which would account for its rarity in collections.

Little attempt has been made at accurate descriptions of the body pattern, since they are practically identical in all species. Mr. Williamson's extended description will serve as the mean for all other species of the genus.

The wing photographs shown with this paper have been furnished by Mr. Williamson. Originally they were intended to show the complete stages of color development found in one species; and such, with the exception of the wings in which the color reaches the nodus, is actually the case in *T. cynosura.*

TABLE OF THE SPECIES OF TETRAGONEURIA.

A. Abdomen of male slender and parallel, a very slight constriction at 3; length 30-33 mm., hind wing 29-32 mm.

B. Wings without brown markings; thoracic stripes black........................**stella** Williamson n. sp.

BB. Wings with brown spots at antenodal intersections, sometimes with spaces filled; thoracic stripes metallic, with violet reflections...........**petechialis** n. sp

AA. Abdomen of male spatulate, 3 distinctly constricted; sides of thorax rarely metallic, and only on sides below.

B. Male appendages with tips widely separate, an inferior angle at basal third, and a lateral ridge leading beyond, no superior modification; female appendages not exceeding 1.7 mm., vulvars flattened, divaricate. V-shaped, the tips divergent.

C. Color of hind wings not exceeding last antecubital; T-spot usually present, or indicated by metallic reflection in median frontal sulcus; length abdomen rarely less than 28 mm. (28-32), hind wing 28-32 mm.; thoracic pile predominately gray.

D. Brown of hind wings reaching base of triangle. or less.................**cynosura** Say

DD. Brown of hind wings reaching tip of triangle and filling it, or more........**simulans** n. n.

CC. Color of hind wings reaching nodus; T-spot absent; length abdomen rarely more than 27 mm. (23-27. hind wing 24-26 mm.; thoracic pile predominately brown.....**semiaquea** Burmeister

BB. Male appendages with tips approximate, the inferior angle produced, no lateral ridge beyond angle, no superior modification; female appendages longer than 1.7 mm., vulvars U shaped, the tips parallel.

C. T-spot absent; small species, abdomen 29-31 mm., hind wing 31 mm.; female appendages 2 mm.; hind wing with streak to first antenodal........ ....**williamsoni** n. sp.

CC. T-spot present; large species, abdomen 33-35 mm., hind wing 32-34 mm.; female appendages 3-3.3 mm.; hind wing with color streaks reaching beyond second antecubital (beyond t in the type) ....**morio** n. sp.

BBB. Male appendages with inferior spine, no inferior angle; female appendages 3-3.3 mm., vulvars U-shaped, the tips parallel; hind wings with color streaks to level of the base of the triangle (to level of tip in *morio*); wings hyaline, no flavescent tinge; T-spot always present ....**spinigera** Selys

BBBB. Male appendages with superior modification; no T-spot.

C. Superior appendage slightly curved with sharp spine at apical third above, an inferior obtuse angulation at basal third (not rectangular as in the preceding species); wings hyaline, clear, no flavescent tinge; female ?........**spinosa** Hagen

CC. Superior appenages with apical third sharply declivious a tubercle above at the bend; in lateral view the appendage curved beneath, with two to four tubercles of various size; female apendages 2.3-2.7 mm., vulvars U-shaped; wings with brown at base, usually with flavescent tinge throughout, giving them a dull appearance ....**canis** MacLachlan

CCC. Female appendages 4.5 mm.; wings with costal streaks of brown; male unknown..**costalis** Selys

Tetragoneuria stella Wiliamson, sp. nov.

Labrum golden, clyeus and frons olive or yellowish, the latter and on the sides usually lighter, the frons in one specimen being as bright as the labrum. Vertex olive, with a black border on the frons in front of the vertex, this black produced on either side and anteriorly in the sulcus of the frons, and including the black antennæ. Hair on face pale, cream colored, excepting on frons where it is black. Rear of eyes black.

Thorax yellow or yellowish brown with white or nearly white pile. The humeral and second lateral sutures each with a black stripe, widest above; the humeral stripe very narrowly connected with a spot at the base of the middle legs; the metastigma narrowly surrounded by black.

Wings may be entirely hyaline without trace of spots, the membrane sometimes with faint fumose. In every case the front wings are without spots and the maximum development of color in the hind wings is as follows: a basal spot on either side of the subcostal vein most developed on the posterior side (in the subcostal space) and extending along the vein to the first antenodal, the membrane on either side of the first antenodal slightly but distinctly tinged with brown in the subcostal space; a basal spot in the cubital space, reaching about half way to the cubito-anal across vein, which may have brown traces on either side and posterior to it; a brown spot in the anal triangle on either side of the cross vein, its greatest area on the anterior side of the cross vein, in its maximum development the anterior third and posterior third or fourth of the anal triangle remaining hyaline; the V-shaped cross vein on the distal side of the anal triangle margined with brown. Costa front wings distinctly yellow at base. Membranule white, in the male more or less with brown posteriorly against the anal triangle.

Legs dark reddish brown, bases of all and femora of the first pair pale.

Abdomen long and slender when compared with species of the *cynosura* group. ♂.—Seen in profile of nearly uniform width after segment 3, segments 2 and 3 moderately dilated and largely yellowish, slightly darker than the thorax in color. From above the last seven segments are of nearly the same width, black in color, each segment with a long yellow spot on either side, reaching the lateral margin, and on the anterior segments occupying the entire length of each segment except the extreme apex and base, reduced on the posterior segments and not present on 10; articulations between segments a narrow yellow ring; the lateral spots on the last seven segments, described above are so nearly joined that the abdomen might be described as black with a yellow interrupted stripe on each side. The black area on the dorsum of segments five and six at the narrowest point is 1.5 to 2 mm. wide.

♀.—Flattened in profile, in dorsal view tapering from 3 to the apex; in dried material distorted and shrunken as is so frequently true of the females of many Cordulines. Similar in color to male, the black dorsum beginning on 2, and the lateral spots continuous, forming lateral yellow stripes, and extending on to 10.

Male abdominal appendages.—Superior appendages seen in profile spatulate, with an obtuse inferior angle at one third the length, this angle inconspicuous; if the appendages of *stella* and any of the *cynosura* group are compared the differences in the superior appendages seen in profile are striking—*cynosura* high arched dorsally and excavated ventrically at the base, with a resultant prominent ventral angle, and a decidedly unsymmetrical outline; *stella,* on the other

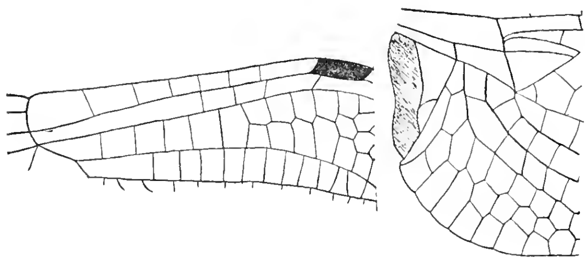
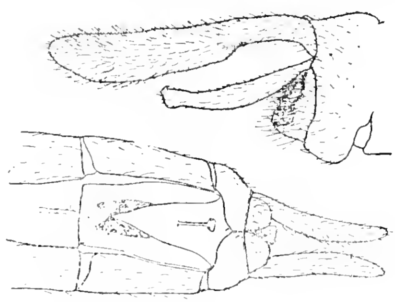


Figure 1.—Details of venation; left figure showing relation of substigmal series to postnodals: right figure illustrating coincidence of cubito-anal cross-vein with A4. From *T. spinigera.*



hand, without this arching and excavation, and with an outline almost symmetrical. Seen from above the superior appendages of *stella* have a dilatation on the inner side just distal to the apex of the inferior appendage: the latter is relatively shorter than in the *cynosura* group.

Length abdomen (incl. appendages): ♂ 33-34, ♀ 33-34 mm.

Length fore wing: ♂ 30-32. 5, ♀ 32.5-33-5 mm., average ♂ 31.7, ♀ 32 mm.

Material studied: 3 ♂, 1 ♀, West Palm Beach, Fla., March 11th, Pennsylvania State Museum, Harrisburg, Pa., all bearing the accession number 8759 r, one male with last seven segments and one male with last six segments lost, female teneral and distorted, apices of left wings gone.

5 ♂, 3 ♀ and four wings of a ♂, all collected by Mrs. Charles C. Deam and in my collection: 4. ♂ West Palm Beach, Fla., Feb. 22 and Feb. 24, 1904; one ♂, Rockledge, Fla., March 2, 1904; 3 ♀, Lantana, Fla., Feb. 23, 1904.

Holotype ♂, West Palm Beach, Fla., Feb. 22, 1904; allotype ♀, Lantana, Fla., Feb. 23, 1904, Mrs. Charles C. Deam, collection E. B. Williamson.

This species is named for Stella Mullin Deam, who has collected much botanical and zoological material in Florida. The botanical material has been collected for her husband, Charles C. Deam. I am indebted to her for the specimens of this new species as well as for many other dragon flies from Florida.

When I received these specimens in 1904 I thought they represented an undescribed species. One of each sex was examined by Dr. Calvert and it was through him that I received for study the specimens belonging to the Pennsylvania State Museum. Later specimens were sent to Dr. Ris for comparison with material in the de Selys collection. After this examination by Dr. Ris some new questions as to identity came up and specimens were sent a second time to him. As a result of this double examination and study by Dr. Ris he sent me several closely written pages of notes, representing a great deal of work and time on his part. It is through his care and interest that I am now able, seven years after first studying the material, to describe this species as new.

Dr. Ris's notes on *Tetragoneuria* have been turned over to Mr. Muttkowski for a proposed revision of the genus. It is interesting to note that Dr. Ris found *stella* in the de Selys collection under the label *cynosura*. One of these specimens is from Louisiana (Morrison), the other from Georgia (Morrison). In Dr. Ris's opinion *stella* is quite distinct from all the *cynosura* group by the form of the abdomen (narrow, not spindle shaped), by the color of the abdomen, and by the superior abdominal appendages of the male, which are longer and have a second distal dilatation.—*E. B. Williamson.*

I have the types before me and have compared them with other material on hand. Mr. Wiliamson's species is well represented in the lots before me by the following specimens:

TABLE I. *Tetragoneuria stella* Williamson, n. sp.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	R. f. w.	L. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
A1	♀	7–6	4–4	5–5	6–6	$2\frac{3}{1}$	$3\frac{1}{2}$	$3\frac{1}{2}$	5	......	+	33	2	33	32	a	abs.	Fla.
A2	♂	6–6	4–4	5–5	6–5	$3\frac{1}{3}$	$3\frac{1}{3}$	3	$3\frac{1}{2}$	coin.	+	32	3	30	29	a	abs.	Fla.
A3	♀	7–8	4–4	4–5	5–6	$2\frac{3}{4}$	$3\frac{1}{3}$	$3\frac{1}{2}$	$3\frac{2}{3}$	......	+	....	.....	33	32	a	abs.	Fla.
A4	♂	7–7	4–4	5–6	5–5	$3\frac{1}{2}$	4	$3\frac{1}{3}$	$3\frac{1}{3}$	coin.	+	....	3	31	30	a	abs.	Fla.
A8	♂	7–7	4–4	7–	7–6	$4\frac{1}{2}$	4	$4\frac{1}{2}$	4	coin.	+	33	3	32	31	a	abs.	Fla.
A9	♀	7–7	5–4	6–5	7–6	4	4	$4\frac{1}{2}$	$3\frac{1}{4}$	......	+	....	.....	32	31	a	abs.	Fla.
A10	♀	8–7	4–4	5–6	6–6	3	4	$3\frac{1}{2}$	$3\frac{1}{2}$	......	+	31	.....	32	31	a	abs.	Fla.
B1	♂	6–6	4–4	5–5	5–6	$3\frac{1}{2}$	3	$3\frac{1}{3}$	3	coin.	+	30	3	28	27	a	abs.	Fla.
B3	♂	6–7	4–4	5–5	5–5	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{3}$	$3\frac{1}{2}$	coin.	+	....	.....	30	29	a	abs.	Fla.

A1.	♀	Bisc. Bay, Fla., Mrs. A. T. Slosson; coll. Calvert.
A2.	♂	Lake City, Fla.; Milwaukee Museum.
A3.	♀	Lake City, Fla.; Milwaukee Museum.
A4.	♂	Lake City, Fla.; Milwaukee Museum.
A8.	♂	Haulover, Fla., March 13th, Hubbard & Schwartz; U. S. N. M.
A9.	♀	Haulover, Fla., March 13th, Hubbard & Schwarz, U. S. N. M.
A10.	♀	Haulover, Fla., March 2, Hubbard & Schwartz, U. S. N. M.
B1.	♂	Lake City, Fla.; Milwaukee Museum.
B3.	♂	Lake City, Fla.; Milwaukee Museum.

Of these A8 is an exceptionally fine male in beautiful coloration: the black of the abdomen starts on the posterior half of 3. I am in doubt of another specimen B1 which differs from the remaining by its smaller size and the clearness and transparency of its wings; all the others show a decided tinge of yellowish dulling throughout the wing; in addition the stigma of B1 is shorter. The form of appendages and other characters, however, lead me to place it with *T. stella.*

Besides the characters shown in the table Mr. Williamson adds the following notes from his material:

Antenodals: fore wings 6 in 4 wings, 7 in 22 wings; hind wings 4 in 23 wings, 5 in 3 wings, 7 in 3 wings.

Postnodals: fore wings 5 in 9 wings, 6 in 12 wings, 7 in 7 wings, 8 in hind wings, 5 in 4 wings, 6 in 1 wing.

Cubital vein: coincident with A4 in 6 wings of the males, distal in 12 wings.

Substigmal series arising: fore wings, between 3-4: 10 wings; at 4: 6 wings; between 4-5: 8 wings; opposite 5: 1 wing. Hind wings, between 3--4: 15 wings; opposite 4: 4 wings; between 4-5: 7 wings; opposite 5: 1 wing.

Triangle fore wing free: 2 wings; crossed: 24 wings.

Tetragoneuria petechialis, sp. nov.

♂.—Colors brown, yellow and olive.

Labrum bright yellow, face with olive band, frons bright yellow (except in C4). Vortex olive, a black line at the base, slightly produced in the middle along the frontal sulcus. Antennæ black. Hair on frons and vertex black, otherwise pale. Thorax yellowish brown, covered with white pile which is longest dorsally. Humeral, first suture below and second lateral suture with dark stripe, widest above, of metallic blue, showing a decided violet reflection.

Wings hyaline, membranule white, slightly fumose at the lower end. Fore wings with small basal spot in C and Sc half way to or reaching the first antenodal, the first and second antenodals with a small fuscous spot surrounding the intersection at Sc. A linear spot surrounding the nodus. Hind wings with costal and subcostal streak half way or to the first antecubital. All antenodals with fuscous at the intersections, nodus with linear spot. A brown spot in the cubital space at the extreme base reaching to the marginal vein. A spot in the lower half of the anal triangle, following the oblique vein which divides this triangle, or filling the lower half. Costa of fore wings yellow at base.

Legs dark brown, bases and fore femora yellowish.

Abdomen long and slender as in the foregoing species, segments two and three moderately dilated. Segment 8 as long as 9 + 10. Dorsum black, a yellow stripe occupying the lateral fifth of each side of 3 to 9, reduced on the posterior segments. Male appendages intermediate between *cynosura* and *stella*, though more nearly related to the latter.

♀.—Much like the male. The segment 10 of the abdomen shows a small yellow spot on each side which is absent in the male. The female appendages are longer than those of *cynosura* and less spiculiform. Vulvars slender and recurved, not flattened and divaricate as in *cynosura*, the tips sub-parallel.

Length abdomen: ♂ 28-31, ♀ 31 mm. Hind wing: ♂ 27-31, ♀ 30 mm. Average wings 30 mm., abdomen 30.

Described from the following material:

C1.	♂	Round Mt. Blanco Co., Texas, April 25, 1894; coll. Calvert.
C2.	♀	Round Mt. Blanco Co., Texas, Schaupp; coll. Calvert.
C3.	♂	Round Mt. Blanco Co., Texas, April 9, 1894; Milwaukee Museum.
C4.	♂	Cypress Mill, Texas, April 10, 1893; A. N. S. Phila.
C5.	♀	Florida, March 6, 1899, Blatchley; coll. Williamson.

TABLE II. *Tetragoneuria petechialis*, n. sp.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	R. f. w.	L. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
C1	♂	7–7	4–4	5–5	5–6	3½	3½	3½	3½	coin.	+	28	3	28	27	b	abs.	Tex.
C2	♀	7–7	4–4	6–6	5–6	3½	3¾	3½	3¾	......	+	31	2.3	32	30	b	abs.	Tex.
C3	♂	7–7	4–4	5–6	6–6	3⅓	3½	3¾	3¾	coin.	+	31	3	32	31	b	abs.	Tex.
C4	♂	7–7	4–4	6–6	6–5	4	4½	3½	3½	c/d	+	31	3	29	28	b	abs.	Tex.
C5	♀	7–6	4–4	6–6	6–6	4	3½	4	3½	......	+	27	2	31	30	b	abs.	Fla.

Holotype male—C3—Milwaukee Public Museum, allotype female —C2—and paratypes in coll. Calvert.

The species is at once distinct from the others by the narrow abdomen, the form of the appendages and the conspicuous spots at each antenodal of the hind wings. I was greatly in doubt whether to name this species or not; yet, as will be later apparent, it did not seem to belong to any of the forms listed.

Tetragoneuria cynosura Say.

♂.—Colors brown, yellow and black.

Labrum and frons yellow, face with an olive band, the pile on the frons black. Frons above showing various degrees of a black T-spot, from a mere indication of the black stem to the fullest development of stem and cross piece, the latter then covering the entire width of the frons. Usually, however, even in such cases where the stem of the T-spot is rudimentary, there is a metallic glint in the median frontal sulcus. Vertex and antennæ black, head black behind.

Thorax brownish yellow, humeral and lateral sutures with irregular spots of bright yellow. Usually the black stripes show but little or no metallic glints, and then only in fully matured specimens; these metallic glints are confined, as a rule, to the latero-inferior convex plates of the thorax though occasional specimens may have the metallic glints farther up below the wings, in which case the pile hides most of the iridiscence. In no case is the metallic reflection as bright as in *petechialis*; the latter shows decidedly violet reflections throughout the extent of the lateral stripes, while *cynosura* may show dark blue reflections, which are confined to the lower lateral ridge.

Legs black, fore femora and bases of all legs, luteous.

Abdomen flattened, and therefore appearing shorter than *stella* and *petechialis*, usually constricted as segment 3 after a moderate dilation of segments 2 and 3. Segments often "telescoped", a comparison is therefore uncertain. Yellow lateral stripes interrupted at base and apex of segments, absent on 10.

Appendages spatulate, an inferior angle at the basal third, a lateral ridge continued for a short distance beyond the inferior angle. Viewed from above the appendages divaricate.

♀.—Similar to the male. Middle femora often luteous. Segment 10 of abdomen with small lateral spots of yellow. Vulvars divaricate, flattened, the tips subacute. Appendages short, spiculiform, pointed.

Length abdomen (incl. app.) 27-31 mm., hind wing 27-31 mm. Though exhibiting some variability, the appendages of *cynosura* are

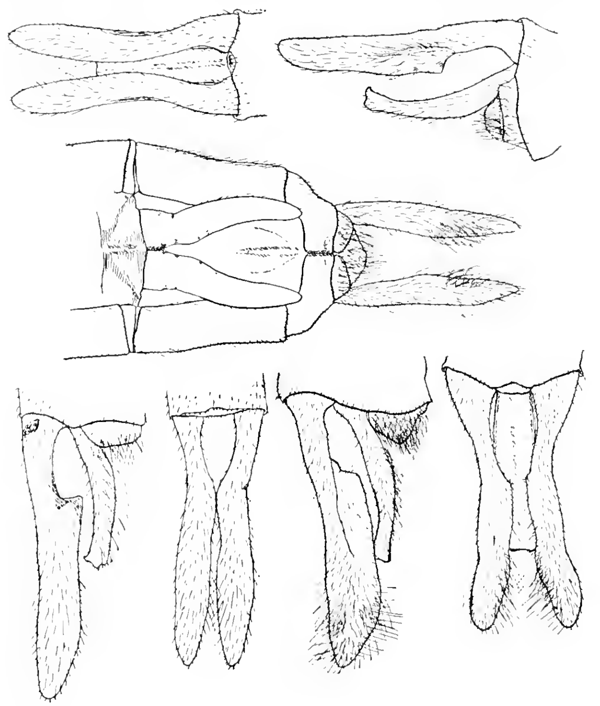


Figure 3.—*T. cynosura* Say. The two bottom figures to the left are from a male (B12) which approximates *T. williamsoni.*

distinctive from those of the two preceding species and *semiquea.* Occassionally a specimen, such as B12, approaches *stella*, but if the regional difference be taken into account there is little difficulty in separating the forms.

In width of the abdomen there is much variation. The series from Wisconsin, F10-F30, shows much variability. Thus F11 is sub-parallel, segment 5 is but 2 mm. wide at the base, while F23 is 3.5 mm. at the same segment. As a rule the apical segments have a wider expansion than the constriction at 3, and also the 9th and 10th segments are markedly narrower than the preceding ones. The insects therefore present a much different appearance from the slender and parallel form of *stella* and *petechialis.*

As to wing markings the long series on hand permit a division into more common forms, though intermediates are not wanting. Certain types, however, usually from a single region, show constancy in the type of their markings. For convenience the following division of color types was made, applying only to the hind wings:

c1.	Colors reaching	half way to the first antenodal.
c2.	" "	to first antenodal.
d.	" "	base of triangle.
e.	" "	tip of triangle.
f.	"	extending beyond tip of t. and to third antenodal.
g.	" "	" " " t, " " fourth "

Very rarely a specimen exceeds the latter type of coloration. Of these forms c1 and c2 and e and f are more common. Their distribution and increase in color markings is from south to north, a striking phenomenon and the direct opposite of what we find in *Epicordulia princeps.* The transition of forms from c1 to f is so close and regular that there can be little doubt of their identity. Yet if extremes, c1 and g, be placed side by side they would hardly be considered identical. C1 is the form described by Say, while all the rest of the names *(basiguttata, lateralis)* are synonymical. I am loath to rename any of the various forms of *cynosura* since their identity is so obvious. Nevertheless, after much consideration I have decided to name the extremes represented by forms c1 to d and forms e to g, more as a matter of advisable convenience, and to prevent future synonymic entanglement, than because of natural distinctions. In doing so its seems advisable to have each name cover as large a series as possible.

Hindwings with markings reaching the base of the triangle or less.................................... **cynosura cynosura** Say

Hindwings with markings reaching to tip of triangle and beyond ....**cynosura simulans** n. n.

TABLE III. *Tetragoneuria cynosura* Say. Color type *c*.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	R. f. w.	R. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
B2	♂	7–7	4–4	5–5	6–6	3½	3	3½	3⅔	coin.	−+	30	3	28	27	c	abs.	N. Y.
B4	♀	6–6	4–4	5–5	7–5	3	3½	4½	3	......	+	28	1.5	29	28	c	shad.	Pa.
B5	♂	6–6	4–4	5–5	5–5	3½	3½	3½	3	coin.	+	29	2.5	29	28	c	shad.	N. Y.
B8	♂	6–7	5–4	5–5	6–7	3⅓	3	4⅓	4½	coin.	+	31	3	30	29	c	shad.	Ia.
B10	♂	7–7	4–4	6–5	6–8	4⅓	3¾	3¾	5⅓	dist.	+	30	3	30	29	c	shad.	Ind.
B11	♂	6–7	4–4	7–6	7–7	4½	4	4	4	dist.	+	30	3	29	28	c	shad.	Ohio
B12	♂	6–6	4–4	5–6	6–7	3¼	3⅔	3¾	4	coin.	+	31	3.5	30	29	c	abs.	Ohio
B13	♂	6–6	4–4	6–6	6–6	3⅓	4	3⅓	3½	c/d	+	30	3	30	29	c	......	Pa.
B14	♂	6–6	4–4	5–5	6–6	3	3⅓	3½	3½	dist.	+	28	3	29	28	c	shad.	Ind.
B15	♀	7–6	4–4	5–5	6–6	3½	3½	3½	3½	......	+	30	2	32	31	c	shad.	Ia.
B16	♂	8–7	5–4	6–6	7–6	4	3½	3½	4	d/c	+	30	3	30	29	c	shad.	Ind.
B18	♂	7–7	5–5	6–5	6–5	3½	3⅓	4	4	coin.	+	29	3	29	28	c	shad.	Ia.
B19	♂	6–6	4–4	5–5	5–6	3½	3	3½	4⅓	c/d	+	29	3	28	27	c	abs.	N. J.
B20	♂	6–6	5–4	6–5	6–6	4	3½	3½	3½	coin.	+	29	3	30	29	c	pres.	Ind.
B21	♂	6–6	4–4	5–5	5–6	3¾	3½	3¾	4¼	dist.	+	29	3	29	28	c	pres.	Ind.
B22	♂	7–6	4–4	6–5	6–6	4½	3⅔	4½	4½	dist.	+	30	3	29	28	c	abs.	Ind.
B23	♂	6–6	4–4	5–5	6–6	3½	3	3⅔	4½	coin.	+	27	2.7	29	28	c	pres.	Ohio
B24	♂	6–6	4–4	4–5	5–6	2¾	3½	3¾	4½	coin.	....	30	3	29	28	c	pres.	Ia.
B25	♂	6–7	4–4	5–5	6–6	4	4	3⅓	3¾	dist.	+	31	3	30	29	c	pres.	Ia.
B26	♀	6–6	4–4	5–5	6–6	3⅓	3½	3⅔	4	......	+	27	1.5	29	28	c	pres.	N. J.
B28	♂	6–6	4–4	5–5	5–6	3½	3½	3½	4	coin.	−+	28	3	28	27	c	shad.	Ind.
B29	♂	7–6	4–4	6–5	5–6	4½	3⅓	3½	4	dist.	+	29	3	29	28	c	pres.	Ia.
F44	♂	8–8	4–4	8–7	7–8	6	5	4½	5	dist.	+	....	.....	30	29	c	shad.	N. Y.
F45	♂	6–6	4–4	6–5	6–5	4	3¾	4	3½	coin.	+	31	3	32	31	c	abs.	Kans.
F48	♂	6–6	4–4	6–7	6–7	4	3⅓	3½	4¼	dist.	+	31	3	30	29	c	abs.	Mich.
F49	♀	6–7	4–4	5–6	6–6	4	3½	4	3½	......	+	29	1.7	31	30	c	abs.	Mich.
F50	♀	6–6	4–4	4–4	5–5	3	3	3½	3½	......	+	29	.....	30	31	c	abs.	Ill.

MATERIAL STUDIED.

1. Color type c1, *cynosura* Say.

B2. ♂ Staten Island, N. Y., June, W. T. Davis; coll. Calvert.
B4. ♀ Folsom, Del. Co., Pa., June 6th, 1892; coll. Calvert.
B5. ♂ Lake George, N. Y.; coll. A. N. S. Phila.
B8. ♂ Waterloo, Ia., June 7, 1906; N. Miller; coll. Williamson.
B10. ♂ Bluffton, Ind., June 23, 1907; coll. Williamson.
B11. ♂ Danville, Ohio, June 22, 1899, J. B. Parker; coll. Williamson.
B12. ♂ Spring Grove, Ohio, June 26, 1898, Chas. Dury; coll. Williamson.
B13. ♂ Westmoreland County, Pa., May 30, 1899; coll. Williamson.
B14. ♂ Blue River, Ind., June 10, 1903; coll. Williamson.
B15. ♀ Waterloo, Ia., June 8, 1906, N. Miller; coll. Williamson.
B16. ♂ Wells Co., Ind., May 22, 1900; coll. Williamson.
B18. ♂ Waterloo, Ia., June 7, 1906, N. Miller; coll. Williamson.
B19. ♂ Newark, N. J., May 9, 1896; coll. Williamson.
B20. ♂ Bluffton, Ind., June 16, 1903; coll. Williamson.
B21. ♂ Bluffton, Ind., May 28, 1905; coll. Williamson.
B22. ♂ Same.
B23. ♂ Mahoming Co., Ohio, June 10, 1900; coll. Williamson.
B24. ♂ Waterloo, Ia., June 7, 1906, N. Miller; coll. Williamson.
B25. ♂ Same.
B26. ♀ Newark, N. J., May 9, 1896; coll. Wlliamson.
B28. ♂ Elkhart, Ind., May 20, 1900; coll. Williamson.
B29. ♂ Waterloo, Ia., June 7, 1906, N. Miller; coll. Williamson.
F44. ♂ New York, C. V. Riley; U. S. N. M.
F45. ♂ Kansas, C. V. Riley; U. S. N. M.
F48. ♂ Detroit, Mich., Hubbard & Schwartz; U. S. N. M.
F49. ♀ Same.
F50. ♀ Summit, Ill., May 19, 1906, J. D. Hood; coll. Williamson.

2. Color type c2, *cynosura* Say.

B6. ♂ Bluffton, Ind., May 28, 1905; E. B. Williamson; coll. Calvert.
B7. ♂ Same.
B9. ♀ Waterloo, Ia., June 7, 1906, N. Miller; coll. Williamson.
B17. ♂ Bluffton, Ind., May 28, 1905; coll. Williamson.

TABLE IV. *Tetragoneuria cynosura* Say. Color type *c2*.

Number	Sex	Antenodals F. w.	Antenodals H. w.	Postnodals F. w.	Postnodals H. w.	Substigmal series arises at L. f. w.	Substigmal series arises at R. f. w.	Substigmal series arises at L. h. w.	Substigmal series arises at R. h. w.	Venation Cu-vein	Venation t f. w.	Length Abd.	Length App.	Length F. w.	Length H. w.	Color Wings	Color T-spot	Place
B6	♂	6–6	5–4	5–5	5–5	3⅔	3½	3½	3¼	coin.	+	30	3	29	28	c2	pres.	Ind.
B7	♂	6–6	4–4	6–6	6–5	3½	3½	3½	4½	coin.	+	29	3	29	23	c2	pres.	Ind.
B9	♀	6–7	4–4	6–7	6–6	4½	4½	4	3¾	......	+	28	1.7	30	29	c2	pres.	Ia.
B17	♂	7–7	4–4	6–6	7–7	4¼	4	4½	4¼	coin.	+	32	3	30	29	c2	shad.	Ind.
B27	♂	6–6	4–4	4–5	5–6	3	3½	3¼	3⅓	coin.	+	28	.....	28	27	c2	abs.	N. C.
B30	♀	6–6	4–4	5–6	6–5	3½	4	3½	3	......	+	27	1.5	29	28	c2	abs.	N. C.
D27	♂	6–7	4–4	6–6	6–6	4	4	3½	3½	coin.	+	28	2.7	29	28	c2	shad.	N. C.
D28	♂	7–7	4–5	6–5	6–6	4	3⅓	3½	4	......	+	28	1.7	30	29	c2	abs.	N. C.
D29	♀	6–6	4–4	5–5	6–5	3½	3	3¾	3	......	+	28	1.3	30	29	c2	abs.	N. C.
D30	♂	7–7	4–4	6–6	5–6	4	4	3½	3½	coin.	+	28	3	30	29	c2	abs.	N. C
D31	♀	7–7	4–4	6–6	5–7	3	3½	3	4½	......	+	27	.....	30	29	c2	abs.	N. C.
D32	♂	6–6	4–4	5–5	5–5	3½	3½	3½	3½	coin.	+	29	2.7	30	29	c2	abs.	N. C.
D33	♀	7–7	4–4	7–8	6–7	4	5	3⅔	4	......	+	28	1.7	30	29	c2	abs.	N. C.
D34	♂	6–6	4–4	5–5	6–7	3½	3¼	4	4	c/d	+	28	2.7	30	29	c2	abs.	N. C.
D35	♀	6–6	4–4	5–6	5–5	3½	4	3½	3½	......	+	27	1.5	29	29	c2	shad.	N. C.
D36	♀	7–	4–4	5–	6–6	3½	..	4	4	......	+	25	1.5	29	28	c2	abs.	N. C.
D37	♀	7–7	4–4	6–6	6–7	3½	4	4	4½	......	+	27	1.7	30	29	c2	abs.	N. C.
D38	♂	7–6	4–4	6–5	7–6	3½	3½	4	4	coin.	—+	31	3	29	28	c2	abs.	N. C.
D39	♂	7–7	4–4	8–7	6–7	5	4	3½	4	dist.	+	....	.....	30	29	c2	shad.	N. C.
D40	♂	6–7	4–4	5–5	5–7	3½	3½	3½	4½	dist.	+	27	3	29	28	c2	abs.	N. C.
D41	♂	6–6	4–4	5–5	5–7	3½	3⅓	3	3⅓	coin.	+	28	3	29	28	c2	abs	N. C.
D42	♂	7–7	4–4	5–5	6–6	3½	3	3½	4	dist.	+	27	.....	29	28	c2	abs.	N. C
D43	♂	6–7	4–4	6–5	6–6	4	3	3½	3½	coin.	+—	27	.....	30	29	c2	abs.	N. C.
D44	♂	7–6	4–4	5–5	6–5	3	3½	3½	3¼	coin.	+	27	3	28	27	c2	abs.	N. C.
F51	♂	7–8	5–5	6–6	6–7	4	4	3½	4	coin.	+	28	3	31	30	2	abs.	Pa.

TABLE V. *Tetragoneuria cynosura* Say, Color type *d*, and intermediates.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	R. f. w.	L. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
D25	♂	7–7	4–4	5–5	7–7	$3\frac{1}{3}$	3	$4\frac{1}{2}$	$4\frac{1}{2}$	dist.	+	28	3	27	26	d	pres.	Ind.
E1	♂	6–6	4–4	6–6	6–6	$4\frac{1}{3}$	$4\frac{1}{4}$	$3\frac{1}{2}$	4	coin.	+	29	3	29	28	d	pres.	Ia.
D26	♂	6–6	4–4	7–6	6–6	$4\frac{1}{3}$	$3\frac{1}{2}$	4	$3\frac{1}{3}$	coin.	+	28	3	29	28	d-e	pres.	Ind.
D46	♂	7–6	4–4	5–6	8–6	$3\frac{1}{3}$	$3\frac{1}{2}$	5	3	coin.	+	....	.....	29	28	d-e	pres.	N. C.
D47	♂	6–6	4–4	5–5	5–7	$3\frac{1}{2}$	$3\frac{1}{2}$	3	$3\frac{1}{2}$	d/c	+	29	3	29	28	d-e	pres.	N. C.
E2	♂	7–7	4–4	6–6	7–7	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{4}$	$4\frac{1}{2}$	dist.	+	30	3	30	29	d-e	pres.	Ind.
C5	♂	7–7	4–4	6–6	6–7	$3\frac{1}{2}$	$3\frac{3}{4}$	$4\frac{1}{4}$	$4\frac{1}{2}$	coin.	+	29	3	28	27	d-e	shad.	Mass.
F47	♂	6–7	4–4	6–6	5–6	3	$3\frac{1}{3}$	3	3	dist.	+	30	.....	29	28	d-e	abs.	N. Y.
F52	♂	7–7	5–5	6–6	6–6	$3\frac{1}{2}$	$3\frac{1}{2}$	4	$3\frac{1}{2}$	coin.	+	30	3	30	29	d	abs.	Ohio

B27.	♂	Raleigh, N. C., April 24, 1903, C. S. Brimley; coll. Williamson.
B30.	♀	Raleigh, N. C., April 11, 1903, C. S. Brimley; coll. Wilson.
D27.	♂	Raleigh, N. C., April 24, 1903; coll. Brimley.
D28.	♀	Lumberton, N. C., April 7, 1903; coll. Brimley.
D29.	♀	Raleigh, N. C., mid-April, 1908; coll. Sherman.
D30.	♂	Raleigh, N. C., March 24, 1903; coll. Sherman.
D31.	♀	Same.
D32.	♂	Same.
D33.	♀	Old Fort, N. C., Sept. 9, 1902; coll. Sherman.
D34.	♂	Raleigh, N. C., March 24, 1903; coll. Sherman.
D35.	♀	Same.
D36.	♀	Lumberton, N. C., April 9, 1903; coll. Sherman.
D37.	♀	Raleigh, N. C., March 24, 1903; coll. Sherman.
D38.	♂	Same.
D39.	♂	Lumberton, N. C., April 7, 1903; coll. Sherman.
D40.	♂	Raleigh, N. C., March 24, 1903; coll. Sherman.
D41-44.	♂♂	Same.
F51.	♂	Westmoreland Co., Pa., May 30, 1899; coll. Williamson.

3. Color type d, and intermediates d to e.

C5.	♂	Sherborn, Mass., A. L. Babcock; coll. Calvert.
D25.	♂	Elkhart, Ind., May 20, 1900; coll. Williamson.
D26.	♂	Same.
D46.	♂	Raleigh, N. C., March, 1903; coll. Sherman.
D47.	♂	Same.
E1.	♂	Waterloo, Ia., June 7, 1906, N. Miller; coll. Williamson.
E2.	♂	Bluffton, Ind., June 23, 1907; coll. Williamson.
F47.	♂	Baldwinsville, N. Y., June 14th, 1891, N. Banks; U. S. N. M.
F52.	♂	Ohio, J. S. Hine; coll. Williamson.

4. Color type e, *simulans* n. n.

D1.	♂	Bluffton, Ind., May 28, 1905, E. B. Williamson; coll. Calvert.
D2.	♂	Same.
D5.	♂	Milwaukee Co., Wis., June 4, 1899; Milwaukee Museum.
D6.	♂	Ontario, June 20, 1907, E. M. Walker; coll. Williamson.
D7a.	♀	Same.

TABLE VI. *Tetragoneuria cyn. simulans*, n. n., Color type, *e*.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	L. f. w.	L. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
D1	♂	7–6	4–4	5–5	5–5	3	2¾	3⅓	3⅓	coin.	+	29	3	29	28	e	pres.	Ind.
D2	♂	7–7	5–4	6–6	6–5	3¾	4	3½	3½	coin.	+	29	3	29	28	e	pres.	Ind.
D5	♂	6–7	4–4	5–6	6–5	3	3½	4	3½	coin.	+	28	3	28	27	e	pres.	Wis.
D6	♂	7–8	4–4	6–7	7–7	4	4	4½	3½	c/d	+	29	3	30	29	e	pres.	Ont.
D7a	♀	6–6	4–4	6–6	6–6	3½	3½	3½	3½	......	+	29	1.7	31	30	e	pres.	Ont.
D8	♂	7–7	5–4	6–6	6–6	3½	3½	3	3½	dist.	+	29	3	29	28	e	pres.	Ind.
D9	♂	6–6	4–4	6–5	6–6	3½	3⅓	3⅓	3⅓	dist.	+	29	3	29	28	e	pres.	Ind.
D10	♂	6–6	4–4	4–5	5–6	2½	3½	3¼	3½	dist.	+	29	3	28	27	e	abs.	Ind.
D11	♂	7–6	4–4	6–5	6–6	4½	3½	4	4	d/c	+	29	3	30	29	e	shad.	Ind.
D13	♂	7–7	4–4	6–5	6–6	4	3¼	3½	3½	coin.	+	30	3	30	29	e	pres.	Ind.
D14	♂	7–7	4–4	5–5	6–6	3	3⅔	4	3⅔	coin.	+	30	3	31	30	e	shad.	Ind.
D15	♂	8–8	5–5	7–8	8–7	4½	5	4½	4	coin.	+	30	3	30	29	e	pres.	Ind.
D16	♂	6–6	4–4	6–6	7–6	4½	4½	5	4	dist.	+	29	3	29	28	e	pres.	Ind.
D17	♂	6–6	4–4	5–6	6–6	3¾	4½	4½	4⅔	dist.	+	30	3	30	29	e	pres.	Ind.
D18	♂	6–6	4–4	6–5	5–6	4	3½	3	3½	dist.	+	29	3	28	27	e	pres.	Ind.
D19	♂	6–6	4–4	6–5	6–6	4	3	4	4	coin.	+	29	3	28	27	e	pres.	Ind.
D20	♂	6–6	4–4	5–4	5–5	3½	3	3½	3¾	coin.	+	29	3	30	29	e	pres.	Ind.
D22	♂	7–7	4–4	7–8	7–7	4½	4½	4⅓	3½	coin.	+	29	3	29	28	e	abs.	Ind.
D23	♂	8–8	5–4	6–5	6–7	4½	4	2¾	3⅓	c/d	+	29	3	28	27	e	abs.	Ind.
D24	♀	7–6	4–5	6–6	6–6	4	4	3⅔	3½	......	+	27	1.7	28	27	e	abs.	N. C.
D45	♂	6–6	4–4	5–5	6–5	3	4	3⅓	3	dist.	+	28	.....	31	30	e	abs.	N. C.
F44	♂	6–7	4–4	6–6	7–7	4	4	4½	4½	dist.	+	28	3	29	28	e	abs.	N. C.
F45	♂	7–6	4–4	5–6	6–5	3½	4	4	3¼	dist.	+	27	2.7	28	27	e	abs.	N. C.
F34	♂	6–6	4–4	5–4	5–5	3	2½	3½	3⅓	dist.	+	30	3	28	27	e	abs.	Ind.
F53	♀	6–7	4–4	6–5	7–7	4	3½	4½	4½	......	+	30	1.7	31	30	e	abs.	Ill.
F54	♂	7–7	4–4	5–5	6–6	3½	3½	3½	4	dist.	+	31	3	31	30	e	abs.	Ind.

D8.	♂	Clear Lake, Ind., June 12, 1904, Deam; coll. Williamson.
D9.	♂	Bluffton, Ind., June 5, 1904; coll. Williamson.
D10.	♂	Clear Lake, Ind., June 12, 1904, Deam; coll. Williamson.
D11.	♂	Blue Lake, Ind., June 10, 1903; coll. Williamson.
D13.	♂	Clear Lake, Ind., June 12, 1904, Deam; coll. Williamson.
D15.	♂	Same.
D14.	♂	Blue Lake, Ind., June 10, 1903; coll. Williamson.
D16.	♂	Fort Wayne, Ind., June 17, 1906; coll. Williamson.
D17.	♂	Bluffton, Ind., May 28, 1905; coll. Williamson.
D18.	♂	Bluffton, Ind., June 23, 1907; coll. Williamson.
D19.	♂	Blue Lake, Ind., June 10, 1903; coll. Williamson.
D20.	♂	Bluffton, Ind., May 28, 1905; coll. Williamson.
D22.	♂	Rome City, Ind., June 7, 1908; coll. Williamson.
D23.	♂	Same.
D24.	♀	Raleigh, N. C., April 14, 1903; coll. Williamson.
D45.	♂	Raleigh, N. C., March 24, 1903; coll. Sherman.
F34.	♂	Elkhart, Ind., May 26, 1897, R. J. Weith; coll. Calvert.
F44.	♂	Raleigh, N. C., April 22, 1905; coll. Brimley.
F45.	♂	Same.
F53.	♀	Summit, Ill., May 19, 1906, J. D. Hood; coll. Williamson.
F54.	♂	Whitley Co., Ind., June 8, 1898; coll. Williamson.

5. Color type e to f, *simulans* n. n.

D3.	♂	Georgian Bay, Ont., June 20, 1907; coll. Walker.
D4.	♂	Go Home Bay, Ont., July 22, 1907; coll. Walker.
D7b.	♂	Bluffton, Ind., June 23, 1907; coll. Williamson.
D12.	♂	Maine, June 26, 1899, Harvey; coll. Williamson.
D21.	♂	Blue Lake, Ind., June 10, 1903; coll. Williamson.
F19.	♂	St. Croix Dam, Douglas Co., Wis., July 17-22, 1909; Milwaukee Museum.
F46.	♂	Manchester, Me., June 22, 1897, Miss Wadsworth; U. S. N. M.

6. Color type f, *simulans* n. n.

F1.	♀	Go Home Bay, Ont., July 21, 1907; coll. Walker.
F2.	♂	Go Home Bay, Ont., June 28, 1908; coll. Walker.
F3.	♂	Go Home Bay, Ont., June 26, 1907; coll Walker.
F4.	♀	Go Home Bay, Ont., July 5, 1908; coll. Walker.
F5.	♀	Go Home Bay, Ont., June 27, 1907; coll.Walker.
F6.	♂	Go Home River, Ont., June 25, 1907; coll. Walker.
F7.	♀	Same.

TABLE VII. *Tetragoneuria c. simulans*, n. n., Intermediates *e-f*.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	R. f. w.	L. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
D3	♂	7–7	4–4	7–6	6–7	$4\frac{1}{2}$	$3\frac{3}{4}$	4	$4\frac{2}{3}$	coin.	+	31	3.3	31	30	e-f	pres.	Ont.
D4	♂	7–7	4–4	6–6	6–6	$3\frac{3}{4}$	$3\frac{3}{4}$	$3\frac{1}{2}$	$3\frac{3}{4}$	dist.	+	29	3	29	28	e-f	pres.	Ont.
D7b	♂	7–7	4–4	6–6	6–6	4	4	4	$4\frac{1}{5}$	dist.	+	28	3	28	27	e-f	pres.	Ind.
D12	♂	7–7	4–4	6–7	6–6	$3\frac{1}{2}$	$4\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{4}$	dist.	+	27	3	28	27	e-f	pres.	Me.
D21	♂	6–7	4–5	6–5	7–6	$3\frac{3}{4}$	$3\frac{1}{2}$	5	$3\frac{3}{4}$	coin.	+	28	3	28	27	e-f	pres.	Ind.
F19	♂	6–6	4–4	6–5	6–7	$3\frac{1}{2}$	$3\frac{1}{2}$	4	$3\frac{1}{2}$	dist.	+	31	3	32	30	e-f	shad.	Wis.
F46	♂	6–6	5–4	6–6	6–6	3	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	coin.	+	29	3	28	27	e-f	pres.	Me.

F8.	♀	Go Home Bay, Ont., June 25, 1907; coll. Walker.
F9.	♀	Cottage City, Mass., June 23, 1899, J. P. Morse; coll. Calvert.
F10.	♂	St. Croix Dam, Douglas Co., Wis., July 17-22, 1909; Milwaukee Museum.
F11.	♂	Same.
F12.	♂	Same.
F13.	♂	Solon Springs, Douglas Co., Wis., July 7-15, 1909; Milwaukee Museum.
F14.	♂	St. Croix Dam, Douglas Co., Wis., July 17-22, 1909; Milwaukee Museum.
F15.	♂	Same.
F16.	♂	Same.
F17.	♂	Same.
F18.	♂	Solon Springs, Douglas Co., Wis., July 7-15, 1909; Milwaukee Museum.
F20.	♂	Same.
F24.	♂	Same.
F28.	♂	Same.
F30.	♂	Same.
F19.	♂	St. Croix Dam, Douglas Co., Wis., July 17-22, 1909; Milwaukee Museum.
F21-23.	♂♂	Same.
F25-27.	♂♂	Same.
F29.	♂♂	Same.
F31.	♀	Manchester, Me., 1888; coll. Calvert.
F32.	♀	Manchester, Me., May 29, 1889; coll. Calvert.
F33.	♂	Same.
F35.	♂	Maine, June 4, 1895, Harvey; coll. Williamson.
F37.	♂	Orono, Me., June 8, 1899, Harvey; coll. Williamson.
F38.	♂	Same.
F39.	♀	Same.
F40.	♂	Orono, Me., June 24, 1891, Harvey; coll. Williamson.
F41.	♀	Orono, Me., June 10, 1899, Harvey; coll. Williamson.
F42.	♀	Orono, Me., June 14, 1899, Harvey; coll. Williamson.
F43.	♂	Orono, Me., June 7, 1899, Harvey; coll. Williamson.
F55-57.	♂♂	Orono, Me., Harvey; coll. Williamson.

TABLE VIII. *Tetragoneuria c. simulans*, n. n., Color type *f*.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	R. f. w.	L. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
F1	♀	7–7	4–5	7–8	7–7	4	$4\frac{1}{2}$	$4\frac{1}{3}$	$4\frac{3}{4}$	......	+	28	1.5	31	30	f	pres.	Ont.
F2	♂	7–8	4–4	6–6	7–6	4	4	$4\frac{1}{2}$	$3\frac{1}{2}$	dist.	+	29	3	29	28	f	pres.	Ont.
F3	♂	7–6	4–4	6–6	7–6	4	$3\frac{1}{2}$	4	$3\frac{1}{2}$	d/c	+	31	3	31	30	f	pres.	Ont.
F4	♀	8–7	4–5	6–6	7–7	$3\frac{3}{4}$	$3\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{3}{4}$	......	+	29	1.7	33	32	f	pres.	Ont.
F5	♀	7–8	5–5	6–6	7–7	$4\frac{1}{3}$	4	4	4	......	+	27	1.5	31	30	f-g	pres.	Ont.
F6	♂	8–7	4–4	7–6	7–6	4	$3\frac{1}{2}$	4	$3\frac{2}{3}$	dist.	+	31	3	30	29	f	pres.	Ont.
F7	♀	8–7	4–4	6–6	7–7	$3\frac{1}{2}$	$3\frac{2}{3}$	$4\frac{1}{2}$	$3\frac{3}{4}$	......	+	29	1.7	32	31	f	pres.	Ont.
F8	♀	8–8	4–5	5–6	6–6	$3\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{4}$	$3\frac{3}{4}$	......	+	28	1.7	32	31	f	pres.	Ont.
F9	♀	6–6	4–4	6–6	5–6	$4\frac{1}{3}$	$3\frac{3}{4}$	$3\frac{1}{2}$	$4\frac{1}{4}$	......	+	26	1.7	30	29	f	abs.	Mass.
F10	♂	7–7	5–5	5–6	5–6	$3\frac{3}{4}$	$4\frac{1}{3}$	3	$2\frac{1}{2}$	dist.	+	30	3	30	29	f	pres.	Wis.
F11	♂	6–7	4–4	6–6	6–7	4	$3\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	dist.	+	33	3	31	30	f	pres.	Wis.
F12	♂	7–7	4–5	5–6	5–6	$3\frac{1}{2}$	4	$3\frac{3}{4}$	$3\frac{1}{2}$	dist.	+	31	3	31	30	f	shad.	Wis.
F13	♂	6–6	4–4	5–5	6–5	4	4	$3\frac{1}{2}$	$3\frac{1}{2}$	dist.	+	30	3	31	30	f	abs.	Wis.
F14	♂	7–7	4–4	6–5	6–6	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	3	dist.	+	29	3	30	29	f	abs.	Wis.
F15	♂	6–7	4–4	6–5	6–6	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	dist.	+	30	3	30	29	f	pres.	Wis.
F16	♂	6–6	4–4	6–6	7–6	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	c/d	+	30	3	29	28	f	pres.	Wis.
F17	♂	7–7	4–4	7–7	7–8	$4\frac{3}{4}$	4	$3\frac{3}{4}$	$5\frac{1}{3}$	dist.	+	30	3	31	30	f	pres.	Wis.
F18	♂	7–7	4–4	5–5	5–5	$3\frac{1}{2}$	3	$3\frac{1}{3}$	$2\frac{1}{2}$	dist.	+	31	3	31	30	f	abs.	Wis.

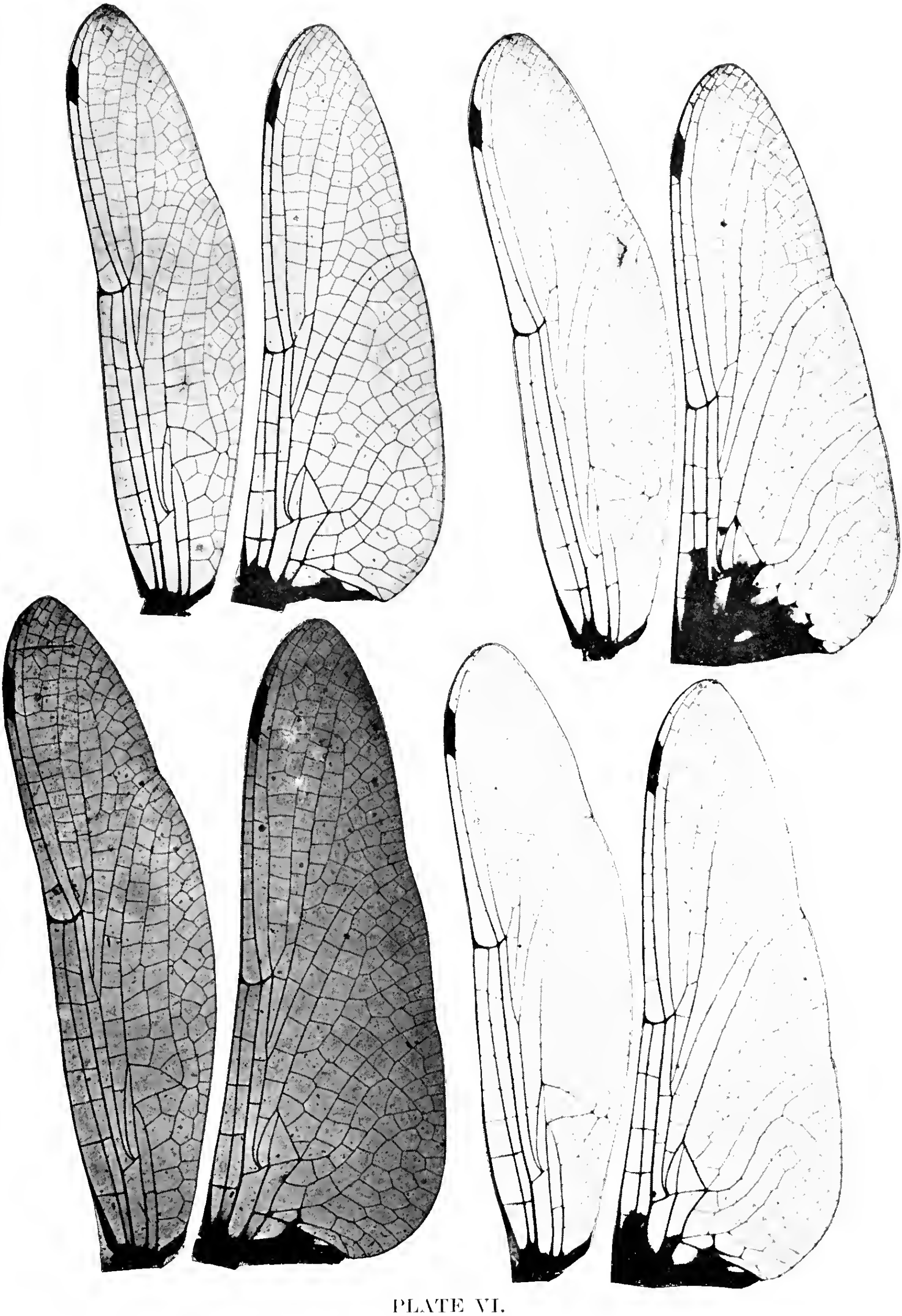


PLATE VI.

WINGS OF TETRAGONEURIA.

T. williamsoni, n. sp. T. cynosura Say.

T. stella Williamson, n. sp. T. cynosura Say.

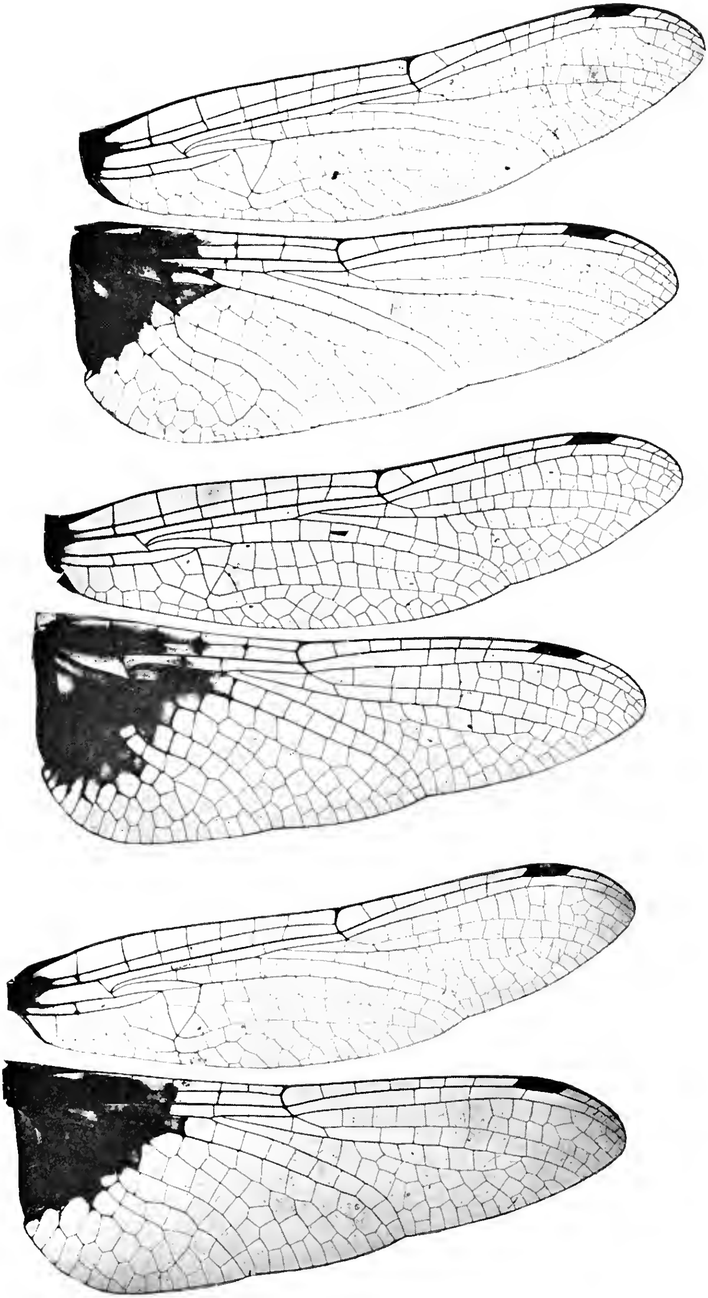


PLATE VII.

WINGS OF TETRAGONEURIA.

Top figure: T. cynosura Say.

Middle and bottom figures: T. cynosura simulans n. n.

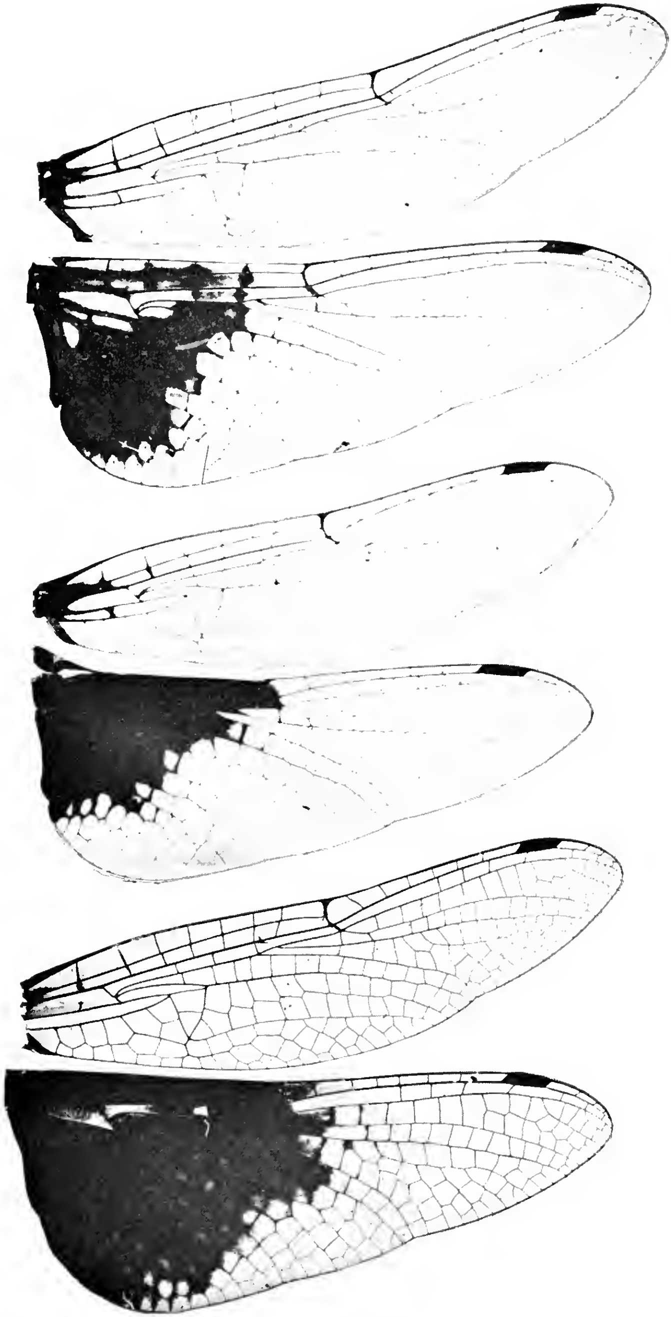


PLATE VIII.

WINGS OF TETRAGONEURIA.

Top figure: T. cynosura simulans n. n.
Middle and bottom figures: T. semiaquea Burmeister.

F20	♂	7–7	4–5	6–6	6–7	3½	4	3½	4½	dist.	+	31	3	32	30	f	abs.	Wis.
F21	♂	7–7	4–4	6–6	7–7	4	3½	4	4	dist.	+	30	3	31	30	f	abs.	Wis.
F22	♂	6–6	4–4	5–5	7–6	3½	3⅓	4	2¾	c/d	+	31	3	31	30	f	shad.	Wis.
F23	♂	6–6	4–4	5–6	6–6	3½	4	3½	3⅓	coin.	+	30	3	31	30	f	pres.	Wis.
F24	♂	7–7	4–4	7–6	6–7	4½	4½	4	4½	c/d	+	30	3	31	30	f	pres.	Wis.
F25	♂	6–6	4–4	6–7	7–7	4	4	4	3½	dist.	+	31	3	31	30	f	pres.	Wis.
F26	♂	7–7	4–4	6–6	6–6	4	4	4½	3½	dist.	+	31	3	31	30	f	shad.	Wis.
F27	♂	7–7	4–5	6–6	6–5	3½	4	3¾	3½	dist.	+	32	3	31	30	f	pres.	Wis.
F28	♂	6–7	4–4	6–7	6–6	3½	4	4	3¾	d/c	+	31	3	31	30	f	shad.	Wis.
F29	♂	6–7	4–4	5–6	6–5	4	4	3½	3½	dist.	+	31	3	31	30	f	pres.	Wis.
F30	♂	6–6	4–4	5–5	6–5	3½	3¾	4	3¾	dist.	+	30	3	31	30	f	shad.	Wis.
F31	♀	7–6	4–4	5–5	5–5	3½	3½	3½	3½	......	+	28	1.7	30	29	f	shad.	Me.
F32	♀	6–6	4–4	5–5	6–5	3⅓	3½	3½	3½	......	+	26	1.5	29	28	f	pres.	Me.
F33	♂	6–6	4–4	6–6	6–5	5	4	3¾	3¾	coin.	+	30	3	29	28	f	shad.	Me.
F35	♂	8–7	4–4	5–5	6–6	3	3⅓	3½	4	dist.	+	26	3	29	28	f	shad.	Me.
F37	♂	6–6	4–4	5–6	7–7	3⅓	3¾	4	3⅓	dist.	+	28	3	29	28	f	abs.	Me.
F38	♂	7–6	5–4	7–7	8–6	4¾	4½	4	4½	dist.	+	29	3	29	28	f	abs.	Me.
F39	♂	6–6	4–4	6–5	6–5	4½	3½	4½	3½	......	+	28	1.5	29	28	f	abs.	Me.
F40	♂	6–6	4–4	6–6	7–7	3¾	3	4	4	d/c	+	29	3	29	28	f	abs.	Me.
F41	♀	6–6	4–4	5–4	7–7	3½	2¾	4	4	......	+	26	1.5	29	28	f-g	abs.	Me.
F42	♀	7–7	4–4	6–6	6–7	3¾	3¾	3½	4½	......	+	29	1.5	31	30	f-g	abs.	Me.
F43	♂	6–6	4–4	6–5	6–6	4	3½	4½	4½	dist.	+	26	3	29	28	f	abs.	Me.
F55	♂	6–6	4–4	5–	6–7	3	..	4	4	dist.	+	28	3	29	28	f-g	abs.	Me.
F56	♂	6–6	4–4	5–5	5–5	3½	4	3	3½	dist.	+	28	3	29	28	f-g	abs.	Me.
F57	♂	6–6	4–4	6–6	7–6	4	4	4½	3½	dist.	+	....	.....	30	29	f-g	abs.	Me.

Tetragoneuria semiaquea Burmeister

This species, hitherto known as *complanata* Rambur and as representing the extreme of the *cynosura-semiaquea-complanata* series, I regard as distinct. It is essentially an Atlantic coast species covering the region from Massachusetts to Georgia.

Its main distinction from *cynosura* and *simulans* is the smaller size and the wing markings, though some minor points exist such as the largely brown pile of the thorax—grayish-white in *cynosura*—and the more marked tubercle on the superior appendix of the male.

Head, thorax and abdomen of typical coloration. T-spot absent, never more than the stem visible in black. Thorax with pile largely brown, so that it is little apparent. The lateral stripes occasionally with a metallic glint.

Wings with brown reaching to nodus. Three forms are usual:

i—color to nodus, often reaching beyond nodus in the space between M3 and Rs and M3-4, then to hind margin beyond level of triangle, occasionally to hind margin at level of nodus.

i2—color to nodus, then in oblique irregular line to the anal angle, or two to three cells along the hind margin, usually before level of triangle. (*Semiaquea* type and *complanata* types).

i3—color to nodus, then in a nearly straight oblique line past the triangle to the anal margin, usually leaving the lower end of the anal triangle free.

Extreme cases of *simulans* can be easily distinguished by the transparent axial streak at the base of the wings which occupies the median space, at least the centers of the cubital and hypertriangular spaces and part of the anal triangle, and finally the arcular space, extending to near the level of the apex of the triangle. In *semiaquea* these spaces are much infumated and the hypertriangular and cubital spaces are brown, rarely with more than lighted centers.

The identity of this species occasioned the most puzzling moments of the present study. The forms of these species seem to be but a continuation of the forms f and g of *simulans;* so I had originally supposed. Leaving the *semiaquea* series—that is those specimens in which the color reaches the nodus—aside for the moment, it was immediately apparent that for the rest of the *Tetragoneuriæ* the color development showed a progression from south to north: Specimens from North Carolina, Ohio, Indiana and New Jersey showed much less color development than specimens from New York, Maine, Ontario and Wisconsin. This phenomenon was obviously at variance with the apparent development of the *semiaquea* series.

Here, then, existed a state, North Carolina, one of the most southern places from which *Tetragoneuriæ* had been collected, in which the color had reached a higher development in the wing of the species than along the line of its regular geographical distribution. Here, in the compass of a few miles, the same results were achieved which otherwise necessitated a broad geographical expanse of approximately a thousand miles.

To co-ordinate this apparent fact with the real fact of color development from south to north seemed an impossibility.

It was about this time (March) that Mr. Brimley sent me an extensive series of species from North Carolina. These together with other material from North Carolina already at hand, formed the basis of a prolonged study in which the final conclusion was reached that *semiaquea* is a distinct spedies.

Distributing this material among the color divisions c to i, as noted under *cynosura*, it was found that they easily divided into two lots: (a) color not extending beyond triangle and (b) color reaching the nodus.

(a) Among the first lot the large majority fell under the color type c2—the color reaching the first antecubital, two specimens came under the intermediates d-e, while but four fell under e, and none at all under e-f, f and g. Considering this lot in the light of the evidence shown by material from other regions the large majority of forms of c2 was conclusive: it marks the typical southern form of *cynosura*, the first step in the color progression toward the north as found in this species.

(b) The second lot showed the three forms i1, i2 and i3 as before indicated.

A further result was remarkable: only two other specimens, from New Jersey and Massachusetts, reached the high color development shown by the North Carolina forms. Furthermore, the nearest approach to *semiaquea*—the forms f and f-g of *simulans*—occur only in northern states (Wisconsin, Maine, Ontario and Massachusetts), so that in this case the geographical isolation of *semiaquea* seems fairly complete. In as far as the material would indicate I believe *semiaquea* to be an Appalachian species, confined to the Atlantic coast, its distribution in many respects analagous to that of *Erythrodiplax berenice.*

Length of abdomen 22-27 mm. Hind wing 24-27 mm.

MATERIAL STUDIED.

1. Color type i1.

G2.	♂	Lumberton, N. C., April 7, 1903, C. S. Brimley; coll. Calvert.
G5.	♂	South Pines, N. C., March 9, 1910, C. S. Brimley; Milwaukee Museum.
G6.	♂	Same.
G11.	♂	Lumberton, N. C., April 7, 1903; coll. Sherman.
G12.	♀	White Lake, Bladen Co., N. C., mid-April, 1910; coll. Sherman.
G13.	♂	Same.
G14.	♂	Same.
G15.	♂	Lumberton, N. C. April 7, 1903; coll. Brimley.
G18.	♂	South Pines, N. C., April 7, 1908; coll. Brimley.
G19-20.	♀ ♀	South Pines, N. C., April 8, 1907, Brimley; coll. Williamson.

2. Color type i2.

G3.	♂	Lake Ellis, N. C., May 14, 1906, C. S. Brimley; coll. Calvert.
G4.	♀	Same.
G16.	♀	Same.

3. Color type i3.

G1.	♂	Clementon, N. J., C. J. Green; A. N. S. Phila.
G7.	♂	Lake Ellis, N. C., May 12, 1906, C. S. Brimley; coll. Williamson.
G8.	♂	Same.
G9.	♂	Same.
G10.	♂	Same.
G17.	♂	Same.
F36.	♂	Massachusetts; coll. Williamson.

TABLE IX. *Tetragoneuria semiaquea* Burmeister.

Number	Sex	Antenodals F. w.	Antenodals H. w.	Postnodals F. w.	Postnodals H. w.	Substigmal series arises at L. f. w.	R. f. w.	L. h. w.	R. h. w.	Venation Cu-vein	t f. w.	Length Abd.	App.	F. w.	H. w.	Color Wings	T-spot	Place
G2	♂	7–7	4–4	5–5	6–5	3¾	3½	3⅓	3½	coin.	+	27	3	27	26	i	abs.	N. C.
G5	♂	7–7	4–4	7–6	8–7	4½	3¾	4½	4	c/d	+	26	2.7	26	25	i	abs.	N. C.
G6	♂	7–7	4–4	5–5	5–5	3¾	3½	3¾	4½	coin.	+	24	2.7	26	25	i	abs.	N. C.
G11	♂	6–6	4–4	5–5	5–5	3½	3½	2¾	3½	dist.	+	26	2.5	27	26	i	abs.	N. C.
G12	♀	6–7	4–4	5–6	7–5	3½	3½	3½	3⅓	......	+	22	1.7	26	25	i	abs.	N. C.
G13	♂	6–6	4–4	5–5	6–6	3½	3½	3⅔	3½	dist.	+	24	2.7	25	24	i	abs.	N. C.
G14	♂	6–6	4–4	5–5	5–5	3⅓	3	2½	2½	dist.	+	25	2.5	26	25	i	abs.	N. C.
G15	♂	6–6	4–4	4–4	6–5	3	3	4	3½	dist.	+	24	2.5	27	26	i	abs.	N. C.
G18	♂	6–6	4–4	5–5	6–7	3½	4	4	4½	coin.	+	26	2.7	27	26	i	abs.	N. C.
G19	♀	–7	4–4	–5	5–6	..	3	3	3½	......	+	24	1.7	27	26	i	abs.	N. C.
G20	♀	7–6	4–4	6–5	6–6	4	4	3	3	......	+	24	1.7	27	26	i	abs.	N. C.
G3	♂	7–7	4–4	6–6	7–6	3½	4	4½	3½	coin.	+	26	2.7	27	26	i2	abs.	N. C.
G4	♀	6–6	4–4	5–5	5–5	3½	3	3½	2¾	......	+	24	1.3	27	26	i2	abs.	N. C.
G16	♀	6–6	4–4	5–5	6–6	3½	3½	4	3½	......	+	24	1.3	28	27	i2	abs.	N. C.
G1	♂	6–6	4–4	4–5	5–7	2¾	3½	3½	5	c/d	—+	26	.....	28	27	i3	abs.	N. J.
G7	♂	5–6	4–4	6–6	6–5	3¾	4	3½	3½	dist.	+	26	3	26	25	i3	abs.	N. C.
G8	♂	7–7	4–4	5–6	6–6	3¼	3¾	3¾	3½	dist.	+	25	3	27	26	i3	abs.	N. C.
G9	♀	6–6	4–4	6–6	7–7	3⅔	4	4	4	......	+	23	1.3	23	22	i2-3	abs.	N. C.
G10	♂	6–6	4–4	5–5	6–5	3½	3½	4	3½	dist.	+	27	3	28	27	i3	abs.	N. C.
G17	♂	6–6	4–4	5–6	6–5	3½	3¾	3½	3	dist.	+	26	2.7	28	27	i3	abs.	N. C.
F36	♂	7–7	4–4	6–5	7–6	4	4	4½	4¼	coin.	+	27	3	27	26	i3	abs.	Mass.

There can be little question of the identity of *semiaquea* Burmeitser (nec Auctorum) and *complanata* Rambur. Calvert (Trans. Am. Ent. Soc., 25, pp. 27-104, 1898; pl. 1) in his notes on the types of Burmeister has published the following (p. 88):

♀ (type). No T-spot or other black spot on the frons. Front wings unspotted. Hind wings with brown extending along the costal margin from base to nodus, thence obliquely towards the anal angle, the outer margin of the brown being very irregular as the central parts of the cells there are clear; the median, submedian and hypertrigonal spaces, the areas between the sectors of the arculus and above the upper sector of the arculus out to the level of the apex (distal angle) of the triangle are clear.

In his notes made of Rambur's types in the de Selys collections at Brussel, Dr. Ris has written as follows:

Hindwing: brown basal spot in C and S to the nodus, in an oblique line to three cells distally from the end of the anal triangle; the margins of the markings lacerate by the color being reduced to vein borders; central clearings of cells especially in m. (The specimen referred to is the male type of Rambur).

(Of the female type) Hindwing: brownish spot to nodus and on the anal margin to end of anal loop. Between M3 and M4 some brown cells distally of an oblique line between those two points. Very many clear centers of cells.

Tetragoneuria williamsoni sp. nov.

Colors olive, yellow, black and brown.

♂.—Labrum and frons rich yellow, face with olive band in middle; vertex olive, frons with a black T-spot. Pile and frons and vertex black, otherwise pale. Antennæ black.

Thorax brown, irregular lateral stripes black, shining in places, but not metallic. Irregular yellow spots enclosed by the stripes. Pile gray, somewhat mixed with brown on the sides.

Fore wings without color. Hind wings hyaline, membranule fumose. A streak of brown in the costal space and sub-costal space to half-way to the first antenodal. First antenodal with small spot at intersection. Lower half of anal triangle margined with brown.

Legs black, fore femora pale.

Abdomen slender, segments 2 and 3 inflated, 3 constricted at middle, 3 to 10 thence slightly spindle-shaped, though much less noticeably than in *cynosura*. Sides with yellow interrupted lines as usual.

Appendages much like *cynosura*, but lacking the lateral ridge.

♀.—Similar to the male. Wings with color extending to the first antenodal. Abdomen without constriction at 3. Appendages longer than in *cynosura*. Vulvars with lobes gently curved and sub-parallel, somewhat U-shaped—not broadly divaricate and V-shaped as in *cyonsura*.

Length abdomen (including appendages) 27-29 mm., hindwings 26 to 28 mm.

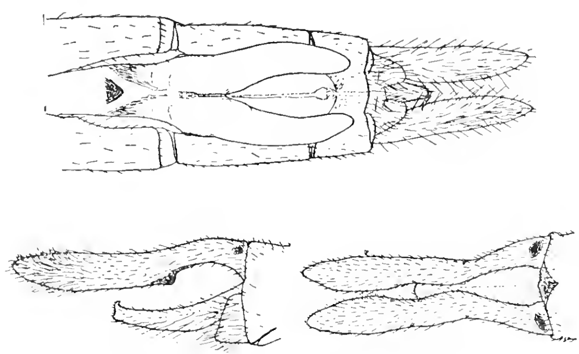


Figure 4.—*T. williamsoni* n. sp.

Material studied:

A5. ♂ Wister, Okla., June 3, 1907; coll. Williamson.
A6. ♀ Wister, Okla., June 4, 1907; coll. Williamson.
A7. ♂ Same as A5.

Holotype male (A5) and allotype female (A6) in coll. Williamson, paratype male (A7) in Milwaukee Museum.

This species falls exceedingly close to *cynosura*. Yet the differences in the length of the female appendages and the form of the vulvars are such as to make this species fully distinct.

TABLE X. *Tetragoneuria williamsoni* n. sp.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	R. f. w.	L. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
A5	♂	7–7	4–4	6–5	6–6	3½	3½	3	3½	dist.	+	28	3.3	27	26	c	pres.	Okla.
A6	♀	7–7	4–4	6–6	6–6	3½	3½	3½	3½	......	+	27	2.3	29	28	c2	pres.	Okla.
A7	♂	6–6	4–4	6–7	5–5	3½	4½	3	4	dist.	+	28	3.3	28	27	c	pres.	Okla.

TABLE XI. *Tetragoneuria morio* n. sp.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	R. f. w.	L. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
1	♂	6–6	5–5	6–7	7–7	4	4¾	4¼	4	dist.	+	33	3.3	34	33	...	pres.	Wis.
2	♂	7–7	4–4	6–6	6–7	3½	4	3½	4½	dist.	+	32	3.3	32	31	...	pres.	Me.
3	♀	8–8	5–5	7–7	8–8	4¾	4¾	5½	5½	......	+	32	3	33	32	...	pres.	Me.
4	♀	6–6	4–4	6–5	6–5	4	4	4½	3½	......	+	33	3.3	32	31	...	pres.	Mich.

Tetragoneuria morio n. sp.

Colors brown, black, yellow and olive.

♂.—Labrum and frons bright yellow, face with an olive band. T-spot always present. Pile on frons and vertex olive.

Thorax brown, humeral and lateral sutures with irregular black lines, these lines often metallic and enclosing ill-defined yellow spots. The pile on the dorsum gray, on the sides copiously mixed with brown.

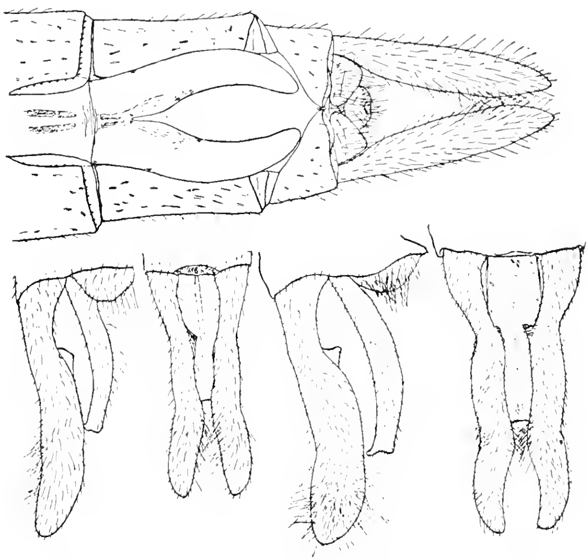


Figure 5.—*T. morio* n. sp. The two lower left figures are from the type.

Legs black, fore femora and bases of all legs pale.

Abdomen with typical markings. The form of the abdomen is spindle shaped, more decidedly so than any of the previous species, so that the appearance is distinctly spatulate.

Wings hyaline, fore wings without color, hind wings with brown reaching the first antenodal in C and Sc. Brown at the intersections of the arculus, at the ends of the triangles and anal veins. A large blot in the lower anal triangle and the adjoining two series of veins.

Male appendages in dorsal view like those of *spinigera*, that is twice curved and with the tips approximated. In lateral view somewhat like *cynosura*, but with a longer, slightly produced angle, and no lateral ridge.

♀.—Similar to the male. The vulvars like those of *spinigera*. Appendages somewhat stouter and longer. The wings with fuscous in

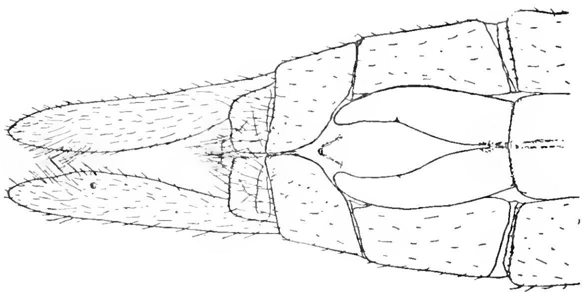


Figure 6.—*T. spinigera* Selys.

the anal field, usually only along the veins out to the level of the triangle.

Length of abdomen 30 to 34 mm., hind wing 30 to 33 mm.

Described from the following materials:

1. ♂ Solon Springs, Douglas Co., Wis., July 7-15, 1909; Milwaukee Museum.
2. ♂ Maine, June 10, 1898, Harvey; coll. Williamson.
3. ♀ Same.
4. ♀ Detroit, Mich., Hubbard & Schwartz, U. S. N. M.

Holotype male in collection Milwaukee Museum, allotype female in collection Williamson, paratype male in collection Williamson, paratype female U. S. N. M.

This species can be regarded as an intermediate between *cynosura* and *spinigera,* to both of which it shows many points of similarity. The male is easily distinguished, while the female presents some difficulty, though separable by the longer appendages.

Tetragoneuria spinigera Selys.

Very much like the preceding species.

T-spot always present, the pile on the sides of the thorax much mixed with brown. Altogether the insect presents a darker appearance than those of the *cynosura* series.

Wings of the male with color like that of *cynosura* c2. The female similar, but with the veins in the anal field, near the base only and not extending out to the triangle, edged with brown.

Length of abdomen 30 to 34 mm., hind wing 30 to 33 mm.

The following material is at hand:

1.	♂	Wis., Milwaukee Museum.
2.	♂	Milwaukee Co., 1900, F. Rauterberg; Milwaukee Museum.
3.	♂	St. Croix Dam, Douglas Co., Wis., July 17-22, 1909; Milwaukee Museum.
4.	♂	Wis., Milwaukee Museum.
5.	♂	Dane Co., Wis., June, 1890, E. T. Owen; coll. A. N. S. Phila.
6.	♀	Same.
7.	♂	Manchester, Me., June 21, 1890, Miss M. Wadsworth; coll. Calvert.
8.	♂	Seattle, Wash., June 15th, 1894, O. B. Johnson; coll. Calvert.
9.	♂	Langford, L. B. C., July 20, 1902, R. Osborne; coll. Williamson.
10.	♀	Same.
11.	♀	No label; coll. Williamson.
12.	♂	Saranac Inn., N. Y., June 14, J. Needham; coll. Williamson.
13.	♂	Same.
14.	♂	Clear Lake, Ind., June 12, 1904, Deam; coll. Williamson.

TABLE XII. *Tetragoneuria spinigera* Selys.

Number	Sex	Antenodals		Postnodals		Substigmal series arises at				Venation		Length				Color		Place
		F. w.	H. w.	F. w.	H. w.	L. f. w.	R. f. w.	L. h. w.	R. h. w.	Cu-vein	t f. w.	Abd.	App.	F. w.	H. w.	Wings	T-spot	
1	♂	7–7	4–4	6–6	6–5	4	4	4½	3¼	dist.	+	33	3.3	32	31	...	pres.	Wis.
2	♂	7–8	5–4	6–6	7–7	4½	4	5	4½	dist.	+	32	3.3	31	30	...	pres.	Wis.
3	♂	7–7	4–4	7–6	8–7	4½	4	5	4½	dist.	+	34	.....	33	32	...	pres.	Wis.
4	♂	6–6	4–4	6–6	7–6	4½	4½	4½	4	d/e	+	30	3.3	31	30	...	pres.	Wis.
5	♂	6–6	4–4	5–7	6–6	3¾	4½	4⅓	4	dist.	+	31	3.3	31	30	...	pres.	Wis.
6	♀	8–7	4–4	6–6	6–6	4	4½	3¾	4½	dist.	+	31	3	32	31	...	pres.	Wis.
7	♂	7–7	5–5	7–7	7–7	4½	4¾	3½	4	dist.	+	31	3.3	32	31	...	pres.	Me.
8	♂	6–6	4–4	7–7	7–7	4⅓	4	4¾	4	dist.	+	33	3.5	32	31	...	pres.	Wash.
9	♂	8–7	4–5	7–7	7–10	4⅓	4½	3¾	4½	dist.	+	33	3.5	34	33	...	pres.	B. C.
10	♀	7–7	4–4	7–8	7–7	4¼	5¼	4½	5	......	+	33		33	32	...	pres.	B. C.
11	♂	7–7	4–4	7–7	8–8	4½	3½	4½	4	......	+	34	3.3	35	34	...	pres.	?
12	♂	8–8	4–4	6–6	7–6	4	4¼	4½	4	c/d	+	31	3.3	30	29	...	pres.	N. Y.
13	♂	7–8	4–5	7–8	9–7	4	4½	5½	4	dist.	+	31	3.3	31	30	...	pres.	N. Y.
14	♂	7–7	4–4	7–7	6–6	4½	4¾	4	4	dist.	+	33	3.3	32	31	...	pres.	Ind.
15	♂	7–7	4–4	7–7	8–8	4	4½	5¼	5	dist.	+	32	3.3	31	30	...	pres.	Me.
16	♀	7–7	4–4	7–7	8–8	4	4½	5¼	5	dist.	+	32	3	34	33	...	pres.	Me.
17	♀	6–6	4–4	7–6	8–7	4½	3½	5	4½	......	+	31	2.7	33	32	...	pres.	Me.
18	♂	7–7	4–4	6–6	7–7	4	4	4⅓	4¼	dist.	+	32	3.5	32	31	...	pres.	Ont.
19	♀	7–7	5–5	7–6	8–8	4	3½	4½	4½	......	+	30	2.5	33	32	...	pres.	Me.
20	♂	6–7	4–4	7–6	6–6	4½	3½	3½	4	dist.	+	30	.....	31	30	...	pres.	Me.
21	♂	7–8	4–5	6–6	6–8	4	4	4½	4½	dist.	+	32	3.5	32	31	...	pres.	Me.
22	♀	7–7	5–4	7–7	8–8	4	4	5	5	......	+	30	2.7	33	32	...	pres.	Me.
23	♀	8–8	5–5	8–8	8–7	4½	5	5	4	......	+	32	2.7	34	33	...	pres.	Me.
24	♀	7–8	4–5	6–6	7–6	4	4½	4½	4½	......	+	....	.....	33	32	...	pers.	N. Y.

15.	♂	Maine, June 10, 1898, Harvey; coll. Williamson.
16.	♀	Same as above.
17.	♀	Same as above.
18.	♂	Go Home Bay, Ont., July 4, 1907; coll. Walker.
19.	♀	Manchester, Me., June 9, 1898, Miss Wadsworth; U. S. N. M.
20.	♂	Same as above.
21.	♂	Same as above.
22.	♀	Same as above.
23	♀	Same as above.
24.	♀	Oswego, N. Y., May 18, 1895; U. S. N. M.

This species is more easily distinguished than any of the preceding, notably by the male appendages which have an inferior spine, and by the female vulvars which approximate each other also by the female appendages which usually reach a length of 2.7 to 3 mm.

Specimen No. 19 is an aberrant form. Briefly described: All antenodals of the hind wings as well as the nodus itself edged with brown. The costal field to the stigma in oblique view shows a decided flavescent tinge on all wings. Furthermore, there are blackish, widening streaks in the upper half of the wings as follows: A streak beginning at the first antenodal and reaching to the nodus at which place the streak is widest; a second streak beginning at the first postnodal and reaching to the distal end of the stigma, being widest at the proximal end of the stigma. This shading is not pronounced, having more the appearance of a black veil covering the wings than any decided coloration. Though the specimen is unique it would hardly be fair to give it a name, since in all other respects it agrees with the general *spinigera* type of coloration.

Under this falls *indistincta* Morse. I had already placed it here when Dr. Calvert sent me the following notes in a recent letter (May 20, 1911):

"Following is the copy of a note which I made in June, 1899, on Morse's type of *Tetragoneuria indistincta* in the M. C. Z.

" '*Tetragoneuria indistincta* Morse. An examination of his type shows that his expression "basal part of median space and basal antecubital cell of each series fuscous" refers only to the hind wings, not to the front, on which there is merely a very small brown spot in the subcostal space reaching only ¼ of the way to the first antecubital.

" 'A female from Peterborough, N. H., June, '88, agreeing in other respects with *indistincta* has the right app. rounded at tip, the left acute.

" 'I suspect that *indistincta* = *spinigera*.' "

This latter condition—female appendages of unequal length—is one not infrequently found in *Tetragoneuriæ*. In placing *indistincta* with *spinigera* I base its identity upon the black T-spot, the length of the appendages and the color description, all of which agree perfectly with *spinigera*.

Tetragoneuria canis MacLachlan.

Colors brown, black yellow and olive. Similar to the preceding species in the main points.

T-spot never present. The pile on the thorax gray and very little mixed with brown. The insect therefore presents a much lighter appearance than *spinigera*.

The color of the wings is confined to a few basal spots. In general the wings throughout show a decidedly flavescent tinge, not hyaline as *spinigera*.

The male appendages with the apical third sharply bent downwards, a tubercle at the bend. In lateral view beneath regularly rounded, with several tubercles.

The following material is before me:

1. ♂ Franconia, N. H., Mrs. A. T. Slosson; coll. Calvert.
2. ♂ Divide, Vilas Co., Wis., June 24-30, 1907; Milwaukee Museum.

TABLE XIII. *Tetragoneuria canis* MacLachlan.

Number	Sex	Antenodals F. w.	Antenodals H. w.	Postnodals F. w.	Postnodals H. w.	Substigmal series arises at L. f. w.	R. f. w.	L. h. w.	R. h. w.	Venation Cu-vein	Venation t f. w.	Length Abd.	Length App.	Length F. w.	Length H. w.	Color Wings	Color T-spot	Place
1	♂	7–8	5–5	6–6	7–6	$4\frac{1}{2}$	$4\frac{1}{4}$	$4\frac{1}{3}$	$3\frac{1}{2}$	coin.	+	34	2.5	31	30	...	abs.	N. H.
2	♂	8–8	5–5	7–7	7–7	$4\frac{1}{2}$	$4\frac{3}{4}$	4	$4\frac{1}{2}$	dist.	+	36	2.7	31	30	...	abs.	Wis.
3	♂	7–7	5–5	7–5	6–6	$3\frac{1}{2}$	$4\frac{1}{2}$	4	4	dist.	+	....	.....	....	....	...	abs.	Ont.
4	♂	7–8	5–5	6–6	6–7	$4\frac{1}{2}$	5	$3\frac{1}{2}$	$4\frac{1}{2}$	dist.	+	....	.....	....	....	...	abs.	Ont.
5	♂	7–9	6–5	7–7	7–6	4	$4\frac{1}{2}$	4	$3\frac{2}{3}$	dist.	+	....	.....	....	....	...	abs.	Ont.
6	♂	7–8	5–5	6–5	6–6	$3\frac{2}{3}$	$3\frac{3}{4}$	$3\frac{3}{4}$	$3\frac{3}{4}$	dist.	+	....	.....	....	....	...	abs.	Ont.
7	♂	9–10	6–6	8–7	9–8	5	$4\frac{1}{2}$	$5\frac{1}{2}$	5	coin.	+	31	2.7	31	30	...	abs.	Me.
8	♀	8–9	5–6	6–7	7–7	4	$4\frac{1}{2}$	4	$4\frac{1}{2}$	......	+	....	.....	31	30	...	......	N. Y.
9	♂	7–8	6–5	5–5	6–6	$2\frac{1}{2}$	3	4	$3\frac{1}{2}$	coin.	+	31	2.7	31	30	...	......	N. Y.

3-6	♂ ♂	Ontario; coll. Walker.
7.	♀	Manchester, Me., June 9, 1898, Miss Wadsworth; U. S. N. M.
8	♀	Ithaca, N. Y., Banks; U. S. N. M.
9.	♂	Same.

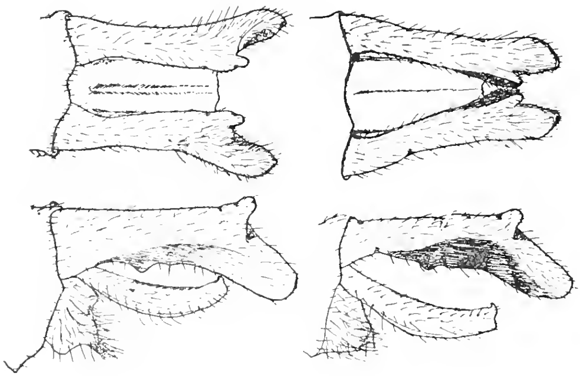


Figure 7.—*T. canis* MacLachlan.

This is the species recorded by most American authors as *spinosa*. The species is one of the most easily distinguished of *Tetragoneuria*. The tubercles on the appendages of the male and the general flavescent tinge of the wings will determine it from its allies. I have not seen the vulvars of the female, as the specimens on hand are broken.

Tetragoneuria costalis Selys.

Male unknown.

* Female.—Head yellow, the space between the yellow frontal tubercles and the clypeus black, the clypeus yellow, thickly punctured,

* The following description is a literal copy from a letter by Mr. Kirby, June 14, 1911.

and below it a broad olive-green band as far as the rhinarium, which like all the mouth-parts, is yellow.

Pronotum bronzed, very thickly clothed with whitish hair, abdomen broadly black in the middle, first segment dull yellow above, the other segments with a narrow orange stripe on each side widely interrupted with brown before the end of each segment. Underside of pronotum and abdomen mostly yellow. Legs brown, fore femora yellow beneath.

Wings clear hyaline, except the smoky brown subhyaline costal space. 7-6 antenodal and 7-8 postnodal crossnervures on fore wing; 4 antenodals and 7 postnodals on hind wing. Fore wing with broad traversed triangle, 3 cells in subtriangular space, a subtriangular nervule on left side. Triangle followed by 3, then 2 rows of cells not increasing. Hind wing with triangle free, followed by 2 rows of cells rapidly increasing; sectors rising just below the middle of the arculus, distinctly separated.

Wing colors: Broad subhyaline brown bar extending along the whole costal and subcostal areas of all the wings as far as, and including the cell. The lower basal cell, the upper more faintly, and the space above the upper sector of the arculus to the level of the nodus, the space above the triangle, and even the triangle itself on the hind wings, are less deeply stained with smoky brown.

Appendages straight, black, 4.5 mm. long.

There is only one specimen (a female) and Abbott's figure, to which Hagen refers, is also a female. We have no *T. spinigera,* except the female which Selys refers to *T. spinosa.* I believe the male is not known at all, and that Selys' reference to it simply relates to Abbott's figure, which I think represents a female.—*W. F. Kirby.*

The foregoing description was sent to me by Mr. Kirby from the type in the British Museum at my request.

From Selys' descriptions I had assumed that the species might be none other than *canis*, or, at best, an aberration of the latter species, and I so wrote Mr. Kirby.

It is chiefly because of the length of the female appendages that I regard this species as distinct. These are the longest of any known species of *Tetragoneuria,* the nearest species, *spinigera,* reaching 3.3 mm. The length of the appendage as a character is all the more certain, as the other species of *Tetragoneuria* show much smaller differences among themselves (see the table at the beginning of this paper). This same feature is also a proof that *costalis* is not an ally of *cynosura,* as a subspecies of which it has been considered by Selys and Martin; its nearer relation to *spinigera* and probably *spinosa* (of which the female is unknown to me) is clearly indicated.

Milwaukee Public Museum, June 29, 1911.

(To be continued.)

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BULLETIN

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Vol. 9. OCTOBER, 1911. No. 4

ON THE IDENTITY OF THE MOST COMMON SPECIES OF THE FAMILY *TRICHOGRAMMATIDAE* (*HYMENOPTERA.*)

By A. A. Girault.

Although it is apparent to one to whom this family of minute parasitic *Hymenoptera* is familiar, that so far we have not explored it very thoroughly, yet to the same person or persons there is one species which to our present knowledge stands out most prominently as a representative of the group. This species is the one which has generally been cited as the *Trichogramma pretiosa* of Riley. Nearly every entomologist is familiar with the name, but what the latter represents has become during the past few years a mooted question. It is in the following pages that I hope to define clearly just what the name does represent and to determine the correct one.

The following citations referring to this species occur in the literature and represent its synonomy. This synonomy has not been worked out with satisfaction for the reason that the types of its synonomic species (*pretiosum, minutissium, intermedium, odontotœ*) have been lost or were never deposited. However, Howard (1889*a*) states definitely that he was unable to separate *pretiosum, minutum, minutissimum* and *intermedium* structurally, and that statement and those occurring in the original descriptions of each named species, considered in connection with the now known color variation of all of the species of the genus, clearly unites these. As concerns *odontotœ*, Howard, its author has stated to me that he does not know what it is; its type has not been found. On account of its host, it is better to consider it but a doubtful synonym of *minutum*. I firmly believe that it is best to accept the synonomy as given here because it is beyond question that the identities of *intermedium*, *minutissimum* and *pretiosum* can never again be established with certainty[1]. As for *odontotæ* it may be that its host is peculiar to it and for that reason I place it as a doubtful synonym of *minutum*. Of those citiations marked with an asterisk I have seen the actual specimen; of the others there are only one or two about which doubt may arise concerning the actual identity of the species[2].

I have gone into the history of this species more at length than is necessary in most cases, but the importance of establishing its identity and synonomy is such that I believe the details had better be aired and the matter settled, if possible, once for all to the satisfaction of the systematic hymenopterologist.

Family Trichogrammatidæ.

SUBFAMILY TRICHOGRAMMATINÆ.

Genus **Pentarthron** Riley.

1. **Pentarthron minutum** (Riley) [3]

Ichneumon species—Peck, 1879, p. 14.
Trichogramma ? minuta Riley, 1871, pp. 157-158, fig. 72.
Trichogramma ? minuta Riley—Packard, 1872, p. 8.
Pentarthron minutum (Riley)—Idem, ib.
Trichogramma pretiosa Riley, 1879, pp. 161-162.
Pentarthrum minuta (Riley), ibidem.
Trichogramma pretiosa Riley—Comstock, 1879, pp. 193-194.
Pentarthrum minuta (Riley)—Idem, ib.

---

1. This statement should perhaps except *minutissimum* whose types are probably still in existence. I have been unable to obtain possession of them, or certain knowledge of their existence.

2. The list of literature is omitted here. It will be given in a sequel, published elsewhere.

3. Though for the present retained as a species of *Pentarthron* the latter will undoubtedly fall as a synonym of *Trichogramma* and the specific name of this insect will become of course *Trichogramma minutum* Riley as originally. It would seem that the species has finally come back to its own.

Trichogramma minuta Riley—Idem, ib., p. 193, fig. 39, a-e.
Trichogramma minuta Riley, 1881, pp. 68-69.
Pentarthron minuta (Riley), Idem, ib.
Trichogramma pretiosa Riley, 1882, p. 914.
Trichogramma pretiosa Riley—Saunders, 1882, pp. 146-147.
Arichogramma pretiosa Riley—Lintner, 1883, pp. 48-51.
Trichogramma minutum Riley—Packard, 1883, p. 37.
Pentarthron minutum Riley—Id., ib., p. 38.
Trichogramma minutissimum Packard, 1883, pp. 37-38.
Trichogramma minuta Riley—Howard, 1885 *a*, p. 47
Trichogramma minutissimum Packard—Idem, ib.
Trichogramma pretiosa Riley—Idem, ib.
? *Trichogramma odontotæ Howard* 1885 *b*, p 117.
Trichogramma pretiosa Riley—Hubbard, 1885 *a*, appendix I, pp. (7), (8), (10-11), (12) and (16); id., 1885 *b*, *minutum* fig.
Trichogramma pretiosa Riley—Lintner 1885, pp. 217-221.
Trichogramma pretiosa Riley, 1885, pp. 101, 102-104, 377, fig. 31, a-d and note 79, p. (107).
Trichogramma minuta Riley—Idem, ib., fig. 68, a-e.
Trichogramma minuta Riley, ib., note 79, p. (107).
**Trichogramma pretiosa* Riley—Ashmead, 1887, pp. 11, 16, 17.
Trichogramma minutissimum Packard—Cresson, 1887, p. 246.
Trichogramma ? minutum Riley—Idem, ib.
Trichogramma odontotæ Howard—Idem, ib.
Trichogramma pretiosa Riley—Idem, ib.
Trichogramma pretiosa Riley, 1887, fig. 23, a-d.
Trichogramma pretiosa Riley—Howard, 1888 *b*, pp. 124, 128.
Trichogramma minutum Riley—Howard, 1889 *a*, pp. 1894-1895.
Trichogramma minutissimum Packard—Idem, ib.
Trichogramma intermedium Howard, ibidem, pp. 1894-1895, pl. 89, fig. 8.
Trichogramma minutissimum Packard—Howard, 7887 *b*, p.
Trichogramma pretiosa Riley—Idem, ib., pp.
Trichogramma minuta Riley—Scudder, 1889, I, p. 279.
Trichogramma minutissima Packard—Ib.
Trichogramma intermedia Howard—Scudder, 1889, I, p. 429.
Trichogramma minutissima Packard, idem, II, p. 1304.
Trichogramma intermedia Howard, ibidem, p. 1467.
Trichogramma pretiosa Riley—Davis, 1890, p. 10.
Trichogramma pretiosa Riley—Howard, 1891, pp. 568, 577.
Trichogramma pretiosa Riley—Mally, 1891, p. 28.
Trichogramma pretiosa Riley—and Howard, 1891, p. 306.

Trichogramma pretiosa Riley—Mally, 1892, p. 47.
Chætostricha pretiosa (Riley)—Dyar, 1893, p. 256.
Chætostricha minutissimum (Packard)—Idem, ib.
**Trichogramma pretiosa* Riley—Fletcher, 1893, pp. 158-159, 161.
Trichogramma pretiosa Riley—Mally, 1893, p. 25.
Trichogramma pretiosa Riley—Smith, 1894, p. 590, fig. 177.
Trichogramma pretiosa Riley—Howard, 1896, pp. 324, 331, fig. 13 a-d.
Trichogramma pretiosa Riley—Slingerland, 1896, p. 70.
Trichogramma pretiosa Riley—Aurivillius, 1897, p. 252, footnote 4.
Trichogramma minuta Riley—Idem, ib.
Trichogramma pretiosa Riley—Garman, 1897, p. 29.
Trichogramma pretiosa Riley—Howard, 1897, pp. 7, 14.
Trichogramma minuta Riley—Morgan, 1897, pp. 144, 159.
Trichogramma intermedium Howard—de Dalla Torre, 1898, p. 3 and footnote 2.
Trichogramma minutum Riley—Idem, ib., p. 3 and footnote 3.
Chætostricha pretiosa (Riley)—Idem, ib., p. 4 and footnote 1.
Trichogramma pretiosa Riley—Mollrung, 1898, p. 69.
**Trichogramma pretiosa* Riley—Slingerland, 1898, pp. 37-38, fig. 138.
Trichogramma pretiosa Riley—Boucher, 1902, p.
Trichogramma pretiosa Riley—Mally, 1902, p. 30.
Trichogramma pretiosa Riley—Sanderson, 1902, p. 192, fig. 108.
Pentarthron minutum (Riley)—Ashmead, 1904, p. 360.
Xanthoatomus albipes Ashmead ib., pp. xi., 360. Nomen nudum.
**Trichogramma pretiosa* Riley—Quaintance, 1904, p. 14.
**Trichogramma pretiosa* Riley—Quaintance and Brues, 1905, pp. 115-119, figs. 20-21.
Trichogramma pretiosa Riley—Folsom, 1906, p. 313.
Trichogramma pretiosa Riley—Froggatt, 1906, pp. 390-391.
**Trichogramma pretiosa nigra* Girault, 1906 *a*, pp. 81-82.
**Trichogramma pretiosa* Riley—Idem, 1906 *b*, pp. 137-148.
**Trichogramma pretiosa* Riley—Idem, 1907 *a*, pp. 57-60.
**Trichogramma pretiosa* Riley—Idem, 1907 *b*, pp. 80-86.
**Trichogramma pretiosa* Riley—Idem, 1907 *c*, pp. 117-120.
**Trichogramma pretiosa* Riley—Idem, 1907 *d*, pp. 28, 29, 32, 33, 34.
Trichogramma minuta Riley—Idem, ib., p. 32.
Trichogramma intermedia Howard—Idem, ib., pp. 32, 34, 35.
Trichogramma minutissima Packard—Idem, ib., pp. 32, 34, 35.

Trichogramma pretiosa Riley—Swezey, 1907, pp. 26, 37, 46-47, 54, 55 and 56.

Trichogramma pretiosa Riley—Taylor, 1907, p. 4.

Trichogramma pretiosa Riley—Koebele, 1908, p. 91.

**Trichogramma pretiosa* Riley—Quaintance, 1908, p. 443.

**Trichogramma pretiosa* Riley—Severin and Severin, 1908, pp. 68-70, pl. V, fig. 5.

**Oophthora pretiosa* (Riley)—Masi (1909).

Pentarthron minutum (Riley)—Idem, ib.

Trichogramma sp.—Sanderson, 1909.

Trichogramma pretiosa Riley—Silvestri, 1909.

Chætostricha pretiosa (Riley)—Schmiedeknecht, 1909, p. 486.

Pentarthron minutum (Riley)—Schmiedeknecht, 1909, p. 487.

**Pentarthron minutum* (Riley)—Girault, 1911.

**Chætostricha nana* Zehntner (partim)—idem, ibid.

**Trichogramma* sp. I—Howard and Fiske, 1911, p. 87.

**Trichogramma pretiosa* Riley—idem, pp. 143, 257 ff.

**Trichogramma pretiosa*-like—idem, pp. 136, 257 ff.

This is the commonest and best known species of the whole family, yet great confusion exists in the literature concerning it and it has been described, redescribed and figured a number of times quite erroneously. It still remains unrecognizable from the literature but we shall make here some attempt at its more easy and certain identification.

Originally it was described by Riley (1871) in this manner:

> "The *Disippus* Egg-parasite.—The eggs already described were very abundant last fall on a certain clump of willows near Kirkwood, and of about two hundred obtained, fully one-half of them were parasitised. Instead of hatching out into larvæ, as they would have done if they had been unmolested, these last produced little dark colored four-winged flies, from four to six of which would gnaw their way through the shell of each egg. This little fly belongs to the great *Chalcis* family, and though scarcely more than 0.02 inch long, it can jump to the distance of several inches. Its wings, especially the hind ones, are beautifully fringed with hairs. It is inconspicu-

ously marked, the body being dark brown with the antennæ and legs pale, and the wings iridescent. The highly magnified outlines at figure 72 will convey a good idea of its appearance, *a* showing the wings folded on the back, *b* one of the front wings, *c* one of the hind wings, *d* one of the legs, and *e* one of the antennæ.

I shall leave the proper determination of this insect to those who pay more particular attention to the *Chalcididæ*. It comes nearest the genus *Trichogramma*, Westw., and may be provisionally called *Trichogramma* (?) *minuta*. It differs from that genus and from all other Chalcididan genera with which I am acquainted, in the antennæ being but 5-jointed (scape, plus 4 joints), the scape stout and as long, or longer, than joints 2, 3 and 4 together; joints 3 and 4 small and together as long as joint 2; 5 very stout, fusiform and as long as 2, 3 and 4 together. The legs have the trochanters stout and long, the tibiæ not quite so long nor so stout as the femora, and with a long tooth; the tarsi are 3-jointed, with the joints of equal length and with the claws and pulvilli subobsolete. The abdomen is apparently 6-jointed, the basal joint wide, the 2nd narrower, 2-5 increasing in width till 5 is as wide as 1. The ovipositor of ♀ extends a little beyond the apex, and starts from the anterior edge of the 5th joint." [pp. 157-158, fig. 72, *a-e* (p. 157.).]

The figures accompanying this description are excellent as far as the general appearance of the species is concerned but of course their details are carelessly drawn, but only in regard to the wing ciliation, thoracic characters and antennal structure, the antennæ not showing a ring-joint. The latter point mislead others in regard to the generic position of the species and the consequent uncertainty lead to that confusion whose presence has been already intimated in these pages. The original description was republished in Riley (1881) with the heading ("*Trichogramma minuta*, N. Sp.") but all of the first introductory paragraph was omitted and also the first sentence of the second; the figure was also omitted. The latter was republished in Comstock (1879) and by

Hubbard and Lintner (1885) and Fletcher (1893), but neither the figures nor the description have been republished since. But as *Trichogramma minutum* Riley Packard (1883) redescribed it as follows:

Trichogramma minutum Riley.

Four ♂. Uniformly testaceous brown, legs honey yellow. Front broad between the eyes. Antennæ a little longer than head is broad, pubescent. Thorax short, abdomen twice as long as thorax, rather broader than thorax.

Length .03-.03½ inch.

Bred by C. V. Riley from *L. Disippus*."

Concerning its general identity, Howard (1889a) commented as follows:

Trichogramma minutum Riley.

I have been unable to find recognizable specimens of this species. Specimens preserved by Professor Riley, between two flakes of isinglass, are spoiled. Structurally it is identical with the other forms. Colorationally it was described by Professor Riley in the following words:

"It is inconspicuously marked, the body being dark brown, with the antennæ and legs pale, and the wings iridescent.

"The species was figured and described in the Third Report on Insects of Missouri, p. 157, from specimens reared from the eggs of *Basilarchia archippus* in Missouri. From four to six parasites issued from each egg." pp. 1894-1895.

The other species referred to in this quotation are *intermedium* Howard and *minutissimum* Packard which were separated here from *minutum* by color only.

The species has been redescribed as new a number of times. First, Riley (1879) redescribed it as the new species *pretiosa,* thus:

> 1. **Trichogramma pretiosa,** n. sp.—Length about 0.3 mm. Yellow, the eyes red, the wings hyaline. Head wider than the thorax; antennæ 5-jointed, joints 3 and 4 in the ♀ forming an ovate mass and together shorter than joint 2; joint 5 large, thickened and very obliquely truncate; in the ♂ joints 3, 4 and 5 form a more or less distinct, elongate club, beset with long bristles. Hairs of the wings arranged in about fifteen lines. Abdomen not so wide as the thorax, but as long as the head and thorax together; in the ♀ the sides subparallel, and the apical joint suddenly narrowed to a point. Described from numerous specimens reared from the eggs of *Aletia argillacea.*
>
> Differs from *Trichogramma minuta* Riley (Third Rep. Ins. Mo., p. 158, fig. 72, ♀) in its smaller size and uniform pale yellow color, and also in the form of the third and fourth joints of the antennæ. As defined and figured by Westwood, the antennæ of *Trichogramma* are 6-jointed. Walker, in his "Notes on the *Chalcididæ*," pt. vi., p. 105, employing Förster's character, says the antennæ are 8-jointed; but an examination of the figure of the type *Trichogramma evanescens,* l. c., p. 114) shows that one of the joints counted is the "annulus" above the scape, which I do not consider to be a true joint, and that what I have indicated as the apical joint, in agreement with Westwood, is represented in that figure as three coalesced joints. I have proposed the generic name of *Pentarthrum* for *minuta* in MS. now in Mr. Scudder's hands, but until the allied genera are better characterized than at present, it is best to use the old genus *Trichogramma.*" [pp. 161-162.]

This description was republished in full by Comstock (1879) with a single error (in the third line of the first paragraph *joint* 3 is printed instead of *joint* 5 as in the original) and also in part by Riley (1885) who quoted the first paragraph of the original with the exception of its last sentence and also the first sentence of the second paragraph. Swezey (1907) quoted the first paragraph with the exception of the last sentence. Under this name Quaintance and Brues (1905) give the following description of the species:

> "*Trichogramma* is an extremely minute *Chalcis*-fly, scarcely visible to the unaided eye, and resembling closely the numerous other species belonging to this group. It can be recognized readily, however, by the characteristic arrangement of the hairs on the front wings, i. e., in regular rows, and by the presence of only three tarsal joints.
>
> Length 0.3 to 0.4 mm., the males being usually the smaller. Color pale yellow, as a rule, although some specimens are almost black. Eyes dark red and wings hyaline. Head wider than the thorax; antennæ eight-jointed, pedicel about two-thirds the length of the scape, one small ring joint, the two joints of the funicle equal together shorter than the pedicel, club conic ovate, a little longer than the scape; funicle and club beset with many long hairs in the male and with short ones in the female. Hairs of the front wings arranged in about fifteen lines. Abdomen not so wide as the thorax, but as long as the head and thorax together." [p. 118.]

As *Trichogramma pretiosa* Riley, Riley first figured it in 1885 (p. 102, fig. 31) and this figure has been reproduced without change quite frequently by a number of authors, namely, by Smith (1894). Howard (1896), Slingerland (1898), Smith (1900)—but without lettering as in the original—Sanderson (1902), Quaintance and Brues (1905) and Severin and Severin (1908). In 1887, Riley (1887) reproduced it without name.

B. Secondly, as *Trichogramma minutissimum*, Packard (1883) redescribed it as new quite as follows:

> **Trichogramma minutissimum** n. sp.
>
> Eighty specimens, five ♂, seventy-five ♀. Body uniformly pale testaceous or honey yellow, legs and antennæ scarcely paler than the body, which is much paler than

in *T. minutum* Riley. Abdomen a little longer than the thorax, but no wider seen from above. Antennæ of male with long hairs, those on the club, in some cases, as long as the club itself; in ♀ they are naked; joint a little shorter than in *T. minutum*, as are the entire antennæ. Wings and legs much as in *T. minutum*, but the legs are rather slenderer.

This minute form may be at once distinguished from *T. minutum* by being about half as large, and by the much paler, naked antennæ in ♀, and narrower abdomen.

Length ♂, .01-.01½ inch; ♀, .01⅔-.02 inch.

Bred from *Papilio turnus*, June 29-30 by S. H. Scudder.

These two species seem, without doubt, to be closely allied to and congeneric with the species of *Trichogramma* figured by Prof. J. O. Westwood in his "Descriptions of some minute Hymenopterous Insects. (Trans. Linnæan Soc. London, 1878, pl. lxxiii.)" [pp. 37-38.]

This description has never been repeated in print but Howard (1889a) paraphrased it as follows, giving additional details also, in a note of Scudder's making and previously indicating its difference from *intermedium* and *minutum* in the manner quoted in full elsewhere:

Trichogramma minutissimum Packard.

Body uniformly pale testaceous or honey-yellow, legs and antennæ scarcely paler than the body. Abdomen a little longer than the thorax, but no wider, seen from above. Antennæ a little longer than in *minutum*, legs a little slenderer. Length, ♂, .25 mm. to .37 mm.; ♀, .38 mm.-.5 mm. (After Packard.)

(The following description of the colors was taken during life:—Body and head wax-yellow; face a little paler; eyes and ocelli dark orange; body with yellow-green internal blotches appearing through the skin; legs and antennæ pale yellow, apical half of tarsi a little dusky. S. H. S.)

In the material sent me by Mr. Scudder I find eight slides of this species, three labelled from eggs of *Jasoniades glaucus*, three from eggs of *Basilarchia archippus*, and two from eggs of *Vanessa atalanta*." p. 1895.

C. Thirdly as *Trichogramma odontotæ* by Howard (1885 b)

"3. **Trichogramma odontotae,** n. sp. *Female.*—Length 0.55 mm., expanse 1.12 mm. Color: eyes red, head, antennæ, thorax and basal joint of abdomen orange yellow, all legs light fuscous, remainder of abdomen light brown. Antennæ except scape and including pedicel with a few short sparse hairs. Basal portion of fore wing included by the stigmatal vein slightly fuscous, remainder hyaline.

Male.—Length averages about .05 to .1 mm., shorter than ♀, with wings of about the same proportionate length. Colors the same except that the abdomen is darker, and the fuscous patch on the base of the fore wings is more pronounced. In the balsam-mounted specimens no complete division of the flagellum into joints can be observed and the antennæ appear 3-jointed (scape 1, pedicel 2, flagellum 3). Conspicuous whorls of hair are present, however, indicating possible sub-divisions. The appearance is much like that of the ♂ antennæ of *Tr. erosicornis*, Westw. (Trans. Linn. Soc. London, Ser. 2, Vol. I (1878) Pl. 73, figs. 24 and 25) for which Westwood erects the sub-genus *Aprobosca.*

Described from ♂ and ♀ specimens bred during the month of July from the egg masses of *Odontota suturalis* on Locust at Washington, D. C." [p. 117.]

This description has never been repeated.

D. Fourthly and finally it was redescribed as new under the name *Trichogramma intermedium* by Howard (1889a) in this manner:

Trichogramma intermedium sp. nov. Pl. 89, fig. 8.

Male.—General color dirty yellow in effect; face bright yellow, eyes and ocelli red, antennæ slightly dusky; mesonotum very light yellow-gray; metanotum yellow; abdomen above slightly darker than mesonotum; all coxæ dusky, hind femora slightly dusky above, remainder of legs dull yellowish. Wings with a slight cloud below submarginal vein. The nearly straight line of hairs running downwards from tip of stigma consists of five hairs, the first one sometimes included in stigmal club, leaving only four apparent in the row. Average length, .55 mm.; average expanse, 1.0 mm.

Female.—Slightly smaller, and not quite so dark as male.

(The following description of the colors was taken during life: Honey-yellow, the abdomen pale and banded transversely with dusky; eyes and ocelli salmon-red; legs and antennæ greenish olive; apical two-fifths of tarsi fuscous. S. H. S.)

Of this species Mr. Scudder has sent me six slides, four containing specimens reared from eggs of *Aglais milberti*, and two from eggs of *Thanaos lucilius*. Mr. James Fletcher has since sent me from Ottawa four specimens reared during the summer of 1888, from eggs of *Oeneis macounii*." [p. 1895.]

The figure of the insect given with this description shows (pl. 89, fig. 8) a typical *Pentarthron* female but the ring-joint of the antenna is not shown and the structural details are obviously incorrect; specifically also, the details of the wing ciliation are obviously incorrect for while the description states that only five cilia are present in the oblique line of discal cilia running back from the stigmal vein the figure shows about eight; also in the figure the discal ciliation of the posterior wings is represented by but a single long line. The figure differs from the other figures of this species (*minutum*, Riley 1871; *pretiosum*, Riley, 1885 and others) mainly on account of the fact that they are drawn on a different scale and from a different aspect: thus in *pretiosum* the marginal ciliation is figured as if moderately long, obviously incorrect and the arrangement of the discal ciliation of both the fore and hind wings in all three sets of figures is incorrect as is also the venation; these minor differences in the figures therefore are due to the drawings themselves and are not to be taken as actual differences in the specimens from which the drawings were made. They are quite without value for purposes of specific distinction in this genus as we shall see later. Neither the description nor the figure have reappeared in print.

After the original description of this species was published (Riley, 1871) Packard (1872) stated that Riley had proposed the MS. name of *Pentarthron* for it (see p.) and as we have seen in the quotations just given this proposal was mentioned later by both Riley and Comstock (1879, as *Pentarthrum* and again by Riley in 1881 as *Pentarthron*. In 1897, Aurivillius referred the species to his genus *Oophthora* (see page) but as has been mentioned already elsewhere this genues is a true synonym of *Pentarthron;* finally Ashmead (1904) again gave it as the type of *Pentarthron* and he was certainly correct..[4] Otherwise the species has been treated as of *Trichogramma* Westwood with these exceptions:—Dyar (1893) referred it to *Chætostricha* Haliday (*Chætosticha* Dyar) without explanation, including at the same time *minutissimum* as a synonym; and de Dalla Torre (1898) under the name of *pretiosa* treated it in the same manner that Dyar did.

Further references to it in a systematic way are too unimportant for detailed mention, but all are sufficiently clear as given in the bibliographical list preceding these remarks. As a matter of fact the great majority of these references do not have any bearing at all on the taxonomy of the species but concern its economy in nature as a parasite of injurious insects and also its biology. It has not received serious attention from the systematic standpoint since Packard (1883).

Both from the standpoint of taxonomy and from that of economic entomology this species is an important one, in fact the

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4. At the same time Ashmead also proposed *Xanthoatomus* as a genus to be separated from *Pentarthron* by its slender abdomen; its type species ***allopes*** was simply mentioned. I am certain that this species is none other than *minutum* and [illegible] (1909) has shown it to be generically similar to *Oophthora;* it is desirable to rid ourselves of it and for obvious reasons I make it a synonym.

most common and most widely distributed of the entire family. On these accounts its identification should be made easy and certain, a fact not true up to the present writing excepting the evidence of its identity afforded by certain of its well-known hosts; but hosts in this genus are apparently extraspecific, hence identification of the species according to the host is more or less hazardous, depending upon circumstances. Originally the species was erroneously described and figured, its antennæ were variously considered as 5 or 8-jointed, usually without a ring-joint, the club variously considered a single, solid piece or else consisting of 3 more or less distinct joints, the figures of the antennæ did not agree with the accompanying descriptions and thus one was left to the necessity of chosing, an obvious fault in taxonomic work. Originally, Riley (1871) described the antennæ as being 5-jointed (the club solid, the ring-joint absent) and in redescribing it as *Trichogramma pretiosa* in 1879, the same statement was repeated; but later a statement was made that the ring-joint was not considered to be a true joint and thus left uncounted, intimating plainly that it was present in this species, hence the antenna of *Trichogramma* Westwood was understood by Riley to be 6-jointed, the club being composed of 3 supposedly coalesced joints, hence by inference, solid. Reading between the lines it is not difficult to infer the antennal structure of *minutum* as variously described thus—scape, pediced, 1 ring-joint (inferred to be purposely neglected in the count by Riley), 2 funicle joints and a solid club (from analogy or suggestion supposed to be three coalesced joints, which, however, were *not visible*) this inferred structure agreeing with the known facts.

From the large series of specimens listed beyond, I have drawn up the following redescription of the species:

Redescription of **Pentarthron minutum** (Riley).

Normal position.

Female:—Length, variable, averaging about 0.43 mm., ranging from about 0.27 mm. to 0.80 mm.

General body color uniformly deep pale cadimum yellow,[5] sulphur or orange yellow, iridescent in bright lights, varying through brownish to piceous black, the eyes and ocelli a brilliant red, the legs pallid yellowish with the distal tarsal joints slightly dusky, the legs varying to blackish femora and tibiæ, the abdomen yellow to dilute black or dusky at base somewhat more pallid, the antennæ concolorous with the legs, slightly dusky and slightly deeper in color, the club more so. Venation dusky yellowish. Fore wings hyaline, fumated slightly but distinctly proximad, the fumated area extending from the base of the wing distad to the apex of the stigmal vein and involving in the middle area of the wing a pointed projection proximad of the discal ciliation; most of the fumated area naked; the area varies in intensity, in some specimens barely visible, perhaps absent, in other extremes intense and conspicuous, nearly as in the species *semifumatum* Perkins. Posterior wings correspondingly fumated but less conspicuously. Ovipositor concolorous with the legs.

Sculpture of the body alutaceous, consisting of very delicate striations on the genæ ventrad of the eyes, inconspicuous. Clothing or body pubescence sparse, short, scattered bristly setæ. Discal ciliation of the fore wing, across its greatest width, arranged in about from 14-16 longitudinal lines, some of which are shortened or else irregular; the cilia are moderately short and uniform, not dense; the curved oblique line leading caudo-proximad from the end of the stigmal vein contains from 3 to 5 cilia, usually 5 and very rarely 6. Marginal vein proper bearing from the middle of its surface 4 large setæ (a 5th is present at the apex of the submarginal vein and a 6th on the stigmal) and between them 2 or 3 short ones, making a total of 6 or 7. Caudal wings with but a distinct, complete line of discal cilia, intermediate and nearer the cephalic margin, a second half-complete line caudad, nearer the caudal margin of the wing, faint, and a 3rd cephalic line, present caudad only and containing but from 2 to 4 cilia (rarely a maximum of 7).

Antennæ usually sparsely pubescent, the setæ moderately long, soft and irregularly placed, most numerous on the club where they become moderately abundant, giving a bristly appearance. Scape

5. Sometimes the whole of the cephalic aspect of the head in both sexes contrasts with the general body color by being pallid (in balsam mounts silvery) as in the species *euproctidis*.

cylindrical, slightly thickened at the middle, subequal to the club in length and distinctly longer than the pedicel, ring-joint and funicle taken together. Pedicel obconic, about a half of the length of the club and somewhat longer than the combined lengths of the two funicle joints and distinctly wider than either of them; the single ring-joint narrow, not as wide as the base of the first funicle joint and not a third as long as the latter; the first funicle joint wider than long, somewhat shorter than the second which is subquadrate but still slightly wider than long, in general both joints about equal and subquadrate; the solid club conic-ovate, distinct and forming over half of the flagellum. (From many specimens, ⅔-inch objective, 1-inch optic, Bausch and Lomb.)

Male:—The same with the secondary sexual characters pointed out in the generic description and with these particulars: fully winged, agreeing in all particulars with the female with the exception of the antennæ and the smaller, ovate abdomen. The antennæ with long, numerous, very conspicuous, hair-like bristles on the funicle and club, the latter unjointed, the scape, pedicel and ring-joint distinct as in the female but the funicle and club united and with a knotted appearance due to the tubercular spots giving rise to the long hairs and the segmentation is not distinct, sometimes invisible but usually the divisions between the two funicle joints and the club can be distinguished; the part corresponding to the club is also roughened and is not differentiated from the funicle as in the female and as is normal; the hairs are in irregular whorls. In general the segmentation is as in the female, namely 6-jointed with a ring-joint but the funicle and club practically united and clothed with long, slender hairs from tubercles. (From many specimens, ⅔-inch objective, 1-inch optic, Bausch and Lomb.)

A species characterized by the ciliation of the fore and posterior wings, namely in the oblique line of cilia of the fore wing having usually but 5 cilia and being disconnected from the remaining discal ciliation; the short cephalic line of discal ciliation of the posterior wing having usually but 4 cilia, never more than 7 and in the half-complete, faint posterior line of cilia of the posterior wing; by the faintly clouded bascal half of the fore wing: and the uniform body coloration in individuals. It is nearest to *semblidis* Aurivillius from which it may be most easily distinguished by the dimorphic males and the longer cephalic line of discal ciliation of the posterior wings in the latter species. The uniform coloration of *minutum* is not always present for in some series the abdomen may contrast with the rest of the body of normal, yellowish specimens in being black, especially in the case of some males, the females of the same series being uniformly light yellow in color and the two sexes in some series of reared specimens may easily be determined in this way, by their color alone.

Redescribed from the following series of specimens:

(1) 2 ♂ ♂ (September 3, 4, 1909) and 9 ♀ ♀ (August 25, 29, September 1, 4 and 9, 1909) captured on a small window in a pig-shed on a farm, Centralia, Illinois. Accession No. *41,682*, Illinois State Laboratory of Natural History, Urbana, Illinois; 3 ♀ ♀ in xylol-balsam, August 25, 1909 (2 slides); 1 ♀ similarly mounted, August 29, 1909 and another September 1, 1909 (2 slides).

(2) Four balsam slides labelled: *a* "From egg of *Eriocampoides limacina*. Exp. 62. June 28, 1909. R. L. Webster," 1 ♀ ♂ *b* the same and "Exp. 80, July 5, 1909. R. L. Webster." 2 ♂ ♂, 4 ♀ ♀; *c* the same and "Exp. 82, July 9, 1909. R. L. Webster," 2 ♂ and *d* the same with "Exp. 82, July 13, 1909. R. L. Webster," 1 ♀. The hosts were collected at Ames, Iowa, (R. L. Webster) See No. 53, *seq.*

(3) One balsam slide received from Professor F. M. Webster and labelled "Web. No. 9100. Marion, S. C. Parasite on eggs of *D. saccharalis*. Bred Geo. G. Ainslie." 1 ♂, 2 ♀ ♀. See No. 49, *seq.*

(4) 1 ♂, 10 ♀ ♀ reared from noctuid eggs on *Hicoria alba*, foliage, Urbana, Illinois, July 17, 1908. Accession No. *39,121*, Illinois State Laboratory of Natural History, Urbana, 11 specimens in xylol-balsam, 1 slide.

(5) 1 ♂, 6 ♀ ♀ reared July 22, 1908, from the eggs of *Archips rosaceana* Harris, Accession No. *39,137*, Illinois State Laboratory of Natural History, 7 specimens in xylol-balsam, 1 slide; the hosts were collected at Edwardville, Illinois.

The following specimens from the collections of the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C., through the kindness of Dr. L. O. Howard (and see later also):

(6) 5 ♀ ♀ on a single slide labelled "7187°. Par. in noctuid eggs on leaf of *Sagittaria*, Marshall Hall, Maryland. Iss. August 25, 1896."

(7) 2 ♂ ♂, 3 ♀ ♀ on a single slide labelled "2/3/4."

(8) 3 ♀ ♀ on a single slide with these labels—"33/19," "193°1" and "153°1." Egg-parasite of *Carpocapsa pomonella*. M. V. Slingerland, Ithaca, N. Y., June 9, 1896."

(9) 3 ♂ ♂, 18 ♀ ♀ on a single balsam slide labelled "La. U. Expt. 8, Sub. 46."

(10) 2 ♀ ♀ on a slide labelled "153°4. Bred from egg of *Carpocapsa pomonella*, Wellington, N. Z. T. W. Kirk."

(11) 8 ♀ ♀ on a single slide labelled "7183°" and 7183°. Par. from tortricid egg on leaf of *Sagittaria*, Marshall Hall, Maryland. Iss. August 24, 1896." See ante, 6.

(12) Two slides bearing 2 ♂ ♂ and 4 ♀ ♀ and 2 ♂ ♂, 3 ♀ ♀ respectively, both labelled "78 R. *Trichogramma*. Bred from eggs of *Hyphantria textor*. August 18, 1883. Remounted January 16, 1908, 3/3/78."

(13) Two ♀ ♀ captured on windows, Urbana, Illinois, April 30, 1910. Accession No. *44071*, Illinois State Laboratory of Natural History, 1 slide, xylol-balsam. A. A. Girault.

(14) Two ♀ ♀ captured while running over the windows of a stable, Mattoon, Illinois, July 16, 1910. Accession No. *44,072*, Illinois State Laboratory of Natural History, Urbana, 2 slides, xylol-balsam. A. A. G.

(15) 4 ♂ ♂, 9 ♀ ♀ on single slide labelled as follows: "From ova of *Heliothis obsoleta* (Fabricius.) *Trichogramma pretiosa* Riley. Variation in adults, generation No. 10, October 14, 1904, Paris, Texas, A. A. Girault." Accession No. *44,073*, Illinois State Laboratory of Natural History, Urbana, 1 slide, balsam.

(16) 2 ♂ ♂, 1 ♀ on a single slide labelled as in the preceding and also "generation No. 8, 25 September, 1904." Accession No. *44,074*, Ill. St. Lab. Natural History, 1 slide.

(17) 4 ♂ ♂, 10 ♀ ♀ on a single slide in the National Bureau of Entomology collections, labelled "2/1/15. 468L°1, *Trichogramma pretiosa*."

(18) 1 ♂, 2 ♀ ♀ on a single slide from the same collection, labelled "(Quaintance No. 1501. *Trichogramma pretiosa* Riley. 1 ♂, 2 ♀ ♀, A. A. G. Ova *Heliothis obsoleta*, 18 October, 1904, Paris, Texas, A. A. Girault.

(19) A single slide bearing 9 ♂ ♂, 11 ♀ ♀ from the same collection labelled "Quaintance No. 1503. *Trichogramma pretiosa* Riley.

Quaintance. No. 55. Calvert, Texas, 8/16 (1903.) Bred from eggs of *Heliothis obsoleta*."

(20) A slide bearing 2 ♀ ♀ from the same collection and labelled "153°1. Expt. 240c. Egg-parasites. Emerged 28 June, '96, mounted alive. 32/25" and reared from *Carpocapsa pomonella*.

(21) A slide from the same collection bearing 1 ♂, 2 ♀ ♀ labeled "(Quaintance) No. 1,499. From ova *Heliothis obsoleta* (Fabricius). *Trichogramma pretiosa* Riley. Generation No. 11, November, 1904. Paris, Texas. A. Girault."

(22) Another slide from the same collection with 2 ♂ ♂ and 3 ♀ ♀ labelled "(Quaintance) No. 1,498. *Trichogramma pretiosa* Riley. Paris, Texas, May, 1904. A. A. Girault." Reared from eggs of the *Heliothis*.

(23) Three slides from the same collection bearing 1 ♂, 6 ♀ ♀; 3 ♀ ♀; and 12 ♀ ♀ respectively and labelled "(Quaintance) No. 2,774. *Trichogramma pretiosa* Riley. Nebraska City (Nebraska), August 23, 1906." and reared from the eggs of *Carpocapsa pomonella* by Dudley Moulton.

(24) 4 ♂ ♂, 2 ♀ ♀ + 5 pupæ on a single slide from the same collection and labelled "(Quaintance) No. 2,623. Egg-parasite of grape-berry moth, North East, Pennsylvania, September 7, 1906." Reared from the eggs of *Polychrosis viteana* Clemens by Fred Johnson.

(25) A single slide from the same collection bearing 2 ♀ ♀ and labelled "Quaintance No. 2,260*a*. *Trichogramma pretiosa* Riley 2 ♀'s. On eggs of *Carpocapsa*, Myrtle, Georgia, April 30, 1906. Girault." *Carpocapsa pomonella*.

(26) Another slide from the same collection bearing 3 ♂ ♂, 6 ♀ ♀ and labelled "(Quaintance) No. 1,502. Bred from eggs of *Heliothis obsoleta*. *Trichogramma pretiosa*." Victoria (?), Texas, 1903. A. L. Quaintance.

(27) Fifteen slides bearing 37 ♂ ♂ from the same collection labelled "1859H (Gypsy Moth Laboratory), Am. species. ♂ ♂." Reared from egg mass of *Euproctis chrysorrhœa* collected at Waltham Massachusetts. Second generation." [6]

(28) Seventeen slides bearing 60 ♀ ♀ from the same collection labelled "Gypsy Moth Laboratory 1868." Descendents of the 9th generation from parents obtained from egg masses of *Euproctis chrysorrhœa* imported from Europe.

(29) Eleven slides bearing 32 ♀ ♀ and from the same collection labelled "Gypsy Moth Laboratory. 1868c. *Trichogramma*."

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6. And from two parthenogenetic females.

(30) Four slides bearing 5 ♀ ♀ from same collection labelled "1893, Gypsy Moth Laboratory. American species. ♀."

(31) Eight slides bearing 21 ♂ ♂ from the same collection labelled "1894. Gypsy Moth Laboratory. American species. ♂ ♂."

(32) Three slides bearing 5 ♂ ♂, 7 ♀ ♀ from the same collection labelled "806. E. Gypsy Moth Laboratory. *Trichogramma*, European. Bred from egg masses of *E. chrysorrhœa*. Mounted March 9, 1908."

(33) A slide from the same collection bearing 3 ♀ ♀ and labelled "912 A. B. Gypsy Moth Laboratory. Europ. sp. From *Euproctis* eggs."

(34) One slide from the same collection bearing 4 ♀ ♀ and labelled "912 Ac." and as preceding number.

(35) Another slide of the same series bearing 3 ♀ ♀, similarly labelled but numbered "912. G. G. M. Lab."

(36) Two ♂ ♂ on a slide of the same series similarly labelled but numbered "921. R. G. M. Lab."

(37) Two slides from the same collection bearing 1 ♂, 5 ♀ ♀ and labelled "Bred from eggs of *Agraulis vanillæ* at Los Angeles, California, September 10, 16, 1887."

(38) One slide from same collection bearing 1 ♂, 1 ♀ and the following labels, "No. 336." and "from eggs of *Anisota senatoria*, Sept. 4, '82." Balsam.

(39) Four slides sent for determination by Mr. E. P. Taylor, reared August 12 (2 ♂ ♂ and 3 ♀ ♀; 4 ♂ ♂, 1 ♀ on two slides), Aug. 16, (3 ♂ ♂, 3 ♀ ♀, on one slide), and Aug. 23, 1910 (2 ♂ ♂ 3 ♀ ♀, on one slide) at Grand Junction, Colorado, from the eggs of *Carpocapsa pomonella* Linnaeus; the specimens on the last slide were reared at Urbana, Illinois, on August 23 from the Colorado host eggs collected on August 16 and forwarded to me.

(40) The tag-mounted females in the collection of the United States National Museum labelled "*Trichogramma pretiosa* Riley 39380. From egg of *Sphinx carolina*. E. Florida, Ashmead." Destroyed while remounting.

(41) Two slides bearing 3 ♂ ♂, 7 ♀ ♀ and 4 ♀ ♀ respectively remounted from alcoholic specimens received from Mr. J. C. Crawford for determination, and labelled "29901"; said to have been reared from the eggs of *Calpodes ethlius*, collected at Orlando, Florida, October 12, 1907, reared about a week later.

(42) Two slides bearing 1 ♂, 11 ♀ ♀ and 3 ♂ ♂, 18 ♀ ♀ respectively received from the same source and labelled "247[02]" and said to be from the eggs of *Datana integerrima*, collected at Orlando,

Florida, (H. M. Russell), September 23, 1907 and reared October 2-31, 1907; also again reared from the same host in the same place May 29 and 31, 1909.

(43) One slide bearing 1 ♀ remounted from a tagged specimen in the United States National Museum collection, bearing the label "*Trichogramma pretiosa* (Riley). From eggs of *Mamestra picta*. Ottawa, Canada. Fletcher."

(44) A slide bearing 5 ♀ ♀ similarly remounted from specimens in the same collection bearing the label "Egg-parasite of *Smerinthus* on elm. J. A. Guignard, Ottawa, Canada. 19 July, '95."

(45) Two slides from the same collection and remounted in balsam from tags bearing 2 and 6 ♀ ♀ respectively, labelled "78°. August 18, '83. Through C. V. Riley, 1888," and arranged under *Xanthostomus*.

(46) A slide bearing 4 remounted ♀ ♀ from the same collection labelled "5896. Par. on noctuid eggs. Issued 14 August, '93. J. G. Barlow, Cadet, Mo."

(47). One remounted ♀ from the same collection labelled "*Trichogramma minuta* Riley. Beaten from Pine, Va., April 12, '85."

(48) One ♂, 3 ♀ ♀ remounted on a slide, from the same collection labelled "1705. W. Ohio."

(49). A slide bearing 1 ♂, 5 ♀ ♀, remounted from tagged specimens in the same collection and labelled "Marion, S. C. G. G. Ainslie, collector, Webster No. 9100." See 3.

(50) Two slides bearing 3 ♂ ♂, 3 ♀ ♀ respectively and labelled 'From eggs of a tortricid on an unknown weed. Bloomington, Illinois, August 20, 1910. Girault. Reared August 23, 1910."

(51) Three slides bearing 1 ♀, 4 ♀ ♀ and 1 ♂, 1 ♀ respectively, besides specimens of *cuproctidis* labelled "From lepidopterous eggs. Bloomington, Illinois, August 20, 1910. Girault.

(52) One ♀ captured October 8, 1910 in a greenhouse, campus University of Illinois, Urbana, Illinois (balsam).

(53) Seven balsam slides from R. L. Webster, Ames, Iowa, labelled "From eggs *Eriocampoides limacina*. R. L. Webster." as follows: (a). "Exp. 36. Ames, Iowa, 28 June, 1909." 3 ♀ ♀, 1 slide; (b). "Exp. 83. 13 July 1909." 1 ♂, 1 ♀, 1 slide; (c). "Exp. 87. 15 and 20 July, 1909." 1 ♂, 1 ♀, 1 slide: (d). "Exp. 88. 5-9 July, 1909." 1 slide, 1 ♂, 3 ♀ ♀, and the same "6 August, 1909." 1 slide, 1 ♂ : (e). "Exp. 184. 13 August, 1909." 1 slide, 2 ♀ ♀ ; and (f). "Exp. 185. 13 August, 1909." 1 slide, 3 ♀ ♀.

(54) One ♀ in xylol balsam, October 18, 1910 captured on a window at Hendrix, (Bloomington), Illinois (Girault).

(55) One slide bearing one ♂ and two ♀ specimens reared from the eggs of *Heliothis obsoleta* Fabricius collected at De Rio, Texas, 29 October, 1910 by F. C. Bishopp.

(56) Two slides bearing a ♀ each received from Dr. C. Gordon Hewitt, Dominion Entemologist, Ottawa, Canada and labelled "Ex ovo *Euproctis chrysorrhoea.* Date, 24, VIII, '10. Division of Entemology." The hosts were taken in New Brunswick.

(57) A single slide bearing 1 ♂, 5 ♀ ♀ mounted with 2 ♂ ♂, 2 ♀ ♀ of *Trichogrammatoidea nana* (Zehntner), the slide bearing the following labels, "*Chætostricha nana,* 7 ♀, 3 ♂, Zehntner, Aus *Diatræa striatalis.* Eiern. Java.", and "7345°."

(58) Five slides received from Dr. F. H. Chittenden, labelled "Egg parasite of *Peridroma saucia.* No. 496°° Los Angeles, Cal. June 1910. H. M. Russell" and respectively bearing 14 ♀ ♀; 2 ♂ ♂, 9 ♀ ♀; 9 ♀ ♀; 10 ♀ ♀ and 2 ♂ ♂, 10 ♀ ♀.

(59) Two slides from the same source labelled "Egg parasite of *Peridroma saucia?* Huntington Beach, Calif., Oct 8, 1910. H. M. Russell" and bearing 2 ♂ ♂, 6 ♀ ♀ and 1 ♂, 7 ♀ ♀.

(60) Two slides from the same source each labelled "Egg parasites of *Phlyctænia ferrugalis.* No. 478° Talbert and Compton, Calif. Sep. 12 and 24, 1910 H. M. Russel" and bearing respectively 3 ♂ ♂, 6 ♀ ♀ and 2 ♂ ♂, 8 ♀ ♀.

(61) Five slides from the same source each bearing the label "Egg parasite of *Tortrix sp.* No. 452° Compton, Calif., November 23, 1910. H. M. Russell" and respectively, 2 ♂ ♂, 9 ♀ ♀; 2 ♂ ♂, 3 ♀ ♀; 2 ♂ ♂, 5 ♀ ♀; 1 ♂, 6 ♀ ♀; and 5 ♂ ♂, 3 ♀ ♀.

(62) One slide bearing five male specimens received for identification from Mr. T .E. Holloway of the National Bureau of Entomology reared from the eggs of *Heliothis obsoleta* Fabricius and labelled "5 ♂ ♂. P. 33, Brownsville, Tex. Killed 3/28/11. T. E. H."

(63) A single female captured on the panes of a window in a hennery yard of a private residence, Marissa, Illinois, June 15, 1911, A. A. G.

(64) Five slides bearing respectively 1 ♂, 13 ♀ ♀; 3 ♂ ♂, 9 ♀ ♀; 3 ♂ ♂, 14 ♀ ♀; 3 ♂ ♂, 16 ♀ ♀; and 3 ♂ ♂, 17 ♀ ♀ received from Henry P. Severin of Milwaukee, Wisconsin and reared from the eggs of *Cimbex americana* Leach, July 3, 1911 (Urbana, Ill.) collected at Milwaukee, Wisconsin, June 30, 1911.

(65) A single slide bearing 2 ♂ ♂ and 32 ♀ ♀ reared from the same host as in the preceding, same lot, July 7, 1911.

(66) A series of slides kindly loaned for study by Professor A. L. Quaintance, bearing the following specimens and data—One slide with

a single female, labelled "Bred from eggs, 7 b. on *Heliothis armigera.* Acc. 10 Victoria, Tex., 1903." A slide bearing 1 ♂, 2 ♀ ♀ and labelled "26. Bred from eggs of *H. armiger.*" A slide bearing two females and labelled "25. Bred from eggs of *H. armiger.*" Another slide bearing 6 ♂ ♂, 13 ♀ ♀ and labelled "35. 6/10/'03. Bred from eggs of *H. armiger.*" Another with 1 ♂, 2 ♀ ♀ and labelled "No. 1502. Bred from eggs of *H. armiger. Trichogramma.*" Another bearing two males and the labels "Acc. 23 *T. pretiosa.* Parasites bred from *armiger* eggs." And finally, another with two males, nine females, labelled '33. Bred from bollworm eggs from corn. 6/1-03."

(67) Three slides received from Dr. C. Gordon Hewitt, Dominion Entomologist, Ottawa, Canada, bearing two females, two females and one female respectively and each labelled "From noctuid eggs, Maniwaki, P. Q. 25. VII. 11." Reared by G. E. Sanders.

(68) Two slides from the same source bearing a single female each and the label "From Spruce Budworm eggs, C. E. F., Ottawa, 22 VII, 11."

(69) Nine slides from the same source bearing respectively 1 ♀, 1 ♂, 1 ♀, 1 ♂, 1 ♂, 1 ♀, 1 ♀, 1 ♀, and 1 ♂ and each labelled "From Spruce Budworm Eggs. Maniwaki, P. Q. 22 VII. 11. Division of Entomology." Reared by G. E. Sanders.

HABITAT; *Western Hemisphere.*

United States: Missouri (Kirkwood, Cadet); District of Columbia; Massachusetts (Wood's Holl, Waltham, Walpole); Texas (Victoria, Corsicana, Paris, Sulphur Springs, Brownsville, Calvert, Del Rio and Pittsburg); South Carolina (Batesburg and Marion); Georgia (Myrtle and Albany); Florida (eastern part; Jacksonville, Crescent City, Lake City and Orlando); Alabama (Montgomery); Arkansas (Pine Bluff); Colorado (Grand Junction, Clifton and Fruita); Illinois (Centralia, Edwardsville, Urbana, Bloomington, Marissa, Matoon); Iowa (Ames); Maryland (Marshall Hall); New York (Ithaca, Utica, Schoharie, Albany and Youngstown); Louisiana; Nebraska (Nebraska City); Pennsylvania (North East); California (San Jose, Los Angeles, Talbert and Compton); Virginia; Ohio; Wisconsin (Milwaukee); Maine (York).

Canada: Ontario (London, Ottawa and Galetta); New Brunswick; Quebec (Maniwaki). Also Nepigon, Canada.

West Indies: Jamaica (Kingston).

Eastern Hemisphere.

Europe: Germany—Prussia (Baden and Rhine); Austria (Carniola and Dalmatia).

New Zealand: Waikumete and Wellington.

Java.

Hawaii: Honomu; Honolulu; Olaa; Kohala.

The species thus shows a wide distribution but we do not know all of the facts of the case. We do not know enough about the genus to attempt to trace the place of origin of this species nor at the present time would it be profitable to discuss is distribution from more important standpoints, namely those of ecology and physicogeography. However, some of the ecological aspects of its distribution may be obtained from the next paragraph; its relations to nonorganic factors, in respect to this, seems to me to be of minor importance for food seems to be a factor of more than usual importance in limiting its range.

HOSTS;

Just about four years ago Girault (1907) listed the definitely known hosts of this species, then eleven in number; its synonomy now being known that list should have included eleven others, making a total of twenty-two. A comparatively large number of new hosts have since become of record raising the total number of hosts of this remarkable parasite to forty-five or twice the number formerly known after the synonymic species are included or four times the total of the list published four years ago. Undoubtedly, all of them are not known to us yet and the species is perhaps continually acquiring new ones. The revised list of its hosts are given herewith:

ORDER COLEOPTERA.

Family Chrysomelidæ.

Odontota dorsalis Thunberg.
Odontota suturalis Thunberg.

ORDER LEPIDOPTERA.

Family Papilionidæ.

Papilio glaucus Linnæus
Papilio glaucus turnus Linnæus.

Family Nymphalidæ.

Polygonia interrogationis Fabricius.
Vanessa atalanta Linnæus.
Agraulis vanillæ Linnæus.
Aglais milberti Godart.
Basilarchia archippus Cramer.

Family Lymnadidæ.

Anosia plexippus Linnæus.

Family Agapetidæ.

Oeneis macounii Edwards.

Family Hesperidæ.

Calpodes ethlius Cramer.
Thanaos lucilius Lintner.

Family Sphingidæ.

Smerinthus sp.
Phlegethontius sexta Johanssen.

Family Notodontidæ.

Datana integerrima Grote and Robinson.
Ianassa lignicolor Walker.

Family Liparidæ.

Euproctis chrysorrhœa Linnæus.

Family Arctiidæ.

Hyphantria cunea Drury.
Hyphantria textor Harris.

Family Noctuidæ.

Omiodes meyricki.
Omiodes blackburnii.
Omiodes accepta.
Peridroma margaritosa saucia Hübner.
Autographa brassicæ Riley.
Heliothis obsoleta Fabricius.
Alabama argillacea Hübner.
Laphygma frugiperda Smith and Abbot.
Mamestra picta Harris.

Family Ceratocampidæ.

Anisota senatoria Smith and Abbot.

Family Tortricidæ.

Tortrix fumiferana Clemens.
Tortrix citrana Fernald.
Platynota rostrana Walker.
Carpocapsa pomonella (Linnæus).
Polychrosis botrana Schiffermüller.
Archips rosaceana Harris.

Family Pyralidæ.

Phlyctænia ferrugalis Hübner.
Diatræa saccharalis Fabricius.
Diatræa striatalis.

ORDER HYMENOPTERA.

Family Selandriidæ.

Caliroa obsoleta Norton.
Eriocampoides limacina (Retzius).

Family Nematidæ.

? *Pachynematus palliventris* Cresson.
Pteronus ribesii Scopoli.

Family Cimbicidæ.

Cimbex americana Leach.

ORDER MEGALOPTERA.

Family Chauliodidæ.

Chauliodes rastricornis Rambur.

Thus this parasite attacks four orders of insects, including eighteen families and thirty-eight genera, but the largest number of its hosts are lepidopterous; in this connection, it should be pointed out that those of its hosts which are hymenopterous belong to a group which certainly approaches the Lepidoptera in many ways and of all Hymenoptera are those most closely related to moths and butterflies; its coleopterous hosts also remind us of the Lepidoptera because of the form of their larvae and the leaf-mining habits of the latter. All of its hosts have larvae which are eruciform and all have indirect or complete metamorphosis; also all feed upon the foliage of various trees and plants—none are woodboring insects or carnivorous or predaceous in their larval stages. More significant still is the fact that all of its hosts have eggs which are comparatively delicate or unarmed or with conspicuous micropyles and which are deposited in exposed situations or at least in those which are accessible.

The ecological relations of *minutum* are varied. It is a general parasite and has therefore a wide choice of food; hence as a parasite and as an animal it must be highly adaptive and very successful. Not being dependent upon any single source of food (host) its reproductive rate does not have to be adapted to any single condition; its rate of reproduction must be an average in relation to the average rates of reproduction of its group or groups of hosts. If through fluctuation, a decrease in numbers of one of its hosts occurs, in the same locality it can readily change to another and thus is not likely, on the whole, to lack an optimum supply of food for its progeny at all times. Its rate of reproduction must therefore be an approximately stable, nonfluctuating one, since it must, on the whole, so balance it that the group of its hosts taken as a unit does not suffer. Moreover, this parasite has an advantage in preying upon hosts which, many of them, are widely distributed and general feeders, in themselves adaptive and successful animals. Of these, the browntail moth, the bollworm, the cabbage worm and the codling moth are examples; all of these have a high reproductive rate and furnish a large excess of progeny which must be destroyed for their own welfare and which are available as food for this parasite.

From the standpoint of a single locality, fluctuations must often occur; a host, such as one of the four mentioned, through favorable conditions may become excessively abundant; this parasite may then concentrate its attack upon it and for the time being and in that particular place practically reduce its numbers to zero or even annihilate it without suffering any decrease in numbers itself. This is possible in theory but not too probable as there is still the tendency to be impartial to most of its hosts which must be overcome. Something of this kind must happen frequently in Texas in the case of the bollworm not carried to extremes, however, but seemingly destroying the large excess of individuals of the species which had been reproduced up to the danger point for the species; the parasite then goes to one of its other hosts such as *Alabama* and thus enabled to keep up average rate of reproduction, after it has exhausted the supply of food afforded by the first. That in the end its attacks are beneficial to a host which has thus increased immoderately, paradoxical though it may seem, must be conceded, else in the end it must perish itself or lose greatly in numbers. For its own welfare, then, its must be concerned for the welfare of its hosts or group of hosts. This parasite has no animal enemies and is preyed upon consciously by no other organism. Thus the only organic check which it meets with directly is this factor of the welfare of its hosts taking them as a unit; in other words, the abundance of its food supply. Indirectly, I do not know of any organic unit which affects it for good or bad[7]. The relation of a general insect parasite to its hosts may be said to be homologous to those relations which a general plant-feeding insect sustains to the plants upon which it feeds; on the whole, both are mutually dependent and that is equivalent to being mutually beneficial, not always to each other, but to all organic nature.

THE SO-CALLED RACES OF MINUTUM.

Howard and Fiske (1911) have recently separated two bred series of this species (the series morphologically indistinct) into two race-species because of the fact that these two series have different geographical origins coupled with the fact that each series produces parthenogenetically a certain sex only. One of these series was started from individuals obtained from a host in Massachusetts while the other was started nearly at the same time from individuals imported from Austria. The American series produced only males (five generations) or were arrhenotokous while the Austrian series of parthenogenetic females produced usually females or were usually the lyotokous (seventeen generations or seventeen isolated females of which the progeny was mixed once, female thirteen times and male three times). Once or twice in the American series, the breeding was carried to the second or third parthenogenetic generation; that is, the observed female was known to be a descendent in the second or third generation from a first parthenogenetic female. In both series normal sexual reproduction produced usually mixed sexes but sometimes only females were produced. It seems unreasonable to me to call these two series of individual species because of the observed facts, for certainly what we know of the progeny of parthenogenetic females throughout the entire animal king-

7. Unless it is some phase of parasitism like double parasitism.

dom is so contradictory and shows such variation and adaptability that the more reasonable explanation in this case seems merely to be that the series of experiments were incomplete, as the authors themselves intimate. In other words, the expected would be that in the next generation, or the one following (or even in tenth) the sex of the progeny would be reversed and before very long the American series would become the lyotokous and the Austrian arrhenotokous and both on occasion amphoterotokous. Even in the few observed cases, in the Austrian series, traces of a break occur fulfilling expectations (thus once both sexes were produced and thrice males). The determination of sex remains as yet so unsatisfactorily explained and parthenogenetic reproduction occurs under so many different phases that it is, I believe, uncalled for at present to separate races or species according to whether one is (for all we know to the contrary, temporarily) arrhenotokous and the other the lyotokous or amphoterotokous as the case may be. If so, we must expect complete confusion of the two within the course of events, maybe after several months only or it may be not until after several years. The locality in this case is of course coincidental only. We know that parthenogenesis in a species is very irregular; males only may be produced generation after generation, then suddenly the sex reversed and so on. This is no reason, therefore, for distinguishing races or species for purposes of systematic zoology, at any rate certainly not species. It would be very much like separating species because a certain chance series of individuals were favorable to one food while others were favorable to another, mere cases of individual "choice" or adaption. That morphologically similar bacteria are called species because of their different reactions to definite media is true but that is evidently for convenience, begs the point at issue and confesses probable ignorance. They are not distinct species from any standpoint, systematic or otherwise. If *Tachina mella* and *T. lavarum* are morphologically alike, then they are one species and should be represented by but one name. The differences between the two as described are merely in degrees of adaptation, the expectation under the different conditions in the habitat. *Parexorista cheloniae* is a more typical case. There is no reason why a series of individuals of a species from a chance locality should agree in all habits with a series from another locality and that they are found to differ in this respect shows merely the effect of different degrees of adaptation, fulfills the expectations and denotes no differences of specific value. To settle the matter it is but necessary to see whether or not the two series interbred. The American and whether or not the two series interbreed. The American and European series of *minutum* do interbreed and must therefore be the same species as that term *must* be understood from every standpoint.[7]

We may call groups of individuals of a species biological or physiological species for convenience sake, but fundamentally the term so applied is a confession of ignorance and expresses only some adaptation or some (perhaps incompletely observed) function, which, when fully investigated, we should expect to appear some time in the history of any chance group of individuals of the same species whatever may be its origin. The sum of the matter is that specific difference have so far always been expressed morphologically; the morphological change or difference is an index of a change or difference in the germ, but not necessarily a certain index as in the case of what are called varieties.

LITERATURE SPECIFICALLY CITED.

1911. Howard, Leland Ossian and William F. Fiske. Bull No. 91, Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C., pp. 87, 136, 143 and 256 ff

Urbana, Ill., Aug. 21, 1911.

On the contrary, the second European species mentioned by Howard and Fiske (Ib., p. 257) in reality the second species of *Trichogramma*, which has recently been described by myself as *Pentarthron cuproctidis* and which differs morphologically from the two series of *minutum* would not interbreed with any member of the two series in question.

A SYNONYMICAL NOTE (*ODONATA*).

By Richard A. Muttkowski.

On page 33 o fthe Bulletin of this Society (Vol. 8, Nos. 1-2) I described what I considered at that time a new species of the genus *Enallagma*, the description being based on two males. Shortly before issuance of the Bulletin I was fortunate in securing 29 additional males and 2 females, the latter, contrary to expectations, proving the adherence of the species to the genus *Cœnagrion*. There was just sufficient time to add a footnote to that effect on page 34 (May 29).

Several weeks later an examination of a series of over 50 males and females elicited the disconcerting fact that *Cœnagrion walkeri* was identical with the previously described *C. resolutum* of Hagen. While the figures of the appendages of the type are decidedly different from those figured for *C. resolutum* on the same page (p. 40, ff, 1, 2 and 8, 9) it was then discovered that the apparent differences are due to a peculiarity of the superior appendages. Namely the latter are retractile to a certain extent, the series showing every degree of retractability; in the type specimen of *C. walkeri* the extreme was achieved which occasioned the subsequent erroneous determination. I take this occasion to announce my error and to correct the synonymy.

While collecting I was able to make the following observations which I cite from my notes:

"May 26: This pretty little species frequents the swampy depressions at the northern edge of Johnson's woods. It flies at the immediate edge of the water, among *Fleur de Lis* and *Sagittaria* (both plants not then in bloom), usually only about 4 or 5 inches above the water. The species was nowhere profuse in numbers. Usually 3 or 4 would hunt over a small patch of sunlit grasses and water plants, darting in and out in search of food. Food was plenty as each net stroke would bring forth a cloud of minute flies and midges. I was greatly surprised at the scarcity of females. There was a large number of females of *Ischnura verticalis*, and also a few of *Enallagma calverti* in the same place, the latter especially being quite conspicuous. The two females captured were taken in copula after more than an hour's diligent search.

"I looked over the region very carefully for exuviæ but could find none of *Cœnagrion*. The stems of plants, however, were in places covered with exuviæ of *Leucorrhinia glacialis*, which species was very abundant, the earliest record as yet recorded for Milwaukee."

The same spot was visited on June 1st, when a few specimens were captured, and on June 4th, when a large number were gotten, among them at least 25 females. Under the latter date I have the following:

"June 4: After all, it is the dense shore vegetation which the species hunts and not so much that at the water's edge. In a little wet spot, grown with grass about eighteen inches high, measuring about twenty feet each way and closely surrounded by bushes, I found the true haunt of the species. Here it sported in large numbers. It also flew among the bushes, but not in such numbers, playing with *Ischnura* and *Nehelleunia irene*, and an occasional *Enallagma hageni.*

"The most interesting feature is its perfect color protection. With the sun shining on the grass and a slight wind moving the tips the damsels were hardly discernible as they wove in and out in search for food. The pale bluish green of the body, so marked when a cloud covered the sun, disappeared entirely when the sun shone. It was easier to get specimens by sweeping than to try to single them out. Especially females were difficult to see. When in the net they would usually sit quietly at the bottom and permit themselves to be transferred to the cyanide bottle without trouble."

The venation of *Cœnagrion resolutum* varies considerably. Thus of fifty specimens selected at random only 10 have typical venation, that is, with vein M2 arising at the fifth postnodal in the fore wings and at the fourth postnodal in the hind wings. The remaining specimens show considerable fluctuation. To summarize the results I give the following tabulations:

C. resolutum M2 arising at:

Fore Wings.			Hind Wings.		
Postnodal	5	57 wings.	Postnodal	4	27 wings.
"	4½	10 "	"	3½	26 "
"	4	33 "	"	3	47 "

Of other species of *Cœnagrion*, the following also show some variation:

C. puella.

Fore Wings.			Hind Wings.		
Postnodal	5	13 wings.	Postnodal	5	2 wings.
"	4½	1 "	"	4½	2 "
"	4	2 "	"	4	11 "
			"	3½	1 "

C. pulchellum.

Fore Wings.			Hind Wings.		
Postnodal	5	10 wings.	Postnodal	4	10 wings.
"	4	2 "	"	3½	2 "

C. nigrohamatum shows the following, respectively:

	7:7 5½ : 5½
C. calliphya	7:7 - 5:5
C. xanthomelas	6:6 - 5:5
C. hylas	6:5 - 4½ : 4½ ; 6:6 - 4:4
C. hastulatum	4:4 - 3½ : 3½ ; 4:4 - 3½ : 3
C. glaciale	5:5 - 4:4
C. ecornutum	5:5 - 3½ : 3½ ; 5:5 - 4:4
C. lanceolatum	3½ : 4 - 5:5 - 4:4 ; 5:5 - 4:4
C. vernale	5:5 - 4:3½ ; 5:5 - 4:4 ; 5:5 - 4:4 ; 5:5 - 4:4
C. armatum	5:5 - 4:4 ; 4:5 - 4:4
C. lindeni	5:6 - 4½ : 4
C. ornatum	4½ : 5 - 4:4

Of the last species one male is thoroughly erratic, one fore wing (right) being without M2, while in the left fore wing and right hind wing the first postnodal is not continued to M2. In the left hind wing the origin of M2 is spurious, namely, it arises from a crossvein which forms part of an inserted triangular cell (*Schaltzelle* Ris.)*

In the foregoing three points are evident:

1. In American *Cœnagrion* there is a strong tendency toward *Ischnura* venation, especially in the hind wing.

2. The venation of Palearctic *Cœnagrion* is more normal, i. e. it approximates that of *Enallagma.*

3. Hawaiian species show a tendency to increase the number of postnodals, and the origin of M2 is correspondingly separated from the nodus by a greater number of cross veins.

These considerations offer food for thought for the phylogenist. There can be little doubt of the fact that *Ischnura* is more specialized than *Enallagma* and *Cœnagrion*, which latter genus is more recent than its relative. In the tendency toward simplification the American species of *Cœnagrion* appear to be more advanced than Palearctic species, while Hawaiian species are most primitive.

Milwaukee Public Museum, September 1, 1911.

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* An enlargement of a wing photograph of this specimen has been made and will be published later on with a detailed study of the aberration, which is aberrant not only in respect to M2 but also in respect to most major features of wing venation.—March 18, 1912.

A SYNOPSIS OF THE TYPE SPECIMENS OF FOSSILS FROM THE PALÆOZOIC FORMATIONS OF WISCONSIN.

EDGAR E. TELLER.

PART I

The Palæozoic formations of Wisconsin, as shown by the known geological investigations of all of those epochs in the state overlying the Archaean or Granitic period, are the Potsdam, including the Lower Magnesian and the St. Peters sandstone found in the south central and northwestern parts of the state, the Trenton and the Galena in the southern part, the Lorraine, or, as more commonly known in Wisconsin, the Cincinnati group of the Hudson River formation in the eastern, all parts of the Lower Silurian, the Niagara extending almost the entire length of the eastern part of the state, a small exposure of the Guelph limestone near Cedarburg and Grafton, a limited exposure of the Lower Helderberg, also in the eastern part, the three formations belonging to the Upper Silurian, and a small exposure of the Hamilton formation of the Devonian Age in the eastern part of the state lying north of the City of Milwaukee.

All of these formations may be said to be quite fossiliferous, some parts exceedingly so, and all of them have furnished a large number of genera and species to the investigators of such objects; and considering the limited amount of palaeontological work that has been done upon them a very fair number of new genera and species, and among which there yet remains grand opportunities for future investigators.

The purpose of this paper is to review the work that has been done in the collecting and describing the type specimens of fossils that have been described from these formations within this state, the men whose efforts as collectors have made this possible, those who have made the descriptions, the publications in which the most of these descriptions and the figures were published, and what constitutes a type with such notes as might be proper to present without burdening you with an endless list of scientific names in which you may have little interest and which possibly in many cases would be meaningless.

I. COLLECTORS.

The collectors of fossils from the geological formations in the state of Wisconsin, who have aided the specialists with material for their work, may be said to have commenced with the late I. A. Lapham, who from his collections in the early sixties furnished Prof. James Hall with many specimens. Prof. Lapham had made extensive collections in eastern Wisconsin, which were very freely distributed to interested persons, retaining very little of anything for himself; although he was the director of the state geological survey during the years 1873 and 1874, and thus had unusual opportunities for collecting, he still continued to part with his material and the few specimens left to the members of his family were finally presented by them to the Milwaukee Public Museum.

Dr. F. H. Day, formerly of Wauwatosa, Wis., a very extensive collector from the Niagara formation at that locality, also furnished Prof. Hall with much valuable material for his early works. The very large collection of his early life was disposed of to Prof. Louis Agassiz in the early seventies and is now deposited in the Cambridge Museum of Harvard College; very little of it has ever been unpacked for the lack of space to exhibit, although it contains a very large amount of valuable material. A second small collection was added to the Greene collection, while the collection made during the last few years of his life is still in the possession of members of his family at Lansing, Mich.

Dr. Philo R. Hoy of Racine, Wis., a contemporary of Prof. Lapham and Dr. Day, had made large collections from the Niagara formation at Racine. He also aided Prof. Hall very materially and was very generous with his collections to other specialists and interested persons. At the end what little he had left was divided between the collections of Dr. Day and Racine College.

Mr. T. J. Hale of Chicago, Ill., who was an extensive collector in Wisconsin in a commercial way, at about the same time, also furnished Prof. Hall with many fine specimens.

The collection of the late Thomas A. Greene of Milwaukee, Wis., who for many years in the eighties and nineties, was a very active collector in southeastern Wisconsin, is probably one of the largest in the northwest for a private collection and is still in the possession of the members of his family. From this collection much material was used by Hall and Clarke in illustrating the *Brachiopoda* in volume eight of the Paleontology of New York among which are several types.

The collection of Mr. F. L. Horneffer of Milwaukee, Wis., made during the nineties by a most enthusiastic and careful collector, containing many choice specimens and which has furnished some type material became a part of the Teller collection.

The collection of Mr. Charles E. Monroe, made up largely of specimens from the Hamilton formation of the western states and Canada, and from which a number of types have been described, is now one of the valued possessions of the Milwaukee Public Museum and one of their principal exhibits.

The Teller collection, made during the past thirty years, while large, consists mainly of southeastern Wisconsin material, from which a number of types have been described and is still in the possession of the collector.

Several non-resident collectors have made good collections from several of the formations in the state that have furnished many types, while considerable material was collected by the assistants on the work of the different geological surveys of the state, of which good use was made. As a rule, however, the type material has been derived from private collections.

II. LITERATURE.

The chief palaeontological possessions of the Geological Department of the American Museum of Natural History of New York City is the collection of the late James Hall, which was purchased from that celebrated palæontologist in 1875 and the principal feature of that collection is the large number of type and figured specimens specially of the palæozoic species which it contains.

This collection may well be considered the standard reference collection of all workers in North American palæozoic palæontology.

Among these type fossils we find those that were used to illustrate the sixteenth report of the New York State Museum, collected from the Wisconsin Cambrian beds; the Niagara species collected in southeastern Wisconsin figured in the twentieth report of the same institution published in 1867; the Trenton fossils from the Janesville-Beloit area of Wisconsin described but not figured in the Report of the Geological Survey of Wisconsin for 1861; the latter original descriptions have been republished with figures and notes by the late Prof. R. P. Whitfield, in volume one, part two of the Memoirs of the American Museum of Natural History. In this museum we also find the type specimens used to describe and illustrate Prof. Whitfields' paper on the *Phyllocaridæ* from the Lower Helderberg formation of Waubeka, Wisconsin, in volume 8, 1896, of the Bulletin of the American Museum.

The type specimens used to illustrate volume four of the Geology of Wisconsin for 1882, by Prof. Whitfield, from several of the formations in Wisconsin are partly in the collection of the state at Madison, Wisconsin, and part of them in the University of California.

The new species of Crinoids from the Hamilton formation near Milwaukee, published by Prof. Weller of the University of Chicago, in the Annals of the New York Academy of Science, volume XI, 1898, are in a private collection in Milwaukee, while the types of the fish remains from the same formation and locality described and figured by Prof. C. R. Eastman, of the Museum of Comparative Zoology, Cambridge, Mass., in the American Naturalist for 1898, and in Memoir ten of the New York State Museum, on the Devonic Fishes of the New York formations are in private collections in Milwaukee. The types of a few of the plant remains, also from the Hamilton formation at Milwaukee, were published and figured by Prof. Penhollow in the Bulletin of the Wisconsin Natural History Society, part one, 1908, and are now a part of the Monroe collection in the Milwaukee Public Museum.

A few other types have been described and figured in many other scientific publications and are now to be found in the collections of the Smithsonian Institution, the Geological and Natural History Survey of Minnesota, and in several private collections.

There is shortly to be published by the State of Wisconsin, a work upon the fossils of the Hamilton formation at Milwaukee, by Prof. Cleland of Williams College, which will add materially to the types in several collections made from that locality.

III. NOMENCLATURE OF TYPES.

In 1853 Louis Agassiz wrote of the importance of type specimens in a review of a proposed catalogue of the Cabinet of Natural History of the State of New York. He says, "the regents of the university deserve great credit for directing the publication of this catalogue; nothing is better adapted to secure permanently the interest for public collections and contribute to their increase than the circulation of such catalogues. We only regret that no more direct reference is made to the individual specimens described and figured in the Natural History of New York, the importance of preserving such records to favor the researches in case of doubts upon the identity of newly discovered species cannot be overrated, and we would particularly call the attention of all Directors of Museums to this point.

The chief value of many of the Museums of Europe arises from the circumstance that they contain the original specimens described by the naturalists who have brought our science to its present condition."

While this letter was written in 1853, and referred to the contemplated publication of the list of the type specimens in the collections of the Museum of Natural History of the State of New York, it was not until 1903 that the work was completed and presented to the public as Bulletin 65 of that Museum.

In 1860 Spencer F. Baird, then the assistant secretary of the Smithsonian Institution, in the annual report of that year says: The great value of the Museum of the Institution at the present time consists of its being the depository of so many type specimens or those upon which the first description of species has been established. These constitute the great attraction to the scientific investigators, as however carefully prepared the published description or figures of any species may be there is almost always some doubtful point to be settled alone by an examination of the types. For this reason they are always guarded with jealous care and considered of much more value than new and undescribed materials.

By this we can see the almost priceless value of types is recognized by the scientific institutions into whose possession they must eventually come, and this fact is now also recognized by the individual collector.

Prof. Marsh says: "A type should consist of the remains of a single individual, and it should stand as the original representative of the name given, a second specimen or even more may be used to supplement the first but not to supplant it."

This, however, has unfortunately been done by some specialists, with the natural result of causing endless confusion in the nomenclature.

Thomas Oldfield states that the word "type" itself when first introduced was meant to refer to the particular specimen in the singular originally described, but it soon was naturally applied to any individual of the original series if more than one specimen was examined by the describer; in this there was little cause for confusion, but more recently it has been applied to any individual from the collection of the original author obtained no matter how much later and often not even determined by him as belonging to his species. Of late a still further cause of confusion has been introduced by certain authors who, obtaining specimens from the typical locality have spoken of them as typical specimens, a method of reference which, although due to praiseworthy regard for geographical exactness, is yet certainly liable to give rise to inconvenience and confusion.

The late Dr. G. Brown Goode, in a circular letter to the curators in the United States National Museum, dated July 1, 1893. Says: By a type is meant a specimen which has been used by the author of a systematic paper as the basis of detailed study, and as the foundation of a specific name. In cases where a considerable number of specimens has been used it is desirable to separate one or more as being primary types, while the other specimens which have been used in the same study for the purpose of comparison may be regarded as collateral types.

Prof Charles Schuchert says that these citations show clearly that a type is not always restricted to a single specimen selected by an author but also applies to several or even to all the specimens contained in the original lot. Because of the general imperfection of fossils much of the original material is usually accepted as types, but when specimens are figured as is generally the custom, it is good practice to regard these alone as types.

All type specimens in biology may be divided into two groups, "type material" and "typical specimens." By various writers these have been divided into a number of sub-types known by them as, *Holotype, Cotype (or Syntype), Paraptype, Lectotype, Chirotype, Plesiotype, Neotype* and *Heautotype*, all tending to cause more or less confusion to the one not a thorough specialist, and terms to which the most of them pay little or no attention. The only real purpose of so many type terms would seem to suggest the multiplication of type specimens, and many of these are now obsolete terms which have been rarely or never used by those who proposed them although some of them are now commonly used in the catalogue of the types in the Smithsonian Institution, and the only purpose of such use seems to be to burden science with a useless terminology. One of the most serious objections to these terms is the discouraging effect they must have not only upon the student but specialists in general and the confusion that must arise in the minds of both as to what term may refer to the true types and what do not, as any other term than that of type for a type specimen is entirely unnecessary at any time.

Prof. C. Hart Merriam, writing on this subject says, "type specimens being units of comparison should from the nature of the case be single, not multiple; it is the common experience of naturalists that a considerable percentage of cases where several specimens have been used as types, subsequent study has shown these specimens to belong to different species and in some cases to different genera."

While this fact is in most cases an objection, in palæontology it is often necessary to describe new species from very fragmentary material and to obtain any clear ideas as to just what a perfect specimen would be, it is always customary to use several or many specimens to get that idea so that the types where they can be obtained must in almost all cases consist of several specimens, therefore a series of types; and while it is doubtful if many species have been defined from a single specimen although that must be the case where the one specimen only is known as it sometimes is, we can readily see that a number of types become a necessity and therefore the type specimens of any natural history object, that is the actual material on which published descriptions and figures have been based, are the only ones that should be recognized as the true types and that no other term than that of type should be used at any time. Such objects once lost or destroyed, any replacement is impossible and however imperfect or fragmentary the type may be, or however perfect or better a more recent example of the same creature may be, it cannot serve to replace the functions of the first, as the type specimen is the only one that can be the basis of comparison for all time.

The term type as employed by the Geological Department of the American Museum, includes not only those specimens actually used by the author in the original description of a species, but also those specimens which have been used by the same author in the further elucidation of the species in subsequent publications; the latter therefore become a part of the type specimens. The original types may or may not have been illustrated in connection with the first publication, as in the early days of the science of palæontology very many descriptions of new species were made without illustrations of any kind.

To the specialist and student types are now the most valuable portion of any collection and are always guarded with the utmost care. They are usually marked in some conspicuous manner, usually with a small rhomb or star of enameled paper securely gunned to each specimen, each describer selecting such form and color as may be most pleasing to himself and which is recognized as his private mark.

A specimen may be both a generic and a specific type, this is always the case where the specimen is the one first used in founding a new genus and it must therefore also be the first of a new species; in many instances there are also other individuals in the type series than those that have been figured but have been used in assisting in the description of the genera or species and must therefore become a part of the types.

Type specimens now constitute the most important material in museums of natural history. The true appreciation of this fact has become general in recent years as shown in the lately published catalogues of the types possessed by different museums; the most of these publications have been issued in America and England.

This valuation of type material has also come through the work of specialists in their efforts to monograph groups of organisms as it is upon the type material that the true value of natural history for this purpose depends; therefore it is of the greatest importance and value to learn the whereabouts of types.

For the purpose of this paper we have confined ourselves to the term type as being the proper one for our use and in all cases have confined our research to the original description of species following up all cross references.

IV. MATERIAL AND METHOD.

Something over twenty years ago for our own use and information we started a card catalogue of the species of fossils that have been described from the palæozoic rocks of Wisconsin. When we came across the description of a species that we knew or had reason to believe was from the formations of this state, we made a card of it, by whom it was described, the formation from which it was collected, the publication in which it was described, and if there was no figure of the species in such case we referred as a second reference to that work in which the next description of the species was to be found if accompanied by a figure, and if that work should be one not readily accessible to the student or collector as a third reference to that work in which the Wisconsin collector will find a description and figure of the species; next the locality from which the type was collected, and finally the institution or collection in which the type was deposited.

As many of the earlier publications in which the descriptions were given contained no figures whatever and in many cases no definite locality was given, the work was necessarily slow. Many cards were made that had to be eliminated and some of these finally had to be replaced. Synonyms crept in and had to be carefully guarded against. The most difficult work was to find the location of the types; those that were in the larger institutions were placed after years of work, the publication of the list of the types in the American Museum of Natural History being the most important aid received; as a rule we found that other scientific institutions, colleges, and private collections had no lists whatever, and even in some cases were not aware that they had any such valuable material in their collections until advised of the same. Our research has been very exhaustive. The number of geological works we have reviewed we would not undertake to enumerate.

Volume after volume has been gone through without any results whatever especially where we might look for good results; and then good results were obtained where little or nothing was expected until at the present time we have about completed our task and while we do not claim absolute accuracy as to all of the species being enumerated we have reasons to believe that it is practically complete. In almost every case the types with few exceptions have been located, thus covering the ground up to the present time. As previously stated, in the near future there are to be a number of new species added to the list by the publication of a report which is now ready to go to press. These we do not feel that we can properly include in our list at this time as it would be to trespass upon the rights of priority of the author.

It is rather amazing the number of synonyms that have been introduced into the description of the fossil remains that have been collected in the state, made in many instances by the most able describers of such objects; and the elimination of such species should take place as soon as fully determined so that the science may not be burdened with a long list of useless terms. In many cases we find from two to three or more such instances where a single genus has been given different generic names; the same applies to many of the species.

In making up our list of types described from the state all synonyms have been worked out and while retained as a matter of reference they have been referred to their proper equivalent; they have made the work more laborious than expected and have been the one chief stimulus to urge on the completion of our task and to make every effort to have the list of types as complete as possible. As now worked out the list contains of the known valid species.

Kingdom.	Subkingdom.	Class	Number of Species
Plantæ.	*Cryptogamia.*	*Thallogena*	6
Animalia.	*Porifera.*	*Plothospongia*	3
	Cœlenterata.	*Actinozoa*	20
		Hydrozoa	2
		Bryozoa	7
	Echinodermata.	*Crinoidea*	21
		Cystoidea	11
		Blastoidea	1
	Molluscoidea.	*Polyzoa*	3
		Brachiopoda	53
		Lamellibranchiata	32
		Gastropoda	66
		Pteropoda	3
		Cephalopoda	47
	Vermes.	*Annelida*	1
	Arthropoda.	*Crustacea*	69
	Vertebrata.	*Pisces*	9

A total of the known species the types of which we have been able to locate	354
The number of known species the types of which we have been unable to locate and which we believe can still be found	16
The number of species that seem to be lost and of which some may prove to be synonyms	21
Total	391
The number of known synonyms eliminated	154

When considering the amount of palæontological work that has been done in the State of Wisconsin, this is a very good representation. There is still, however, much work that remains to be done and there is a fine field for the local collector in almost all parts of the state as no matter how closely a locality may be worked over there always remain new species to be found when least expected; and from the collections now made and those that may be made in the future past experience shows that in the hands of the specialist the collector can derive much credit.

Milwaukee, Wis., June 15, 1911.

PART II.

The chief purpose of this list of the type specimens of the fossils collected and described from the palæozoic rocks of Wisconsin is to make available to the local collector and student of such objects the information that will enable them to know by what specialist they were described, the formation from which they were collected, the publication in which the original description of the species was first made, the locality from which they were collected, and the present place of deposit of the type specimens.

In the early days of the science of Palæontology in the State of Wisconsin, many descriptions of new species of fossils were made without figures and in several instances only a general reference as to the locality was given. As the specimens in many cases were derived from the local collector by the specialists who have made the descriptions, some errors of locality are known to have occurred, and observations have been introduced where apparently needed to correct such errors. In many instances species have been described under several generic and specific terms; these synonyms have, we believe, all been worked out so as to enable the student to correctly identify the species.

Our first reference is to that publication in which the original description of the species will be found; should there have been no figure of the specimens to accompany the description, we have as a second reference, referred to that publication in which will be found a redescription of the species with a figure. This may be by the original described of the species or by another authority using the first specific term, a corrected reference or a synonym, as the case may be. In many instances, since the publication referred to in the first or second reference may be one that is not accessible to the student, we have referred as a third reference to such publication as may have a description of the species and is generally to be found in any good circulating library, or in the library of a scientific society; as a rule these descriptions have been published in geological reports and bulletins issued by state and Scientific Societies outside the State of Wisconsin.

Many references will be found to the 18th Annual Report of the Regents of the University of the State of New York 1864, this report will be found bound as a part of the 20th Annual Report of that Institution for 1867. All references to the Annual Report of the Wisconsin Geological Survey 1879, are to the report of T. C. Chamberlin, Chief Geologist for that year, and it is to be found bound with the Governor's Message of that year, and is also known as Public Document No. 15.

For information that has been of the most important assistance to us in our work, we are under many obligations to Dr. John M. Clarke, Director of the New York State Geological Survey, Albany, N. Y.· Prof. C. D. Walcott, Secretary of the United States National Museum, Washington, D. C.; Prof. Stuart Weller, Palæontologist, Department of Geology of the University of Chicago, and Professors Eliot Blackwelder and Arthur Beatty of the University of Wisconsin.

All of the publications referred to in this list we would recommend to the student, to which we would add, "A Synopsis of American Fossil *Brachiopoda*" by Charles Schuchert in Bulletin 87 of The U. S. Geological Survey. And, "A Synopsis of American Fossil *Bryozoa*," Nickles and Bassler, Bulletin 173 of the U. S. Geological Survey.

There is now being issued by the Geological and Natural History Survey of the State of Wisconsin a report known as Bulletin Twenty-one by Prof. Herdman, F. Cleland of Williams College, Williamstown, Mass., under the title, "The Fossils and Stratigraphy of the Middle Devonic of Wisconsin." This bulletin adds some fifty new species of fossils, which are included in this list, to the types known to have been collected from the Hamilton formation in the State of Wisconsin.

In the literature on the Hamilton formation of Wisconsin frequent references will be found to Humboldt, Cementville and Berthelet; all of these refer to the same locality which is contiguous to Milwaukee at the Northern City Limits and in this list is referred to as Milwaukee.

Since the writing of part one of this paper the collection of fossils of the late Thomas A. Greene has passed into the possession of the Milwaukee Downer Female College.

All of the Types in this list credited to the Milwaukee Public Museum are from the collection of Mr. Charles E. Monroe, while those credited to Williams College, were collected by Prof. Herdman F. Cleland.

The Type Specimens deposited in the University of Wisconsin, are the property of the Wisconsin Academy of Sciences, Arts and Letters.

The type specimens from the T. A. Greene collection passed to the collection of the late James Hall and are now a part of the collection of the University of Chicago.

PLANTÆ.

Buthograptus laxus (Hall). Trenton (Ord.)

Geol. Surv Wis., Rept. of Prog., Hall, 1861, p. 19.
Memoirs. Am. Mus. of Nat. Hist., Whitfield 1895, vol 1, Pt. 2, p. 40, pl. 4, figs. 1-3.
Locality—Platteville, Wis.
Type Specimen—Am. Mus. of Nat. Hist.

Callithamnopsis fruticosa (Hall). Trenton (Ord.)

Oldhamia fruticosa, Hall 1865, Can. Org. Rem., Decade 2, p. 50.
Callithamnopsis fruticosa, Whitfield 1895, Memo. Am. Mus. of Nat. Hist., Vol. 1, Pt. 2, p. 42, pl. 4, figs. 4-8.
Locality—Platteville, Wis.
Type Specimen—Am. Mus. of Nat. Hist.

Chælomorpha ? prima Whitfield. Trenton (Ord.)

Bull. Am. Mus. of Nat. Hist., Whitfield, 1894, Vol. 6, p. 355, pl. 4, figs. 9-10.
Locality—Platteville, Wis.
Types—Am. Mus. of Nat. Hist.

Chætocladus plumula Whitfield. Trenton (Ord.)

Bull. Am. Mus. of Nat. Hist., Whitfield, 1894, Vol. 6, p. 356, pl. 2, figs. 11-13.
Locality—Platteville, Wis.
Types—Am. Mus. of Nat. Hist.

Fucus bertheletensis Penhollow. Hamilton (Dev.)

Bull. Wis. Nat. Hist. Soc., Penhollow, 1908, Vol. 6, Pt. 1, p. 11, pl. 2.
Locality—Milwaukee, Wis.
Type—Mil. Pub. Mus.

Nematophycus milwaukeensis Penhollow. Hamilton (Dev.)

Bull. Wis. Nat. Hist. Soc., Penhollow, 1908, Vol. 6, Pt. 1, p. 8, pl. 1.
Locality—Milwaukee, Wis.
Type—Mil. Pub. Mus.

Oldhamia fruticosa Hall = *Callithamnopsis fruticosa.*

Palæophycus plumosum Whitfield = *Palæophycus plumosus.*

Palæophycus plumosus Whitfield. Potsdam.

Palæophycus plumosum, Whitfield, 1877. Rept. Geol. Surv. Wis., p. 50.
Palæophycus plumosus, Whitfield, 1882, Geol. of Wis., Vol. 4, p. 169, pl. 1, fig 1.
Locality—Mendota, Wis.
Type—Univ. of Wis.

PORIFERA.

Receptaculites fungosus Hall. Galena (Ord.)

Geol. Rept. Wisconsin, Hall, 1861, p. 15.
Locality—?
Type—?

Receptaculites globularis Hall. Galena (Ord.)

Geol. Rept. Wisconsin, Hall, 1861, p. 16.
Locality—?
Type—? .

Receptaculites hemisphericum Hall = *Receptaculites hemisphericus.*

Receptaculites hemisphericus (Hall.) Niagara (Sil.)

Receptaculites hemisphericum Hall, 1861, Geol. Surv. Wis. Rept. of Prog., p. 16.
Receptaculites hemisphericum, Whitfield, 1882, Geol. of Wis., Vol. 4, p. 269, pl. 13, fig. 4.
Receptaculites hemisphericus Whitfield, 1895, Mem. Am. Mus. of Nat. Hist., Vol. 1, Pt. 2, p. 46, pl. 5, figs. 3, 4.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Receptaculites infundebulum Hall. Niagara (Sil.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 16.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 46, pl. 5, figs 1, 2.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Receptaculites oweni Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 13.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 239, pl. 10, fig. 7.
Locality—Watertown and Beloit, Wis.
Type—Am. Mus. of Nat. Hist.

CŒLENTERATA.

Alveolites irregularis Whitfield = *Ceramoporella ? irregularis.*

Alveolites ? monroei Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland. 1911, Bull. 21, p. 33, pl. 2, figs. 1, 2.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Amplexus annulatus Whitfield. Guelph (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 80.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 314, pl. 23, figs. 8-11.
Locality—Carlton, Wis.
Type—Univ. of Wisconsin.

Amplexus fenestratus Whitfield. Niagara (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 80.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 278, pl. 15, figs. 1-3.
Locality—Cato, Wis.
Type—Univ. of Wisconsin.

Cyathaxonia columellata Hall. Niagara (Sil.)
Thirty-fifth Ann. Rept. N. Y. State Mus of Nat. Hist., Hall. 1884, p. 415.
Locality—Racine, Wis.
Type—Univ. of Chicago.

Cyathaxonia wisconsensis Whitfield. Niagara (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 79.
Geol. of Wis., Whitfield, 1882, vol. 4, p. 277, pl. 14, figs. 3-5.
Locality—Racine, Wis.
Type—Univ. of Wisconsin.

Cyathophyllum profundum Conrad = *Streptelasma profundum.*

Cystostylus infundibulus Whitfield. Niagara (Sil.)
Syringopora infundibula, Whitfield, Ann. Rept. Geol. Surv. Wis., 1877, p. 79.
Cystostylus infundibulus, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 274, pl. 14, fig. 7.
Locality—Milwaukee, Wis.
Type—Univ. of California.

Cystostylus typicus Whitfield. Niagara (Sil.)

Ann Rept. Geol. Surv. Wis., Whitfield, 1879, p. 64.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 274, pl. 14, figs. 8, 9.

Locality—Cato, Wis.

Type—Univ. of California.

Dendrograptus hallianus (Prout.) Potsdam.

Graptolithus hallianus, Am. Jour. of Sci., Prout, 1851, 2nd Series, Vol. 2, p. 189, pl. 190, figs 1 c-f.

Graptolithus (Dendrograptus) hallianus, Geol. of Wis., Hall, 1861, Vol. 1, p. 21, figs. a-e.

Dendrograptus hallianus, Twentieth Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 177, fig 10.

Locality—Osceola Mills, Wis.

Type—Am. Mus. of Nat. Hist.

Dictyonema neenah Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 17.

Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 47, pl. 5, fig. 13.

Locality—Appleton, Wis.

Type—Am. Mus. of Nat. Hist.

Diphyphyllum obsoletum Hall. Lorraine (Ord.)

Lake Superior Land District, Hall, 1851, Pt. 2, p. 213, pl. 29, figs. 2a b.

Locality—Green Bay, Wis.

Type—Am. Mus. of Nat. Hist.

Diplograptus peosta (Hall.) Trenton (Ord.)

Graptolithus (Diplograptus) peosta, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 17.

Diplograptus peosta, Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 47, pl. 5, fig. 12.

Locality—?.

Type—Am. Mus. of Nat. Hist.

Favosites niagarensis Hall. Niagara (Sil.)

Pal. of New York, Hall, 1852, Vol. 2, p. 125, pl. 34A (bis)., figs. 4f, g., obs. Other specimens of the series of types are from New York State.

Locality—Milwaukee, Wis.

Type—Am. Mus. of Nat. Hist.

Favosites occidens Whitfield. Guelph (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 78.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 313, pl. 23, figs. 6, 7.
Locality—Ozaukee, Wis.
Type—Univ. of Wisconsin.

Graptolites (Dendrograptus.) hallianus Hall. = *Dendrograptus hallianus.*

Graptolites hallianus Prout = *Dendrograptus hallianus.*

Graptolithus (Diplographus.) peosta Hall = *Dendrograptus peosta.*

Hallia divergens Hall. Niagara (Sil.)
Thirty-fifth Rept. N. Y. State Mus. of Nat. Hist., Hall, 1884, p. 412.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Hallia pluma Hall. Niagara (Sil.)
Thirty-Fifth Rept. N. Y. State Mus. of Nat. Hist., Hall, 1884, p. 412.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Halysites catenulatus var. **microporus** Whitfield. Niagara (Sil.)
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 272, pl. 13, fig. 6.
Locality—Baileys Harbor, Wis.
Type—Univ. of California.

Heliolites macrostylus Hall. Niagara (Sil.)
Pal. of New York, Hall, 1852, Vol. 2, p. 135, pl. 36A, figs. 2a-c.
Locality—Milwaukee, Wis.
Types—Am. Mus. of Nat. Hist.

Oldhamia fruticosa Hall = *Callithamnopsis fruticosa.*

Ptychophyllum floriforme Hall. Niagara (Sil.)
Thirty-Fifth Rept. N. Y. State Mus. of Nat. Hist., Hall, 1884, p. 409.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Streptelasma ? (Zaphrentis ?) exstans Hall. Niagara (Sil.)
Thirty-Fifth Rept. N. Y. State Mus. of Nat. Hist., Hall, 1884, p. 409.
Locality—Milwaukee, Wis.
Types—Univ. of Chicago.

Streptelasma ? (Zaphrentis ?) limitare Hall. Niagara (Sil.)

Thirty-Fifth Rept., N. Y. State Mus. of Nat. Hist., Hall, 1884, p. 409.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Streptelasma profundum (Conrad.) Trenton (Ord.)

Cyathophyllum profundum, Conrad, Proc. Acad. of Nat. Sci., Phila. 1843.
Streptelasma profundum, S. A. Miller, Am. Pal. Fossils, p. 61.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Syringopora infundibula Whitfield. = *Cystostylus infundibulus*.

Zaphrentis cristulatum Hall. Niagara (Sil.)

Thirty-Fifth Rept. N. Y. State Mus. of Nat. Hist., Hall, 1884, p. 414.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Zaphrentis racinensis Whitfield. Niagara (Sil.)

Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 65.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 277, pl. 14, figs. 1, 2.
Locality—Racine, Wis.
Types—Univ. of Wisconsin.

Zaphrentis rigida Hall. Niagara (Sil.)

Thirty-Fifth Rept. N. Y. State Mus. of Nat. Hist., Hall, 1884, p. 413.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Zaphrentis subvada Hall. Niagara (Sil.)

Thirty-Fifth Rept. N. Y. State Mus. of Nat. Hist., Hall, 1884, p. 415.
Locality—Racine, Wis.
Types—Univ. of Chicago.

BRYOZOA.

Batostoma ? rugosum (Whitfield.) Lorraine (Ord.)

Fistulipora rugosa, Ann. Rept. Geol. Surv. of Wis., Whitfield, 1879, p. 60.
Fistulipora rugosa, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 255, pl. 11, figs. 20, 21.
Batostoma rugosum, North Am. Geol. and Pal., S. A. Miller, 1889, p. 294.
Locality—Delafield, Wis.
Types—Univ. of Wisconsin.

Batostomella anulifera Ulrich = *Lioclemella annulifera.*

Calloporella ? lens (Whitfield.) Lorraine (Ord.)

Fistulipora lens, Ann. Rept. Geol. Surv. of Wis., Whitfield, 1877, p. 69.
Fistulipora lens, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 256, pl. 11, figs. 5, 6.
Calloporella ? lens, Bull. 173, U. S. Geol. Surv., Nickles and Bassler, 1900, p. 194.
Locality—Delafield, Wis.
Types—Univ. of Wisconsin.

Ceramoporella ? irregularis (Whitfield.) Lorraine (Ord.)

Alveolites irregularis, Ann. Rept. Geol. Surv. of Wis., Whitfield, 1877, p. 72.
Alveolites irregularis, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 251, pl. 11, figs. 1, 2.
Ceramporella ? irregularis, Bull. 173, U. S. Geol. Surv., Nickels and Bassler, p. 200.
Locality—Iron Ridge, Wis.
Types—Univ. of Wisconsin.

Ceratopora sp. Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 36, pl. 2 fig. 6.
Locality—Lake Church, Wis.
Type—Williams College.

Ceratopora rugosa Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 36, pl. 1, fig. 6.
Locality—Milwaukee, Wis.
Type—Williams College.

Chætetes fusiformis Whitfield = *Lioclemella fusiformis.*

Constellaria punctata (Whitfield). Lorraine (Ord.)

Monticulipora punctata, Am. Rept. Geol. Surv. of Wis., Whitfield, 1877, p. 71.
Monticulipora punctata, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 249, pl. 11, figs. 3, 4.
Constellaria punctata, Bull. 173, U. S. Geol. Surv., Nickels and Bassler, p. 214.
Locality—Delafield, Wis.
Types—Univ. of Wisconsin.

Fenestella granulosa Whitfield. Lorraine (Ord.)

Ann. Rept. Geol. Surv. of Wis., Whitfield, 1877, p. 68.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 252, pl. 12, figs. 1, 2.
Locality—Delafield, Wis.
Type—Univ. of Wisconsin.

Fistulipora lens Whitfield = *Colloporella ? lens.*

Fistulipora rugosa Whitfield = *Batostoma ? rugosum.*

Fistulipora solidissima Whitfield = *Lioclemella solidissima.*

Heteronema monroei Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 51, pl. 5, figs. 1, 2.
Locality—Milwaukee, Wis.
Types—U. S. National Museum.

Leptotrypa hexagonalis Ulrich. Trenton (Ord.)

Geol. Surv. of Ill., Ulrich, 1890, Vol. 8, p. 455, pl. 36, figs. 6, 6a.
Locality—Mineral Point, Wis.
Types—U. S. National Museum.

Lioclemella annulifera (Whitfield.) Lorraine, (Ord.)

Trematopora annulifera, Ann. Rept. Geol. Surv. of Wis., Whitfield, 1877, p. 67.

Trematopora annulifera, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 254, pl. 11, figs. 15-17.

Batostomella annulifera, Jour. Cincinnati Soc. Nat. Hist., Ulrich, 1882, p. 141.

Lioclemella annulifera, Geol. of Ohio. (Ulrich) Foerste, 1895, Vol. 7, p. 600.

Locality—Delafield, Wis.

Types—Univ. of Wisconsin.

Lioclemella fusiformis (Whitfield.) Lorraine (Ord.)

Chætetes fusiformis, Ann. Rept. Geol. Surv. of Wis., Whitfield, 1877, p. 70.

Chætetes fusiformis, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 248, pl. 11, figs. 13, 14.

Lioclemella fusiformis, Bull. 173, U. S. Geol. Surv. Nickels and Bassler, 1900, p. 307.

Locality—Iron Ridge, Wis.

Types—Univ. of California.

Lioclemella solidissima (Whitfield.) Lorraine (Ord.)

Fistulipora solidissima, Ann. Rept. Geol. Surv. of Wis., Whitfield, 1877, p. 69.

Fistulipora solidissima, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 255, pl. 11, figs. 18, 19.

Lioclemella solidissima, Bull. 173, U. S. Geol. Surv., Nickels and Bassler, 1900, p. 308.

Locality—Delafield, Wis.

Types—Univ. of Wisconsin.

Monticulipora multituberculata Whitfield = *Monotrypella quadrata.*

Monticulipora punctata Whitfield = *Constellaria punctata.*

Monticulipora rectangularis Whitfield = *Monotrypella quadrata.*

Orbignyella tenera Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 61, pl. 11, fig. 3.

Locality—Milwaukee, Wis.

Type—U. S. National Museum.

Trematopora annulifera Whitfield = *Lioclemella annulifera.*

Trematopora granulata Whitfield. Lorraine (Ord.)
Ann. Rept. Geol. Surv. of Wis., Whitfield, 1877, p. 68.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 253, pl. 11, figs. 22, 23.
Obs. Nickles and Bassler say this species probably belongs to the genus *Eridotrypa.*
Locality—Delafield, Wis.
Types—Univ. of Wisconsin.

Vinella ? devonica Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 51, pl. 5, figs. 5, 6, 7.
Locality—Milwaukee, Wis.
Types—U. S. National Museum.

CRINOIDEA.

Actinocrinus (Saccocrinus.) semiradiatus Hall = *Macrostylocrinus semiradiatus.*

Balanocrinus inflatus Hall = *Lampterocrinus inflatus.*

Callicrinus cornutus (Hall.) Niagara (Sil.)
Eucalyptocrinus cornutus, Eighteenth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1864, p. 322, pl. 11, figs. 8-10.
Eucalyptocrinus cornutus. var *excavatus*, Eighteenth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1864, p. 322, pl. 11, figs. 6, 7.
Callicrinus cornatus, Bull. 4, Pt. 1, The Chicago Acad. of Sci., Weller, 1900, p. 118, pl. 8, figs. 1-3.
Obs. See *Cryptodiscus*. Hall.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Crinocystites rectus Hall = *Rhodocrinus ? rectus.*

Crotalocrinus cora (Hall.) Niagara (Sil.)
Cyathocrinus cora, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 324, pl. 11, figs. 13, 14.
Crotalocrinus cora, Jour. of Geology, Weller, 1902, Vol. 10, p. 532, pl. 3, figs. 1-5.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Cryptodiscus Hall. Niagara (Sil.)

Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, pl. 11, fig. 18.
The Jour. of Geol., Weller, 1897, Vol. 5, pt. 8, p. 803, pl. a, figs. 1-5, pl. B, figs. 6, 7.
Obs. See *Callicrinus cornutus*, Weller, 1900, Bull. 4, pt. 1, The Chicago Acad. of Science.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Cyathocrinus n. s. Hall. Niagara (Sil.)

Geol. of Wis., Hall, 1862, p. 431.
Locality—Racine, Wis.
Type—?

Cyathocrinus cora Hall = *Crotalocrinus cora.*

Cyathocrinus waukoma Hall = *Lecanocrinus waukoma.*

Eucalyptocrinus armosus McChesney = *Siphonocrinus armosus.*

Eucalyptocrinus cornutus Hall = *Callicrinus cornutus.*

Eucalyptocrinus cornutus var. **excavatus** Hall = *Callicrinus cornutus.*

Eucalyptocrinus crassus Hall. Niagara (Sil.)

Trans. Alb. Ins., Hall, 1862, Vol. 4, p. 197.
Eighteenth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1864, p. 323, pl. 14, figs. 2, 3.
Obs. Other specimens of the series of the types are from Waldron, Ind.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Eucalyptocrinus obconicus Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1864, p. 323, pl. 11, fig. 1.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Eucalyptocrinus ornatus Hall. Niagara (Sil.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 20.
Eighteenth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1864, p. 329, pl. 11, figs. 4, 5.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Glyptaster occidentalis Hall = *Thysanocrinus occidentalis.*

Glyptaster pentangularis Hall = *Thysanocrinus pentangularis.*

Glyptocrinus nobilis Hall = *Siphonocrinus nobilis.*

Glyptocrinus siphonocrinus Hall = *Siphonocrinus armosus.*

Ichthyocrinus subangularis Hall. Niagara (Sil.)
Trans. Alb. Ins., Hall, 1864, Vol. 4, p. 201.
Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 325, pl. 11, fig. 15.
Obs. The specimen figured as from Racine, Wis., is from the Chicago Area, as the writer in thirty years collecting at Racine, has never seen a specimen collected at that locality.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Lampterocrinus inflatus Hall. Niagara (Sil.)
Balanocrinus inflatus, Geol. Surv. Wis. Rept. of Prog., Hall, 1860, p. 22.
Lampterocrinus inflatus, Eighteenth Ann. Rept., N. Y. State Cab. Nat. Hist., Hall, 1864, p. 328, pl. 10, fig. 6.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Lecanocrinus pusillus Winchell and Marcy = *Lecanocrinus waukoma.*

Lecanocrinus waukoma (Hall.) Niagara (Sil.)
Cyathocrinus waukoma, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 324, pl. 11, figs. 11, 12.
Lecanocrinus waukoma, Mem. Bost. Soc. Nat. Hist., Winchell and Marcy, 1865, Vol. 1, p. 90.
Lecanocrinus waukoma, Pal. of the Niagara Limestone, in the Chicago Area, Weller, 1900, Bull. 4, Pt. 1, p. 148, p. 15, figs. 6-11.
Locality—Waukesha, Wis.
Types—Am. Mus. of Nat. Hist.

Lyriocrinus sculptilis Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 325.

Locality—Waukesha, Wis.

Type—?

Macrostylocrinus semiradiatus (Hall.) Niagara (Sil.)

Actinocrinus (Saccocrinus) semiradiatus, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 379, pl. 10, fig. 1.

Saccocrinus semiradiatus, Bull. Am. Mus. of Nat. Hist., Whitefield, 1899, Vol. 11, Pt. 2, p. 96.

Macrostylocrinus semiradiatus, The Chicago Acad. of Sci., Weller, 1900, Bull. 4, Pt. 1, p. 94, pl. 4, fig. 9.

Locality—Racine, Wis.

Type—Am. Mus. of Nat. Hist.

Macrostylocrinus striatus Hall. Niagara (Sil.)

Trans. Alb. Ins., Hall, 1862, Vol. 4, p. 207.

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 327, pl. 10, figs 7, 8.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Melocrinites nodosus Hall = *Melocrinus nodosus.*

Melocrinus milwaukensis Weller. Hamilton (Dev.)

Ann. N. Y. Acad. of Sci., Weller, 1898, Vol. 11, Pt. 7, p. 121, pl. 14, fig. 7.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

Melocrinus milwaukensis var **rotundus** Weller. Hamilton (Dev.)

Ann. N. Y. Acad. of Sci., Weller, 1898, Vol. 11, Pt. 7, p. 122, pl. 14, fig. 4.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

Melocrinus nodosus Hall. Hamilton (Dev.)

Melocrinites nodosus, Ann. Rept. Geol. Surv. of Wis., Hall, 1861, p. 19.

Melocrinus nodosus, Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 48, pl. 5, fig. 14.

Locality—Milwaukee, Wis.

Type—Am. Mus. of Nat. Hist.

Melocrinus nodosus var **spinosus** Weller. Hamilton (Dev.)
Ann. N. Y. Acad. of Sci., Weller, 1898, Vol. 11, Pt. 7, pl. 14, fig. 2.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Melocrinus pentangularis Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist Surv., Cleland, 1911, Bull. 21, p. 41, pl. 3, fig. 10.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Melocrinus subglobosus Weller. Hamilton (Dev.)
Ann. N. Y. Acad. of Sci., Weller, 1898, Vol. 11, Pt. 7, p. 120, pl. 14, fig. 1.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Melocrinus verneuili Hall = *Thysanocrinus pentagularis.*

Rhodocrinus ? rectus Hall. Niagara (Sil.)
Crinocystites ? rectus, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 318.
Rhodocrinus ? rectus, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 379, pl. 10, fig. 2.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Rhodocrinus (Lyriocrinus) sculptilis Hall. Niagara (Sil.)
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Revised Ed., Hall, 1868, p. 368.
Locality—Waukesha, Wis.
Type—?

Saccocrinus semiradiatus Hall = *Macrostylocrinus semiradiatus.*

Siphonocrinus armosus (McChesney.) Niagara (Sil.)
Eucalyptocrinus armosus, Description New Palæozoic Fossils, McChesney, 1859, p. 95.
Glyptocrinus siphonatus, Geol Surv. of Wis., Rept. of Prog., Hall, 1861, p. 22.
Glyptocrinus armosus, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 284, pl. 16, fig. 11.
Siphonocrinus armosus, Am. Geologist, S. A. Miller, 1888, Vol. 1, p. 264.
Locality—Racine Wis.
Type—Chicago Academy of Science, destroyed by fire.

Siphonocrinus nobilis (Hall.) Niagara (Sil.)

Glyptocrinus nobilis, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 21.

Glyptocrinus nobilis, Eighteenth Ann. Rept., N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 328. pl. 10, figs. 9, 10.

Glyptocrinus nobilis, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 283, pl. 16, figs. 9, 10.

Siphonocrinus nobilis, Am. Geologist, S. A. Miller, 1889, Vol. 1, Pt. 5, p. 263, figs. 265.

Locality—Racine, Wis.

Type—Am. Mus. of Nat. Hist.

Siphonocrinus pentagonus Wachsmuth and Springer. Niagara (Sil.)

The North American Crinoidea Camarata, Wachsmuth and Springer, 1897 Vol. 1, p. 213, pl. 19, figs. 4a, b.

Locality—Racine, Wis.

Type—Collection of Wachsmuth and Springer, U. S. National Museum, Washington, D. C.

Thysanocrinus occidentalis (Hall.) Niagara (Sil.)

Glyptaster occidentalis, Trans. Albany Ins., Hall, 1862, Vol. 4, p. 204.

Glyptaster occidentalis, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 326, pl. 10, fig. 3.

Thysanocrinus occidentalis, The Chicago Acad. of Science, Weller, 1900, Bull. 4, Pt. 1, p. 73, pl. 1, figs. 6, 7.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Thysanocrinus pentangularis (Hall.) Niagara (Sil.)

Glyptaster pentangularis, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 326, pl. 10, fig. 4.

Melocrinus verneuili, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 327, pl. 10, fig. 5.

Thysanocrinus pentangularis, The Chicago Acad. of Sci., Weller, 1900, Bull. 4, Pt. 1, p. 70, pl. 1, figs. 8-11.

Locality—Racine, Wis.

Type—Am. Mus. of Nat. Hist.

CYSTOIDEA.

Apiocystites imago Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 314, pl. 12, fig. 12, pl. 12a (1), fig. 9.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Caryocystites alternatum Hall = *Holocystites alternatus.*

Caryocystites cylindricus Hall = *Holocystites cylindricus.*

Crinocystites chrysalis Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 318, pl. 12a (1), figs. 10, 11.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Echinocystites nodosus Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Mus. of Nat. Hist., Hall, 1864, p. 316, pl. 12, figs. 10, 11.
Locality—Racine. Wis.
Types—Am. Mus. of Nat. Hist.

Gomphocystites clavus Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 310, pl. 12a (1), fig. 3.
Locality—Racine, Wis.
Type—?

Gomphocystites glans Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 310, pl. 12, fig. 14, pl. 12a (1), figs. 4, 5.
Locality—Racine. Wis.
Types—Am. Mus. of Nat. Hist.

Hemiscosmites subglobosus Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 316, pl. 12, fig. 13.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Holocystites abnormis Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 312, pl. 12, figs. 7, 8.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Holocystites alternatus Hall. Niagara (Sil.)

Caryocystites alternatum, Geol. Surv. Wis. Rept. of Prog., Hall, 1861, p. 23.

Caryocystites alternatum, Geol. of Wis., Hall, 1862, Vol. 1, p. 69, fig. 2.

Holocystites alternatus, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 312, pl. 12, fig. 9, and pl. 12a (1), fig. 6.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Holocystites cylindricus Hall. Niagara (Sil.)

Caryocystites cylindricus, Geol. Surv. Wis. Rept. of Prog., Hall, 1861, p. 23.

Caryocystites cylindricus, Geol. of Wis., Hall, 1862, Vol. 1, p. 69, fig. 1.

Holocystites cylindricus, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 311, pl. 12, figs. 4-6 and pl. 12a (1) fig. 7, 8.

Obs. The specimen fig. 4, is marked as from Grafton, Wis., it is a characteristic Racine specimen. The writer in thirty years collecting has never seen a specimen collected at Grafton.

Locality—Racine and Waukesha.

Types—Am. Mus. of Nat. Hist.

Holocystites ovatus Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall. 1864, p. 313, pl. 12, fig. 2.

Locality—Waukesha, Wis.

Type—Am. Mus. of Nat. Hist.

Holocystites scutellatus Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall. 1864, p. 314, pl. 12, fig. 1.

Locality—Waukesha, Wis.

Type—Am. Mus. of Nat. Hist.

Holocystites winchelli Hall. Niagara (Sil.)
Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 313, pl. 12, fig. 3.
Locality—Waukesha, Wis.
Types—Am. Mus. of Nat. Hist.

BLASTOIDEA.

Pentremitidea milwaukensis Weller. Hamilton (Dev.)
Ann. N. Y. Acad. of Sci., Weller, 1898, Vol. 11, Pt. 7, p. 123, pl. 14, fig. 5.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

BRACHIOPODA.

Acrotreta signalis Walcott. Middle Cambrian.
Proc. U. S. Nat. Mus., Walcott, 1902, Vol. 25, p. 599.
Locality—St. Croix Falls, Wis.
Type—U. S. Nat. Museum.

Atrypa sinuata Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Vol. 21, p. 75, pl.13, figs. 17, 18, 19.
Locality—Lake Church and Druckers, Wis.
Types—Mil. Pub. Museum.

Barandella ventricosa Hall = *Clorinda ventricosa.*

Billingsella major Walcott. Upper Cambrian.
Cambrian Geol. and Pal., Walcott, 1908, Pt. 3, p. 101, pl. 10, figs. 1, 1a.
Locality—Baraboo, Wis.
Types—U. S. Nat. Museum.

Billingsella pepina (Hall.) Potsdam.
Orthis pepina, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 134, pl. 6, figs. 23-27.
Orthis repina, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 170, pl. 1, figs. 4, 5.
Billingsella pepina, Pal. of New York, Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 230, pl. 7, figs. 16-19.
Locality—Kickapoo, Wis. and Reeds Landing, Minn.
Types—Am. Mus. of Nat. Hist.

Brachyprion profundum Whitfield = *Stropheodonta profunda.*

Camarotœchia scitulus Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull 21, p. 71, pl. 13, figs. 6, 7.

Locality—Milwaukee, Wis.

Types—Collection of Edgar E. Teller.

Capellinia mira Hall and Clarke. Niagara (Sil.)

Pal. of New York, Hall and Clarke, 1893, Vol. 8, Pt. 2, p. 248, pl. 70, figs. 6-14.

Locality—Racine, Wis.

Types—Univ. of Chicago.

Chonetes schucherti Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 91, pl. 18, figs. 11, 12, 13.

Locality—Milwaukee, Wis.

Types—Williams College.

Clitambonites diversus (Shaler.) Trenton (Ord.)

Orthisina diversa, Bull. Mus. of Comp. Zool., Shaler, 1865, Vol. 4, p. 27.

Hemipronites americanus, Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 72.

Clintambonites diversus, Minn. Geol. Surv., Winchell and Schuchert, 1893, Vol. 3, p. 378, pl. 30, figs. 11-17.

Locality—Flintville, Wis.

Types—Univ. of California.

Clorinda arcuosa (McChesney.) Niagara (Sil.)

Pentamerus arcuosus, Description New Pal. Foss., McChesney, 1861, p. 87.

Clorinda arcuosa, U. S. Geol. Surv., Schuchert, 1897, Bull. 87, p. 184.

Locality—Milwaukee, Wis.

Types—Chicago Acad. of Science. Destroyed by fire.

Clorinda ventricosa (Hall.) Niagara (Sil.)

Pentamerus ventricosa, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 2.

Pentamerus chicagoensis, Mem. Bost. Soc. of Nat. Hist., Winchell and Marcy, 1865, Vol. 1, p. 94, pl. 2, fig. 11.

Pentamerus (Pentamerella) ventricosus, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 374, pl. 13, (4), figs. 18-21.

Pentamerus ventricosus, Geol. of Wis., Whitfield, 1882, p. 291, pl. 16, figs. 11-13.

Barrandella ventricosa. Pal. of New York., Hall and Clarke, 1893, Vol. 8, Pt. 2, p. 243, pl. 71, figs. 4-10, pl. 84, fig. 46.

Clorinda ventricosa, U. S. Geol. Surv., Schuchert, 1897, Bull. 87, p. 185.

Locality—Waukesha, Wis.

Types—Am. Mus. of Nat. Hist.

Conchidium crassiradiatum (McChesney.) Niagara (Sil.)

Pentamerus crassoradius, Description. New Pal. Fossils., McChesney, 1861, p. 87.

Conchidium crassiradiatum, U. S. Geol. Surv., Schuchert, 1897, Bull. 87, p. 185.

Locality—Milwaukee, Wis.

Types—Chicago Acad. of Science. Destroyed by fire.

Conchidium greenii Hall and Clarke. Niagara (Sil.)

Pal. of New York., Hall and Clarke, 1894, Vol. 8, Pt. 2, p. 368, pl. 66, figs. 20-22.

Locality—Wauwatosa, Wis.

Types—Univ. of Chicago.

Conchidium multicostatum (Hall.) Niagara (Sil.)

Pentamerus multicostatus, Geol. Rept. Wis., Hall. 1860, p. 1, and p. 436.

Pentamerus multicostatus, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 373, pl. 13, (4), figs. 22, 23, 24.

Conchidium multicostatum, Pal. of N. Y., Hall and Clarke, 1894, Vol, 8, Pt. 2, p. 231, pl. 64, fig. 6, and pl. 66, fig. 10.

Locality—Waukesha, Wis.

Types—New York State Museum.

Crania setigera Hall. Trenton (Ord.)

Twenty-fourth Ann. Rept., N. Y. State Cab. of Nat. Hist., Hall, 1872, p. 220, pl. 7, figs. 13, 14.

Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 150, pl. 4H, figs. 14, 15, 16.

Locality—Mineral Point, Wis.

Types—Am. Mus. of Nat. Hist.

Cyrtia meta (Hall.) Niagara (Sil.)

Spirifer radiatus (pars) Pal. of N. Y., Hall, 1852, vol. 2, p. 66, pl. 22 figs. 2a, 2e, 2t.

Spirifer meta, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 372, pl. 13, figs 12, 13.

Cyrtia radiaus, Pal. of N. Y., Hall and Clarke, 1894, Vol. 8, Pt. 2, p. 42 and 362, pl. 28, figs. 4, 5, 50, 52; pl. 39, fig. 33.

Cyria meta, U. S. Geol. Surv., Schuchert, 1897, Bull. 87, p. 196.

Obs. The types were probably collected at Hales Corners. Wisconsin.

Locality—Milwaukee, Wis.

Types—Am. Mus. of Nat. Hist.

Cyrtia radiaus Hall and Clarke = *Cyrtia meta*.

Dalmanella perveta Hall and Clarke = *Dalmanella subæquata pervetus*.

Dalmanella subæquata (Conrad.) Trenton (Ord.)

Orthis subæquata, Proc. Acad. Nat. Sci., Phila., Conrad, 1843, Vol. 1, p. 333.

Orthis subæquata, Pal. of N. Y., Hall, 1847, Vol. 1, p. 118, pl. 32, fig. 2.

Orthis minneapolis, Eighth Ann. Rept., Geol. of Minn., Winchell, 1880, p. 63.

Orthis perveta, Second Ann. Rept., N. Y. State Geologist, Hall, 1883, pl. 34, figs. 17, 18.

Dalmanella subæquata, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 194, 207, 224, pl. 5c, figs. 6-11.

Orthis (Dalmanella.) subæquata, Minn. Geol. Surv., Winchell and Schuchert, 1893, p. 446, pl. 33, figs. 30-36.

Locality—Mineral Point, Wis.

Types—Am. Mus. of Nat. Hist.

Dalmanella subæquata pervetus (Conrad.) Trenton (Ord.)

Orthis perveta, Proc. Acad. Nat. Sci., Phila., Conrad, 1843, Vol. 1, p. 333.

Orthis perveta, Pal. of N. Y., Hall, 1847, Vol. 1, p. 120, pl. 32, fig. 5.

Orthis media, Eighth Ann. Rept., Geol. of Minn., Winchell, 1880, p. 64.

Orthis kussuba, Eighth Ann. Rept. Geol. of Minn., Winchell 1880, p. 65.

Dalmanella perveta, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, pl. 5c, fig. 12.

Orthis (Dalmanella.) subæquata, var. *perveta* Minn. Geol. Surv., Winchell and Schuchert, 1893, Vol. 3, p. 450, pl. 33, figs. 40-42.

Dalmanella subæquata, pervetus, U. S. Geol. Surv., Schuchert, 1897, Bull. 87, p. 203.

Locality—Mineral Point, Wis.

Types—Am. Mus. of Nat. Hist.

Dinobolus conradi Hall. Niagara (Sil.)

Obolus conradi, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 368, pl. 13, (4), figs. 1, 2.

Obolus (Trimerella ?) conradi, Geol. Surv. Ill., Meek and Worthen, 1868, p. 351, pl. 5, fig. 7.

Dinobolus conradi, Twenty-third Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1873, p. 247.

Dinobolus conradi, Pal. of New York, Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 38, pl. 4B, figs. 13-24.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Dinobolus parvus Whitfield. Galena (Ord.)

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 347, pl. 27, figs. 8-10.

Locality—Whitewater, Wis.

Types—Whitewater High School.

Dinorthis deflecta (Conrad.) Trenton (Ord.)

Strophonema deflecta, Proc. Acad. Nat. Sci., Phila., Conrad, 1843, Vol. 1, p. 332.

Strophomema recto, Proc. Acad. Nat. Sci., Phila., Conrad, 1843, Vol. 1, p. 332.

Leptæna deflecta, Pal. of N. Y., Hall, 1843, Vol. 1, p. 113, pl. 31B, fig. 5.

Leptæna recta, Pal. of N. Y., Hall, 1843, Vol. 1, p. 113, pl. 31B, fig. 6.

Plæsiomys deflecta, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 197, pl. 5A, figs. 28-30.

Plæsiomys recta, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 197 and 222.

Plæsiomys loricula, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 341, pl. 5A, figs. 31-34.

Orthis (Dinorthis) deflecta, Minn. Geol. Surv., Winchell and Schuchert, 1893, p. 422, pl. 32, figs. 24-30.

Dinorthis deflecta, Bull. 87, U. S. Geol. Surv., Schuchert, p. 215.

Locality—Mineral Point, Wis.

Types—Am. Mus. of Nat. Hist.

Discina ? inutilis Hall. Upper Cambrian.

Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 130, pl. 6, fig. 11.

Locality—Mazomanie, Wis.

Type—Am. Mus. of Nat. Hist.

Discina marginalis Whitfield = *Lingulodiscina marginalis.*

Glossina truncata Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 68, pl. 12, fig. 6.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

Hebertella bellarugosa (Conrad.) Trenton (Ord.)

Orthis bellarugosa, Proc. Acad. Nat. Sci., Phila., Conrad, 1843, Vol. 1, p. 333.

Orthis bellarugosa, Geol. of Wis., Hall, 1862, Vol. 1, p. 42, figs. 4-6.

Orthis (Hebertella ?) bellarugosa, Minn. Geol. Surv., Winchell and Schuchert, 1893, Vol. 3, p. 434, pl. 33, figs. 1-4.

Hebertella bellarugosa, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 222.

Locality—Mineral Point, Wis.

Types—Am. Mus. of Nat. Hist.

Hemipronites americanus Whitfield = *Clintambonites diversus.*

Leptæna barabuensis Whitfield = *Syntrophia barabuensis.*

Leptæna deflecta Hall = *Dinorthis deflecta.*

Leptæna fililexta Hall = *Strophomena incurvata.*

Leptæna profunda Hall = *Stropheodonta profunda.*

Leptæna recta Hall = *Dinorthis deflecta.*

Lingula mosia Hall. Upper Cambrian.
Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1863, p. 126, pl. 6, figs. 1-3.
Locality—Mazomanie, Wis.
Types—Am. Mus. of Nat. Hist.

Lingula pinnaformis Owen = *Lingulepis pinniformis.*

Lingula pinnaformis Hall = *Lingulepis pinniformis.*

Lingula polita Hall = *Obolella polita.*

Lingulella aurora (Hall.) Upper Cambrian.
Lingula ampla, Geol. Rept. Wis., Iowa and Minn., Owen, 1852, p. 583, pl. 1B, fig. 5.
Lingula aurora, Geol. Surv., Wis., Rept. of Prog., Hall, 1861, p. 24.
Lingulella aurora, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, pl. 2, figs. 12-13.
Locality—Mazomanie, Wis.
Types—Am. Mus. of Nat. Hist.

Lingula sp. undt. Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 70, pl. 12, fig. 5.
Locality—Milwaukee, Wis.
Type—Mil. Pub. Museum.

Lingula ampla Owen = *Lingulella aurora.*

Lingula aurora Hall = *Lingulella aurora.*

Lingula aurora var. Hall = *Lingulella stoneana.*

Lingula milwaukeensis Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 69, pl. 12, figs. 3, 4.

Locality—Milwaukee, Wis.

Types—Mil. Pub. Museum.

Lingulella stoneana Whitfield. Upper Cambrian.

Lingula aurora var., Sixteenth Ann. Rept. N. Y. Cab. Nat. Hist., Hall, 1863, p. 127, pl. 6, figs. 6-8.

Lingulella stoneana, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 344, pl. 27, figs. 6, 7.

Locality—Mazomanie, Wis.

Types—Am. Mus. of Nat. Hist.

Lingulepis pinniformis (Owen.) Upper Cambrian.

Lingula pinnaformis, Geol. Surv. Wis., Iowa and Minn., Owen, 1852, p. 583, pl. 1B, figs. 4, 6, 8.

Lingula pinnaformis, Geol. of Wis., Hall, 1862, p. 21 and 435, fig. 3.

Orbicula prima, Geol. Surv. Wis., Iowa and Minn., Owen, 1852, figs. 17, 19.

Lingulepis pinniformis, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 60, figs. 22, 23, and pl. 1, figs. 35, 36.

Locality—Falls of St. Croix and Hudson, Wis.

Types—?

Lingulodiscina marginalis (Whitfield.) Hamilton (Dev.)

Discina marginalis, Ann. Rept., Geol. Surv. Wis., Whitfield, 1879, p. 70.

Discina marginalis, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 325, pl. 25, fig. 11.

Orbiculoidea marginalis, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 127, pl. 4F, fig. 17.

Lingulodiscina marginalis, Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 84, pl. 12, figs. 11, 12, 13.

Locality—Milwaukee, Wis.

Types—Univ. of Wisconsin.

Liorhynchus greeni Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 71, pl. 13, figs. 1, 2.
Locality—Milwaukee, Wis.
Types—Collection of Edgar E. Teller.

Monomorella egani Hall and Clarke. Niagara (Sil.)
Pal. of N. Y., Hall and Clarke, 1892. Vol. 8. Pt. 1, p. 175, pl. 4e, fig. 16.
Locality—Grafton, Wis.
Type—Univ. of Chicago.

Monomorella greenii Hall and Clarke. Niagara (Sil.)
Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 174, pl. 4D, figs. 5-10.
Obs. The specimen fig. 6, is from Rising Sun, Ia.
Locality—Grafton, Wis.
Types—Univ. of Chicago.

Monomorella kingi Hall and Clarke. Niagara (Sil.)
Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 174, pl. 4D, figs. 1, 2.
Locality—Grafton, Wis.
Types—Univ. of Chicago.

Obelus (Lingulella) phaon Walcott. Upper Cambrian.
Proc. U. S. Nat. Mus., Walcott, 1898, Vol. 21, p. 410.
Locality—Gibralter Bluff; near Lodi, Wis.
Types—U. S. Nat. Museum.

Obolella polita Hall. Upper Cambrian.
Obolus appolinus, Geol. Surv. Wis., Iowa and Minn., Owen, 1852, pl. 1B, figs. 9, 11, 16, 20.
Lingula ? polita, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 24.
Obolella polita, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, pl. 2, figs. 37-41.
Locality—Trempealeau, Wis.
Types—Am. Mus. of Nat. Hist.

Obolus appoiinus Owen = *Obolella polita.*

Obolus conradi Hall = *Dinobolus conradi.*

Obolus (Trimerella ?) conradi. Meek and Worthen = *Dinobolus conradi.*

Orbicula prima Owen = *Lingulepis pinniformis.*

Orbiculoidea marginalis Hall and Clarke = *Lingulodiscina marginalis.*

Orbiculoidea telleri Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 85, pl. 12, figs. 9, 10.
Locality—Milwaukee, Wis.
Types—Mil. Pub. Museum.

Orbiculoidea wardi Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 85, pl. 12, figs. 14, 15, 16.
Locality—Milwaukee, Wis.
Types—Mil. Pub. Museum.

Orthis barabuensis Winchell = *Syntrophia barabuensis.*

Orthis bellarugosa Conrad = *Hebertella bellarugosa.*

Orthis (Dinorthis.) deflecta Winchell and Schuchert = *Dinorthis deflecta.*

Orthis disparilis Conrad = *Orthis tricenaria.* .

Orthis flabellites var. **spania** Hall and Clarke. Niagara (Sil.)

Pal. of N. Y., Hall and Clarke, 1894, Vol. 8, Pt. 2, pl. 84, fig. 10.
Locality—Racine, Wis.
Type—Univ. of Chicago.

Orthis ? glypta Hall and Clarke. Niagara (Sil.)

Pal. of N. Y., Hall and Clarke, 1894, Vol. 8, Pt. 2, p. 359, pl. 84, figs. 8, 9.

Obs. The locality of *O. flabellites* and *O. glypta* is given as near Milwaukee, should be Racine.

Locality—Racine, Wis.
Types—Univ. of Chicago.

Orthis incurvata Castelneau = *Strophomena incurvata.*

Orthis kassuba Winchell = *Dalmanella subæquata perretus.*

Orthis media Winchell = *Dalmanella subæquata perretus.*

Orthis minneapolis Winchell = *Dalmanella subæquata.*

Orthis pepina Hall = *Billingsella pepina.*

Orthis perveta Conrad = *Dalmanella subæquata perretus.*

Orthis perveta Hall = *Dalmanella subæquata.*

Orthis plicatella White = *Orthis tricenaria.*

Orthis subæquata Conrad = *Dalmanella subæquata.*

Orthis subæquata Hall = *Dalmanella subæquata.*

Orthis (Dalmanella.) subæquata Winchell and Schuchert = *Dalmanella subæquata.*

Orthis (Dalmanella.) subæquata var. **perveta** Winchell and Schuchert = *Dalmanella subæquata perretus.*

Orthis tricenaria (Conrad.) Trenton (Ord.)

Orthis tricenaria, Proc. Acad. Nat. Sci., Phila., Conrad, 1843, p. 333.
Orthis disparilis, Proc. Acad. Nat. Sci., Phila., Conrad, 1843, p. 333.
Orthis tricenaria, Pal. of N. Y., Hall, 1847, Vol. 1, p. 121, pl. 32, fig. 8.
Orthis tricenaria, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, pp. 191, 193, 221, 228, pl. 5, figs. 9-14.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Orthisina diversa Shaler = *Clitambonites diversus.*

Orthotropia dolomitica Hall and Clarke. Niagara (Sil.)

Pal. of N. Y., Hall and Clarke, 1894, Vol. 8, Pt. 2, pl. 84, figs. 3-7.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Parastrophia greenii Hall and Clarke. Niagara (Sil.)
Pal. of N. Y., Hall and Clarke, 1894, Vol. 8, Pt. 2, p. 367, pl. 63, figs. 17, 20, 22.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Parastrophia latiplicata Hall and Clarke. Niagara (Sil.)
Pal. of N. Y., Hall and Clarke, 1894, Vol. 8, Pt. 2, p. 368, pl. 63, figs. 23-27.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Parastrophia multiplicata Hall and Clarke. Niagara (Sil.)
Pal. of N. Y., Hall and Clarke, 1894, Vol. 8, Pt. 2, p. 367, pl. 63, figs. 15, 16, 21.
Locality—Racine, Wis.
Types—Univ. of Chicago.

Pentamerella multicostata Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 94, pl. 18, fig. 18.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Pentamerus arcuosus McChesney = *Clorinda arcuosa.*

Pentamerus chicagoensis Winchell and Marcy = *Clorinda ventricosa.*

Pentamerus multicostatus Hall = *Conchidium multicostatum.*

Pentamerus ventricosus Hall = *Clorinda ventricosa.*

Pentamerus (Pentamerella,) ventricosus Hall = *Clorinda ventricosa.*

Plæsiomys deflectus Hall and Clarke = *Dinorthis deflecta.*

Plæsiomys loricula Hall and Clarke = *Dinorthis deflecta.*

Plæsiomys recta Hall and Clarke = *Dinorthis deflecta.*

Producta incurvata Shepard = *Strophomena incurvata.*

Rafinesquina alternata var. **loxorhytis** Winchell and Schuchert = *Rafinesquina kingi.*

Rafinesquina kingi (Whitfield.) Lorraine (Ord.)

Strophomena kingi, Ann. Rept., Geol. Surv. Wis., Whitfield, 1877, p. 72.

Strophomena kingi, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 261, pl. 12, figs. 15, 16.

Rafinesquina alternata, var. *loxorhytis*, Minn. Geol. Surv., Winchell and Schuchert, 1893, Vol. 3, p. 407, pl. 31, figs. 35-37, pl. 32, figs, 59, 60.

Rafinesquina kingi, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 283.

Locality—Delafield, Wis.

Types—Univ. of Wisconsin.

Rhinobolus davidsoni Hall and Clarke. Niagara (Sil.)

Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 176, pl. 4B, figs. 10-12.

Fourteenth Ann. Rept. N. Y. State Geologist, Hall, 1895, p. 2, fig 8.

Locality—Grafton, Wis.

Types—Univ. of Chicago.

Rhynchonella neenah Whitfield. Lorraine (Ord.)

Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 62.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 265, pl. 12, figs. 19-22.

Locality—Neenah, Wis.

Types—Univ. of Wisconsin.

Rhynchonella perlamellosa Whitfield = *Rhynchotrema perlamellosum.*

Rhynchotrema perlamellosum (Whitfield.) Loraine (Ord.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877 p. 73.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 265, pl. 12, figs. 23-25.

Locality—Delafield, Wis.

Types—Univ. of Wisconsin.

Spirifer endora Hall. Niagara (Sil.)

Geol. Surv. Wis., Hall, 1861, p. 25 and 436.
Twentieth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1867, p. 370, pl. 13, figs. 5-7.
Pal. of N. Y., Hall and Clarke, 1894, Vol. 8, Pt. 2,, p. 13, pl. 21, figs. 19-21 and 29.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Spirifer euryteines var. **milwaukeensis** Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 77, pl. 15, figs. 1, 2, 3, 4, 5, 6.
Locality—Milwaukee, Wis.
Types—Mil. Pub. Museum.

Spirifer gibbosa Hall = *Spirifer gibbosus.*

Spirifer gibbosus Hall. Niagara (Sil.)

Spirifer gibbosus, Ann. Rept. Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 25.
Spirifer gibbosa, Twentieth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1867, p. 370, pl. 13, figs. 6-8.
Obs. Schuchert says, probably the same as S. eudora.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Spirifer meta Hall = *Cyrtia meta.*

Spirifer radiatus (pars) Hall = *Cyrtia meta.*

Spirifer sp. Cleland. Hamilton (Dev.)

Wis. Geol and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 82, pl. 14, figs. 13, 14.
Locality—Lake Church and Dreuchers, Wis.
Types—Williams College.

Streptorhynchus cardinale Whitfield. Lorraine (Ord.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1879, p. 61.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 261, pl. 12, figs. 9, 10.
Locality—Delafield, Wis.
Types—Univ. of Wisconsin.

Streptorhynchus (Strophonella ?) deltoideum Conrad = *Strophomena winchelli.*

Streptorhynchus filitexta Hall = *Strophomena incurvata.*

Stricklandinia multilirata Whitfield. Guelph (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 81.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 315, pl. 23, figs. 3-5.
Locality—Sheboygan, Wis.
Types—Univ. of Wisconsin.

Stropheodonta halli Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 87, pl. 14, figs. 7, 8, 9, 10.
Locality—Milwaukee and Lake Church, Wis.
Types—Fig. 7.—Teller collection. Fig. 8.—Mil. Pub. Museum. Fig. 9 and 10—Williams College.

Stropheodonta halli var. **musculosa** Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 88, pl. 14, figs. 11, 12.
Locality—Lake Church, Wis.
Types—Collection of H. F. Cleland. Williams College.

Stropheodonta (Brachyprion.) profunda Hall and Clarke = *Stropheodonta profunda.*

Stropheodonta profunda Hall. Niagara (Sil.)
Leptæna profunda, Pal. of N. Y., Hall, 1852, Vol. 2, p. 61, pl. 21, figs. 4, 5.
Strophomena profunda, Twelfth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1859, p. 82.
Strophomena niagarensis, Mem. Bost. Soc. Nat. Hist., Winchell and Marcy, 1865, p. 92, pl. 2, fig. 9.
Stropheodonta profunda, Twentieth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1867, p. 369, pl. 13 (4), figs. 3, 4.
Stropheodonta (Brachyprion.) profunda, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, pl. 13, figs. 1-5, pl. 20, figs. 29, 31, Pt. 2, 1894, pl. 84, fig. 12.
Brachyprion profundum, Bull. Am. Mus. of Nat. Hist., Whitfield, 1899, Vol. 11, Pt. 2, p. 116.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Strophomena concava Owen = *Strophomena incurvata.*

Strophomena deflecta Conrad = *Dinorthis deflecta.*

Strophomena filitexta Hall = *Strophomena incurvata.*

Strophomena kingi Whitfield = *Rafinesquina kingi.*

Strophomena profunda Hall = *Stropheodonta profunda.*

Strophomena recta Conrad = *Dinorthis deflecta.*

Strophomena winchelli Hall and Clarke. Trenton (Ord.)

Streptorhynchus (Strophonella ?) deltoidea, Second Ann. Rept., N. Y. State Geol., Hall, 1883, p. 39, figs. 10, 12-14.

Strophomena winchelli, Pal. of N. Y., Hall and Clarke, 1892, Vol. 8, Pt. 1, p. 344, pl. 9, figs. 10, 12-14, pl. 20, fig. 26.

Locality—Mineral Point, Janesville and Clifton, Wis.

Types—Am. Mus. of Nat. Hist.

Strophomena wisconsensis Whitfield. Lorraine (Ord.)

Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 61.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 263, pl. 12, figs. 11-13.

Locality—Delafield, Wis.

Types—Univ. of Wisconsin.

Syntrophia barabuensis (A. Winchell.) Upper Cambrian.

Orthis barabuensis, Am. Jour. Sci., A. Winchell, 1864, Vol. 37, p. 229.

Leptæna barabuensis, Geol. Surv. Wis., Whitfield, 1877, p. 60.

Leptæna barabuensis, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 171, pl. 1, figs. 6, 7.

Syntrophia barabuensis, Pal. of N. Y., Hall and Clarke, 1893, Vol. 8, Pt. 2, p. 216.

Locality—Baraboo, Wis.

Types—Alma College, Alma, Mich.

Trematis ? pustulosa Hall. Lorraine (Ord.)

Description of New Species Crinoidea and other Fossils, Hall, 1866, p. 15.

Twenty-fourth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1872, p. 222, pl. 7, figs. 22-25.

GALLEY TWENTY-FOUR—WIS. NAT. HIST.

Locality—Horicon, Wis.
Types—Am. Mus. of Nat. Hist.

Triplecia niagarensis Hall and Clarke. Niagara (Sil.)

Pal. of N. Y., Hall and Clarke, 1894, Vol. 8, Pt. 2, pl. 83, figs. 16-20.
Locality—Wauwatosa, Wis.
Types—Univ. of Chicago.

Triplesia primordalis Whitfield. Upper Cambrian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 51.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 172, pl. 10, figs 1, 2.
Locality— Roche a Cris Bluff, Adams Co., Wis.
Types—Univ. of Wisconsin.

LAMELLIBRANCHIATA.

Ambonychia acutirostra Hall. Niagara (Sil.)

Geol. Rept. Wis., Hall, 1860, p. 2.
Eighteenth Rept. N. Y. State Cab. Nat. Hist., Hall, 1864, p. 336, pl. 14, fig. 2.
Locality—Milwaukee, Wis.
Type—Am. Mus. of Nat. Hist.

Ambonychia altenuata Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 33.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 206, pl. 5, fig. 6.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 59, pl. 7, figs 8-11.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Ambonychia cancellosa Hall = *Ambonychia lamellosa*.

Ambonychia erecta Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 32.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 59, pl. 7, figs. 1, 2.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Ambonychia lamellosa (Hall.) Trenton (Ord.)
Ambonychia cancellosa, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 31.
Ambonychia lamellosa, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 205, pl. 5, fig. 5.
Ambonychia lamellosa, Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 57, pl. 7, figs. 5-7.
Locality—Mineral Point and Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Ambonychia planistriata Hall. Trenton (Ord.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 32.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 58, pl. 7, figs. 3, 4.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Amphicœlia leidyi Hall. Niagara (Sil.)
Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 339, pl. 14, figs. 13-15.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Clidophorus neglectus Hall. Trenton (Ord.)
Pal. of N. Y., Hall, 1847, Vol. 1, p. 150, pl. 34, figs 1g, h.
Geol. of Wis., Hall, 1862, Vol. 1. p. 55, figs. 2, 3.
Locality—Sinsinawa Mound and Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Conocardium ornatum Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 108, pl. 21, figs. 9, 10.
Locality—Milwaukee, Wis.
Types—Collection of Edgar E. Teller.

Cypricardites megambonus Whitfield. Trenton (Ord.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 73.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 210, pl. 5, figs. 7, 8.
Locality—Beloit, Wis.
Types—Univ. of California.

Cypricardites ? modesta Ulrich = *Staffordia modesta.*

Cypricardites niota Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 20.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 208, pl. 5, fig. 10.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 54, pl. 6, figs. 17-20.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Cypricardites rectirostris Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 29.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 55, pl. 6, figs. 21-25.
Locality—Janesville, Wis.
Types—Am. Mus. of Nat. Hist.

Cypricardites rotundatus Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 29.
Geol. of Wis., Whitfield, 1882. Vol. 4, p. 208, pl. 5, fig. 11.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 53, pl. 6, figs. 13-16.
Locality—Beloit and Janesville, Wis.
Types—Am. Mus. of Nat. Hist.

Cyrtodonta billingsi Ulrich. Trenton (Ord.)

Geol. and Nat. Hist. Surv. Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 538, pl. 40, figs. 2-6.
Locality—Beloit and Janesville, Wis.
Types—Minn. State Museum.

Cyrtodonta janesvillensis Ulrich. Trenton (Ord.)

Geol and Nat. Hist. Surv. Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 537, pl. 39, figs. 26, 27.
Locality—Beloit and Janesville, Wis.
Types—Minn. State Museum.

Cyrtodonta oviformis Ulrich. Trenton (Ord.)

Geol and Nat. Hist. Surv., Minn., Ulrich, Vol. 3, Pt. 2, p. 544, pl. 39, fig. 46, pl. 40, fig. 1.
Locality—Janesville, Wis.
Types—Minn. State Museum.

Edmondia fragilis Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 98, pl. 21, figs. 1, 2, 3.
Locality—Milwaukee, Wis.
Types—Fig. 1—Collection of E. E. Teller. Fig. 2, 3.—Williams College.

Endodesma undosum Ulrich. Trenton (Ord.)
Geol. and Nat. Hist. Surv., Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 529, pl. 36, fig. 38.
Locality—Beloit, Wis.
Types—Minn. State Museum.

Glyptodesma sp. Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 105, pl. 21, fig. 6.
Locality—Lake Church, Wis.
Type—Williams College.

Goniophora obtusiloba Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 119, pl. 25, fig. 11.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Gyronema duplicatum Ulrich. Trenton (Ord.)
Geol. and Nat. Hist. Surv., Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 1055, pl. 78, figs. 22-25.
Locality—Beloit, Wis.
Types—Univ. of Wisconsin.

Gyronema liratum Ulrich. Trenton (Ord.)
Geol. and Nat. Hist. Surv., Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 1056, pl. 78, figs. 14-16.
Locality—Beloit, Wis.
Types—Univ. of Wisconsin.

Leptodomus undulatus Whitfield. Niagara (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 81.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 293, pl. 18, figs. 1, 2.
Locality—Wauwatosa, Wis.
Types—Univ. of Wisconsin.

Megambonia wisconsinensis Cleland. Hamilton (Dev.)
Wis. Geol and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 120, pl. 26, figs. 1, 2.
Locality—Milwaukee, Wis.
Types—Collection of Edgar E. Teller.

Modiolopsis curta Hall. Trenton (Ord.)
Pal. of N. Y., Hall, 1847, Vol. 1, p. 297, pl. 82, figs. 2c, d.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Modiolopsis plana (Hall.) Trenton (Ord.)
Modiolopsis planus, Geol Surv. Wis., Rept. of Prog., Hall, 1861, p. 30.
Modiolopsis planus, Geol. of Wis., Hall, 1862, Vol. 1, p. 38, fig. 6.
Modiolopsis plana, Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1. Pt. 2, p. 56, pl. 7, figs. 12-15.
Locality—Beloit and Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Modiolopsis planus Hall = *Modiolopsis plana.*

Modiolopsis ? superba (Hall.) Trenton (Ord.)
Modiolopsis ? superbus, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 31.
Modiolopsis ?superba, Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 56, pl. 7, figs 16-18.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Modiolopsis superbus Hall = *Modiolopsis superba.*

Modiomorpha clarkei Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 115, pl. 24, fig. 5.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E Teller.

Modiomorpha obliqua Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 114, pl. 24, fig. 4.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Modiomorpha schucherti Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 115 pl. 24, figs. 1, 2, 3.
Locality—Milwaukee, Wis.
Types—Williams College.

Mytilarca sp. Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 108, pl. 22, fig. 3.
Locality—Milwaukee, Wis.
Type—Mil. Pub. Museum.

Mytilarca trigonale Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 108, pl. 22, figs. 4, 5, 6.
Locality—Lake Church, Wis.
Types—Williams College.

Nucula levata Hall = *Tellinomya levata.*

Nucula lirata Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 99, pl. 20, figs. 1, 2, 3.
Locality—Milwaukee, Wis.
Types—Williams College.

Nuculites laphami Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 101, pl. 20, fig. 4.
Locality—Milwaukee, Wis.
Type—Williams College.

Nuculites milwaukeensis Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 100, pl. 20, fig. 5.
Locality—Milwaukee, Wis.
Type—Mil. Pub. Museum.

Nyassa elongata Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 111, pl. 22, figs. 10, 11, 12.
Locality—Milwaukee, Wis.
Types—Mil. Pub. Museum.

Palæocardia cordiformis Hall. Niagara (Sil.)

Eighteenth Ann. Rept., N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 341, pl. 14 (5), figs. 11, 12.
Locality—Wauwatosa, Wis.
Types—Am. Mus. of Nat. Hist.

Palæoneilo sp. Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 105, pl. 20, fig. 8.
Locality—Milwaukee, Wis.
Type—Mil. Pub. Museum.

Paracyclas lirata var. Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 118, pl. 25, figs. 6, 7.
Locality—Milwaukee, Wis.
Types—Mil. Pub. Museum.

Paracyclas ohioensis tenuistriata var. Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., cleland, 1911, Bull. 21, p. 119, pl. 25, fig. 9.
Locality—Lake Church, Wis.
Type—Williams College.

Paracyclas sp. Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 119, pl. 25, fig. 8.
Locality—Milwaukee, Wis.
Type—Mil. Pub. Museum.

Pterinea ? paucicostata Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 105, pl. 22, fig. 9.
Locality--Lake Church, Wis.
Type—Williams College.

Pterinopecten telleri Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 112, pl. 25, figs. 1, 2.
Locality—Milwaukee, Wis.
Types—Collection of Edgar E. Teller.

Sphenolium parallelum Ulrich. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 624, pl. 36, figs. 42. 43.
Locality—Mineral Point, Wis.
Types—Minn. State Museum.

Staffordia modesta Ulrich. Galena (Ord.)

Cypricardites ? modesta, Amer. Geol., Ulrich, 1892, Vol. 10, p. 100.
Staffordia modesta, Geol. and Nat. Hist. Surv., Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 627, pl. 41, figs. 29-31.
Locality—Oshkosh, Wis.
Types—Ulrich Collection.

Tellinomya alta Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 27.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 50, pl. 6, figs. 5-8.
Locality—Dodgeville and Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Tellinomya fecunda Hall. Lorraine (Ord.)

Geol. of Wis., Hall, 1861, Vol. 1, p. 55, figs. 1r.-v.
Locality—Scales Mound, Wis.
Types—Am. Mus. of Nat. Hist.

Tellinomya inflata Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 26.
Geol. of Wis., Hall, 1862, p. 38, figs. 4, 5.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 49, pl. 6, figs. 10-12.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Tellinomya levata (Hall.) Trenton (Ord.)

Nucula levata, Pal. N. Y., Hall, 1847, Vol. 1, p. 150, pl. 34, figs. a.-k.
Tellinomya levata, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 2, Pt. 1, p. 48.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Tellinomya ovata Hall. Trenton (Ord.)

Geol. of Wis., Rept. of Prog., Hall, 1861, p. 28.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 52, pl. 6, fig. 9.
Locality—Beloit, Wis.
Type—Am. Mus. of Nat. Hist.

Tellinomya ventricosa Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 27.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 51, pl. 6, figs. 1-4.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Vanuxemi suberecta Ulrich. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 553, pl. 38, figs. 20-22.
Locality—Beloit, Wis.
Types—Minn. State Museum.

GASTROPODA.

Archinacella powersi Ulrich and Scofield. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Ulrich and Scofield, 1897, Vol. 3, Pt. 2, p. 829, pl. 61, figs. 3-5.
Locality—Beloit, Wis.
Type—Univ. of Wisconsin.

Bellerophon antiquatus Whitfield. Upper Cambrian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 52.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 176, pl. 1, figs. 13, 14.
Locality—Osceola Mills, Wis.
Types—Univ. of Wisconsin.

Bellerophon lirata Hall. Trenton (Ord.)

Geol. of Wis., Hall, 1862, Vol. 1, p. 55, figs. 7, 8.

Obs. Miller notes this species as being from the Hudson River Group.

Locality—?
Types—?

Bellerophon patersoni Hall. Trenton (Ord.)
Geol. of Wis., Hall, 1862, Vol. 1, p. 55, fig. 9.
Locality—?
Type—?

Bellerophon wisconsensis Whitfield. Trenton (Ord.)
Bellerophon wisconsensis, Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 76.
Bellerophon wisconsensis, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 223, pl. 6, figs. 15, 16.
Tretranota wisconsinensis, Geol. and Nat. Hist. Surv., Minn., Ulrich and Scofield, 1897, Vol. 3, Pt. 2, p. 881, pl. 65, figs. 26-29.
Locality—Beloit, Wis.
Types—Univ. of California.

Bucania (Tremanotus ?) buelli Whitfield. Trenton (Ord.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 76.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 224, pl. 6, figs. 12-14.
Locality—Beloit, Wis.
Types—Univ. of California.

Clisospira occidentalis Whitfield. Trenton (Ord.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 75.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 222, pl. 5, fig. 21.
Locality—Beloit, Wis.
Type—Univ. of California.

Cyclonema ? elevata Hall = *Cyclonema ? elevatum.*

Cyclonema ? elevatum Hall. Niagara (Sil.)
Cyclonema ? elevata, Eighteenth Ann. Rept. N. Y. State Cab., Hall, 1864, p. 342, pl. 15, fig. 4.
Cyclonema ? elevatum, Bull. Am. Mus. of Nat. Hist., Whitfield, 1899, Vol. 2, Pt. 2, p. 162.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Cyclonema ? subglobosa Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 126, pl. 28, figs. 7, 8, 9, 10.
Locality—Lake Church and Milwaukee, Wis.
Types—Figs. 7, 8 and 9—Mil. Pub. Museum. Fig. 10—Williams College.

Cyrtolites conradi Hall. Trenton (Ord.)
Geol. of Wis., Hall, 1862, Vol. 1, p. 55, fig. 6.
Locality—?
Type—?

Ecculiomphalus undulatus Hall. Trenton (Ord.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 37.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 63, pl. 8, figs. 1-3.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Eccyliopterus beloitensis Ulrich and Scofield. Trenton (Ord.)
Geol. and Nat. Hist. Surv., Minn., Ulrich and Scofield, 1897, Vol. 3, Pt. 2, p. 1032, pl. 62, fig. 70, and pl. 74, figs. 1-4.
Locality—Beloit, Wis.
Types—U. S. National Museum.

Eunema ? trilineatum Hall. Niagara (Sil.)
Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 346, pl. 15, fig. 3.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Euomphalus sp. Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 124, pl. 27, figs. 9, 10.
Locality—Lake Church, Wis.
Types—Williams College.

Euomphalus macrolineatus Whitfield. Niagara (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 82.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 294, pl. 18, figs. 5, 6.
Locality—Manitowoc Rapids, Wis.
Types—Univ. of Wisconsin.

Euomphalus pervetus (Conrad.) Trenton (Ord.)
Inachus pervetus, Proc. Acad. of Nat. Sci., Phila., Conrad, 1843, Vol. 1, p. 333.
Euomphalus pervetus, Am. Pal. Fossils, S. A. Miller, 2 Ed., p. 148.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist?

Euomphalus strongi Whitfield. Lower Magnesian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 66.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 200, pl. 4, figs. 1, 2.
Locality—Richland Co., Wis.
Types—Univ. of Wisconsin.

Euomphalus triliratus Conrad. Trenton (Ord.)

Proc. Acad. of Nat. Sci., Phila., Conrad, 1843, Vol. 1, p. 333.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Fusispire schurcherti Ulrich. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 1076, pl. 80, fig. 1.
Locality—Beloit, Wis.
Type—Minn. State Museum.

Fusispire ventricosa Hall. Trenton (Ord.)

Twenty-fourth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1872, p. 229, pl. 8, fig. 6.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 245, pl. 9, fig. 2.
Locality—Depere, Wis.
Type—Am. Mus. of Nat. Hist.

Holopea ampla Ulrich and Scofield. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Ulrich and Scofield, 1897, Vol. 3, Pt. 2, p. 1065, pl. 79, figs. 22-25.
Locality—Mineral Point and Beloit, Wis.
Types—Univ. of Wisconsin.

Holopea concinnula Ulrich and Scofield. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Ulrich and Scofield, 1897, Vol. 3, Pt. 2, p. 1066, pl. 79, fig. 6.
Locality—Beloit, Wis.
Type—Univ. of Wisconsin.

Holopea magniventra Whitfield. Guelph (Sil.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 83.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 316, pl. 24, figs. 2, 3.
Locality—Carlton, Wis.
Type—Univ. of Wisconsin.

Holopea obesa Whitfield. Lower Magnesian.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 348, pl. 27, fig. 11.

Locality—River Falls, Wis.

Type—Univ. of Wisconsin.

Holopea sweetii Whitfield. Cambrian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1879, p. 44.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 174, pl. 10, fig. 3.

Locality—Osceola Mills, Wis.

Type—Univ. of Wisconsin.

Inachus pervetus Conrad = *Euomphalus pervetus*.

Lophospira tricarinata (Hall.) Trenton (Ord.)

Murchisonia tricarinata, Pal. of N. Y., Hall. 1847, Vol. 1, p. 178, pl. 38, fig. 6a.-e.

Lophospira tricarinata, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 2, Pt. 1, p. 52.

Locality—Mineral Point, Wis.

Type—Am. Mus. of Nat. Hist.

Loxonema (Aclisina) cancellata Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 127, pl. 27, figs. 3, 4.

Locality—Lake Church, Wis.

Type—Williams College.

Loxonema leda Hall. Niagara (Sil.)

Twentieth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1867, p. 367, pl. 15 (6.), fig. 2.

Locality—Wauwatosa, Wis.

Type—Am. Mus. of Nat. Hist.

Loxonema magna Whitfield. Guelph (Sil.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 83.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 317, pl. 24, fig. 1.

Locality—Section 28, Carlton Township, Wis.

Type—Univ. of Wisconsin.

Maclurea bigsbyi Hall. Trenton (Ord.)

Ann. Rept. Geol. Surv. Wis., Hall, 1861, p. 37.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 222, pl. 6, figs. 17, 18.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 62, pl. 8, figs. 12-15.
Locality—Mineral Point and Janesville, Wis.
Types—Am. Mus. of Nat. Hist.

Maclurea cuneata Whitfield. Galena (Ord.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 75.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 246, pl. 20, figs. 5, 6.
Locality—Whitewater, Wis.
Types—Whitewater High School.

Maclurea subrotunda Whitfield. Galena (Ord.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 75.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 246, pl. 9, figs. 7, 8.
Locality—Whitewater, Wis.
Types—Whitewater High School.

Maclurea wadsworthi Whitfield. Upper Cambrian.

Bull. Am. Mus. of Nat. Hist., Whitfield, 1884, p. 153, pl. 14, fig. 16.
Locality—Mazomanie, Wis.
Types—Am. Mus. of Nat. Hist.

Metoptoma barabuensis Whitfield. Lower Magnesian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 60.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 195, pl. 3, figs. 16, 17.
Locality—Baraboo, Wis.
Types—Univ. of California.

Metoptoma ? peracuta Walcott. Upper Cabmrian.

Proc. U. S. Nat. Mus., Walcott, 1890, Vol. 13, p. 267, pl. 20, fig. 1.
Locality—Spoffords Bluff, Wis.
Type—U. S. National Museum.

Metoptoma perovalis Whitfield. Trenton (Ord.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 74.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 211, pl. 5, figs. 13, 14.
Locality—Beloit, Wis.
Types—Univ. of California.

Metoptoma recurva Whitfield. Lower Magnesian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 61.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 196, pl. 3, figs. 14, 15.
Locality—Baraboo, Wis.
Types—Univ. of California.

Metoptoma retrorsa Whitfield. Lower Magnesian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 54.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 197, pl. 3, fig. 18.
Locality—Baraboo, Wis.
Type—Univ. of California.

Metoptoma similes Whitfield. Lower Magnesian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 61.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 196, pl. 3, figs. 12, 13.
Locality—Baraboo, Wis.
Types—Univ. of California.

Murchisonia chamberlini Whitfield. Guelph (Sil.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 84.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 317, pl. 24, fig. 4.
Locality—Carlton, Wis.
Type—Univ. of Wisconsin.

Murchisonia conradi Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1864, p. 344, pl. 15 (6.), fig. 19.
Trans. Wis. Acad. Sci. Arts and Letters, Teller, 1910, Vol. 16, Pt. 2, p. 1286, pl. 15, figs. 1-3.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Murchisonia laphami Hall. Niagara (Sil.)

Geol. Surv., Rept. of Prog., Hall, 1861, p. 36.
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 366, pl. 15 (6.), fig. 20.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 296, pl. 18, fig. 9.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Murchisonia major Hall. Galena (Ord.)

Geol. of the Lake Superior Land District, Hall, 1851, Pt. 2, p. 209, pl. 26, fig. 1a.
Locality—Green Bay, Wis.
Type—Am. Mus. of Nat. Hist.

Murchisonia tricarinata Hall = *Lophospira tricarinata.*

Ophileta (Raphistoma) primordialis A. Winchell. Upper Cambrian.

Straparollus (Ophileta) primordialis. Am. Jour. of Sci., Winchell, 1864, Vol. 37, p. 228.
Ophileta (Raphistoma) primordialis. Geol. of Wis., Whitfield, 1882, Vol. 4, p. 173, pl. 1, figs. 10, 11.
Locality—Baraboo, Wis.
Types—Alma College, Alma Mich.

Palæacmæa irvingi Whitfield. Upper Cambrian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 51.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 173, pl. 1, figs. 8, 9.
Locality—Jackson Co., Wis.
Types—Univ. of Wisconsin.

Platyceras bertheletensis Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 128, pl. 28, figs. 1, 2.
Locality—Milwaukee, Wis.
Types—Collection of Edgar E. Teller.

Platyceras bertheletensis var. **unsymmetricum** Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 129, pl. 28, fig. 3.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Platyceras hornefferi Cleland. Hamilton, (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 129, pl. 28, figs. 4, 5, 6.
Locality—Milwaukee, Wis.
Types—Figs. 4 and 5—Milwaukee Public Museum. Fig. 6—Collection of Edgar E. Teller.

Platyceras primordiale Hall. Upper Cambrian.
Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 136, pl. 16, fig. 28.
Locality—Trempealeau, Wis.
Type—Am. Mus. of Nat. Hist.

Platyceras wisconsinense Ulrich and Scofield. Trenton (Ord.)
Geol. and Nat. Hist. Surv., Minn., Ulrich and Scofield, 1897, Vol. 3, Pt. 2, p. 1068, pl. 61, figs. 49-54.
Locality—Beloit, Wis.
Types—Univ. of Wisconsin.

Pleuronatus sp. Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 126, pl. 27, fig. 11.
Locality—Lake Church, Wis.
Type—Williams College.

Pleurotomaria depauperata Hall. Trenton (Ord.)
Geol. of Wis., Hall, 1862, Vol. 1, p. 55, fig. 5.
Obs. Miller says this species is from the Hudson River Group.
Locality—?
Type—?

Pleurotomaria halei Hall. Niagara (Sil.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 34.
Twentieth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1867, p. 364, pl. 15 (6.), figs. 13, 14.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Pleurotomaria hoyi Hall. Niagara (Sil.)
Pleurotomaria hoyi, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 35.
Pleurotomaria hoyi, Twentieth Ann. Rept. N. Y. State Cab. Nat. Hist., Hall, 1867, p. 364, pl. 15 (6.), fig. 10.
Pleurotomaria (Trochonema) hoyi, Twentieth Ann. Rept. N. Y. State Cab. Nat. Hist., Revised Ed., Hall, 1868, p. 393 pl. 25, figs. 11, 12.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Pleurotomaria (Trochonema) hoyi = *Pleurotomaria hoyi.*

Pleurotomaria idia Hall. Niagara (Sil.)
Geol. of Wis., Rept. of Prog., Hall, 1861, p. 35.
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 365, pl. 15 (6.), figs. 15, 16.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Pleurotomaria labrosa var. **occidens** Hall = *Pleurotomaria occidens.*

Pleurotomaria laphami Whitfield. Niagara (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 84.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 296, pl. 18, fig. 9.
Locality—Ashford, Wis.
Type—Univ. of Wisconsin.

Pleurotomaria (Raphistoma) micula Hall = *Raphistoma micula.*

Pleurotomaria (Raphistoma) nasoni Hall = *Pleurotomaria nasoni.*

Pleurotomaria nasoni Hall. Trenton (Ord.)
Pleurotomaria (Raphistoma) nasoni, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 34.
Raphistoma nasoni, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 215, pl. 6, figs. 2, 3.
Pleurotomaria nasoni, Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 61, pl. 8, figs. 4-7.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Pleurotomaria niota Hall. Trenton (Ord.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 33.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 60, pl. 8, fig. 11.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Pleurotomaria occidens Hall. Niagara (Sil.)
Pleurotomaria labrosa var. *occidens*, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 343.
Pleurotomaria occidens, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 364, pl. 15 (6.), figs. 11, 12.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Pleurotomaria pauper Hall = *Trochonema pauper.*

Pleurotomaria racinensis Whitfield. Niagara (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 84.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 296, pl. 18, figs. 7, 8.
Locality—Racine, Wis.
Types—Univ. of Wisconsin.

Pleurotomaria umbelicata Hall = *Trochonema umbelicatum.*

Porcellia ? kindlei Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland. 1911. Bull. 21, p. 121. pl. 27, fig. 1.
Locality—Milwaukee, Wis.
Type—Williams College.

Protowarthia rectangularis Ulrich and Scofield. Trenton (Ord.)
Geol. and Nat. Hist. Surv., Minn., Ulrich and Scofield. 1897, Vol. 3. Pt. 2, p. 868, pl. 63, figs. 15-20.
Locality—Mineral Point and Janesville, Wis.
Types—Collection of E. O. Ulrich.

Raphistoma micula Hall. Lorraine (Ord.)
Geol. of Wis., Hall, 1862, Vol. 1, p. 55, fig. 4.
Locality—Sinsinawa Mound, Wis.
Type—Am. Mus. of Nat. Hist.

Raphistoma niagarense Whitfield. Niagara (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 82.
Geol. of Wis., Whitfield, 1882. Vol. 4. p. 295. pl. 18. figs. 10-12.
Locality—Wauwatosa, Wis.
Types—Univ. of Wisconsin.

Scævogyra elevata Whitfield. Lower Magnesian.
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 62.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 199, pl. 3, fig. 11.
Locality—Baraboo, Wis.
Type—Univ. of California.

Scævogyra obliqua Whitfield. Lower Magnesian.
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 63.
Geol. of Wis., Whitfield, 1882. Vol. 4, p. 199, pl. 3, fig. 10.
Locality—Baraboo, Wis.
Type—Univ. of California.

Scævogyra swezeyi Whitfield. Lower Magnesian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 62.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 198, pl. 3, figs. 7-9.
Locality—Baraboo, Wis.
Type—Univ. of California.

Scenella beloitensis Ulrich and Scofield. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Ulrich and Scofield, 1897, Vol. 3, Pt. 2, p. 839, pl. 61, figs. 33, 34.
Locality—Beloit, Wis.
Type—Univ. of Wisconsin.

Straparollus mopsus Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 342, pl. 15 (6.), fig. 22.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Straparollus (Ophileta) primordialis Winchell = *Ophileta (Raphistoma) primordialis.*

Subulites ventricosus Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 346, pl. 15 (6.), fig. 1.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Subulites beloitensis Ulrich and Scofield. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Ulrich and Scofield, 1897, Vol. 3, Pt. 2, p. 1072, pl. 81, figs. 9-11.
Locality—Beloit, Wis.
Type—Collection of E. O. Ulrich.

Tetranota wisconsinensis Ulrich and Scofield = *Bellerophon wisconsinensis.*

Trochonema beachi Whitfield. Trenton (Ord.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1879, p. 55.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 213, pl. 6, fig. 6.
Locality—Beloit, Wis.
Type—Univ. of California.

Trochonema beloitense Whitfield. Trenton (Ord.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 74.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 212, pl. 6, figs. 7, 8.

Locality—Beloit, Wis.

Types—Univ. of California.

Trochonema fatua Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 345, pl. 15 (6.), figs. 7, 8.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Trochonema maguum Whitfield. Guelph (Sil.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 83.

Locality—Carlton, Wis.

Type—Univ. of Wisconsin.

Trochonema monroei Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 127, pl. 28, figs. 11, 14, 15, 16.

Locality—Lake Church, Wis.

Types—Williams College.

Trochonema niota Ulrich. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Ulrich, Vol. 3, Pt. 2, p. 1052, pl. 76, figs. 16-18.

Locality—Beloit, Wis.

Types—Collection of E. O. Ulrich.

Trochonema pauper Hall. Niagara (Sil.)

Pleurotomaria pauper, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 343.

Trochonema pauper, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 365, pl. 15 (6.), figs. 5, 6 and 9.

Trochonema (Cyclonema ?) pauper, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Revised Edition, Hall, 1868, p. 395, pl. 25, fig. 13.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Trochonema umbilicatum Hall. Trenton (Ord.)

Pal. of New York, Hall, 1847, Vol. 1, p. 175, pl. 38, fig. 1g.

Obs. Other specimens of the series of types are from N. Y. State.

Locality—Mineral Point, Wis.

Type—Am. Mus. of Nat. Hist.

Turritella sp. Conrad. Trenton (Ord.)

Proc. Acad. of Nat. Sci., Phila., Conrad, 1843, Vol. 1.

Locality—Mineral Point, Wis.

Types—Am. Mus. of Nat. Hist.

CEPHALOPODA.

Actinoceres abnorme (Hall.) Niagara (Sil.)

Orthoceres abnorme, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 355, pl. 18 (9.), fig. 10.

Actinoceres abnormis, Bull. Am. Mus. of Nat. Hist., Whitfield, 1899, p. 170.

Locality—Racine, Wis.

Type—Am. Mus. of Nat. Hist.

Cyrtoceras brevicorne Hall. Niagara (Sil.)

Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 356, pl. 18 (9.), figs. 8, 9.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Cyrtoceras corniculum Hall = *Cyrtoceras tenuistriatum.*

Cyrtoceras dardanus Hall. Niagara (Sil.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1860, p. 43.

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 349, pl. 17 (8.), figs. 3-5.

Locality—Wauwatosa, Wis.

Types—Am. Mus. of Nat. Hist.

Cyrtoceras eugium (Hall.) Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 40.

Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 66, pl. 9, figs. 3, 4.

Locality—Beloit, Wis.

Types—Am. Mus. of Nat. Hist.

Cyrtoceras featherstonhaughi Clarke. Trenton (Ord.)

Geol. and Nat. Hist. Surv., Minn., Clarke, 1897, Vol. 3, Pt. 2, p. 807, pl. 58, figs. 12-15.
Locality—Madison, Wis.
Types—Collection of W. H. Scofield, Cannon Falls, Minn.

Cyrtoceras infundibulum Whitfield. Niagara (Sil.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1879, p. 66.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 300, pl. 20, figs. 4, 5.
Locality—Racine, Wis.
Types—Univ. of Wisconsin.

Cyrtoceras laterale Hall. Niagara (Sil.)

Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 357, pl. 18 (9.), figs. 4-6.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Cyrtoceras loculosum Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 42.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 67, pl. 9, figs. 6-9.
Locality—Madison, Wis.
Types—Am. Mus. of Nat. Hist.

Cyrtoceras lucillus Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 349, pl. 18, figs. 7.
Locality—Wauwatosa, Wis.
Type—Am. Mus. of Nat. Hist.

Cyrtoceras macrostomum (Conrad.) Trenton (Ord.)

Cyrtoceras marginale, Proc. Acad. of Nat. Sci., Phila., Conrad, 1843, p. 334.
Cyrtoceras macrostomum, Pal. of N. Y., Hall, 1847, Vol. 1, p. 194, pl. 42, figs. 1 b. c.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Cyrtoceras marginale Conrad = *Cyrtoceras macrostomum.*

Cyrtoceras neleus Hall. Trenton (Ord.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 40.
Mem. Am. Mus, of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 65, pl. 9, figs. 10, 11.
Locality—Beloit and Janesville, Wis.
Types—Am. Mus. of Nat. Hist.

Cyrtoceras orcas Hall = *Oncoceras orcas.*

Cyrtoceras planidorsatum Whitfield = *Cyrtoceras planodorsatum.*

Cyrtoceras planodorsatum Whitfield. Trenton (Ord.)
Cyrtoceras planidorsatum. Ann. Rept. Geol. Surv. Wis., Whitfield, 1879, p. 57.
Cyrtoceras planodorsatum, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 231, pl. 7, figs. 10-12.
Locality—Beloit, Wis.
Types—Univ. of California.

Cyrtoceras pusillum Hall. Niagara (Sil.)
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 357, and Revised Edition, pa. 407.
Locality—Racine, Wis.
Type—?

Cyrtoceras rectum Whitfield. Guelph (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 85.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 319, pl. 24, figs. 6-8.
Locality—Carlton, Wis.
Types—Univ. of Wisconsin.

Cyrtoceras scofieldi Clarke. Trenton (Ord.)
Geol. and Nat. Hist. Surv., Minn., Clarke, 1897, Vol. 3, Pt. 2, p. 810, pl. 59, figs. 9-11.
Locality—Janesville, Wis.
Types—Minn. State Museum.

Cyrtoceras tenuistriatum (Hall.) Trenton (Ord.)
Cyrtoceras corniculum, Geol. of Wis., Hall, 1862, Vol. 1, p. 41, figs. 1, 2.
Cyrtoceras tenuistriatum, Am. Pal. Fossils, Miller, 1883, p. 243.
Cyrtoceras tenuistriatum, Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, pl. 9, fig. 12.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Endoceras (Cameroceras) subannulatum Whitfield. Trenton (Ord.)
Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 56.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 230, pl. 7, figs. 15, 16.
Locality—Beloit, Wis.
Types—Univ. of California.

Gonioceras occidantle Hall. Trenton (Ord.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 47.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 72, pl 12, figs. 1, 2.
Locality—Platteville, Wis.
Types—Am. Mus. of Nat. Hist.

Gomphoceras sp. Cleland. Hamilton (Dev.)
Jour. of Geol., Cleland, 1907, p. 468, fig. 8.
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 138, pl. 38.
Locality—Milwaukee, Wis.
Type—Williams College.

Gomphoceras sp. Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 140, pl. 42, fig. 1.
Locality—Milwaukee, Wis.
Type—Williams College.

Gomphoceras breviposticum Whitfield. Hamilton (Dev.)
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 339, pl. 26, fig. 15.
Locality—Whitefish Bay, near Milwaukee, Wis.
Type—Univ. of Wisconsin.

Gomphoceras calvini Cleland. Hamilton (Dev.)
Jour. of Geol., Cleland, 1907, p. 465, figs. 4, 5, 6, 7.
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 137, pls. 35, 36, 37.
Locality—Milwaukee, Wis.
Types—Williams College.

Gomphoceras ? fusiforme Whitfield. Hamilton (Dev.)
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 338, pl. 26, fig. 16.
Locality—Whitefish Bay, near Milwaukee, Wis.
Type—Univ. of Wisconsin.

Gomphoceras powersi James. Trenton (Ord.)

Jour. Cincinnati Soc. Nat. Hist., James, 1886, Vol. 8, Pt. 4, p. 255, pl. 4, fig. 2.

Locality—Beloit, Wis.

Type—Univ. of Chicago.

Gomphoceras septoris Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 350, figs. 9, 10.

Obs. The description of the species says from Illinois locality unknown, it is known to have been collected by Dr. Day, at Wauwatosa, Wis.

Locality—Wauwatosa, Wis.

Types—Univ. of Chicago.

Gomphoceras whitfieldi Cleland. Hamilton (Dev.)

Jour. of Geol., Cleland, 1907, Vol. 15, p. 464, figs. 9, 10.

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 137, pls. 39, 40.

Locality—Milwaukee, Wis.

Types—Pl. 39—Collection of Edgar E. Teller. Pl. 40—Williams College.

Gomphoceras wisconsinense Cleland. Hamilton (Dev.)

Jour. of Geol., Cleland, 1907, Vol. 15, p. 461, figs. 1, 2, 3.

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 135, pl. 29, 30, 31.

Locality—Milwaukee, Wis.

Types—Mil. Pub. Museum.

Goniatites sp. Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 141, pl. 42, fig. 4.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

Gyroceras sp. Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 141, pl. 32.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

Gyroceras duplicostatum Whitfield. Trenton (Ord.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 78.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 235, pl. 7, fig. 1.

Locality—Bristol, Dane Co., Wis.
Type—Univ. of California.

Gyroceras eryx Hall. Hamilton (Dev.

Regents Report on the State Cabinet of New York, Hall, 1861, p. 39.
Pal. of New York, Hall, 1879, Vol. 5, Pt. 2, p. 386, pl. 58, fig. 1, pl. 103, fig. 3.
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 140, pl. 33.

Locality—Whitefish Bay, near Milwaukee, Wis.
Type—Am. Mus. of Nat. Hist.

Lituites capax Hall = *Nautilus capax.*

Lituites multicostatus Whitfield. Niagara (Sil.)

Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 67.
Geol. of Wis., Whitfield, 1882, Vol. 4. p. 303, pl. 20, fig. 7.

Locality—Waukesha, Wis.
Type—Univ. of Wisconsin.

Lituites robertsoni Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 38.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 64, pl. 10, figs. 4-6.

Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Lituites undatus var. **occidantalis** Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 38. (referred to the Niagara group in error.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 63, pl. 10, fig. 7, pl. 11, and pl. 12, fig. 3.

Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Nautilus capax Hall. Niagara (Sil.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1860, p. 3.
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 363.
Locality—Waukesha, Wis.
Type—?

Nautilus (Lituites) occidentalis Hall = *Lituites cancellatus.*

Oncoceras abruptum Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 44.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 68, pl. 10, figs. 1-3.
Locality—Beloit and Platteville, Wis.
Types—Am. Mus. of Nat. Hist.

Oncoceras alceus Hall. Trenton (Ord.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 46.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 70, pl. 9, figs. 23-26.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Oncoceras brevicurvatum Whitfield. Trenton (Ord.)

Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 59.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 234, pl. 7, fig. 2.
Obs. The description of this fossil gives the genus as *Oncoceras* while the plate gives it as *Cyrtoceras.*
Locality—Beloit, Wis.
Type—Univ. of California.

Oncoceras lycum Hall = *Oncoceras lycus.*

Oncoceras lycus (Hall.) Trenton (Ord.)

Oncoceras lycum, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 45.
Oncoceras lycus, Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 69, pl. 9, figs. 13, 14.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Oncoceras mumiaforme Whitfield. Trenton (Ord.)
Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 58.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 232, pl. 7, figs. 3-5.
Locality—Beloit, Wis.
Types—Univ. of California.

Oncoceras orcas Hall. Niagara (Sil.)
Cyrtoceras orcas, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 42.
Oncoceras orcas, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 350, pl./17 (8.), figs. 1, 2.
Locality—Waukesha, Wis.
Types—Am. Mus. of Nat. Hist.

Oncoceras pandion Hall. Trenton (Ord.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 45.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 233, pl. 7, fig. 6.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 69, pl. 9, figs. 20-22.
Locality—Beloit and Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Oncoceras plebeium Hall. Trenton (Ord.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 44.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 68, pl. 9, figs. 15-19.
Locality—Beloit, Wis.
Types—Am. Mus. of Nat. Hist.

Orthoceras sp. Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 135, pl. 42, figs. 3, 3A.
Locality—Milwaukee, Wis.
Types—Williams College.

Orthoceras abnorme Hall = *Actinoceras abnorme.*

Orthoceras alienum Hall. Niagara (Sil.)
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 354, pl. 20A, fig. 5.
Obs. There is no such plate or figure in the work cited.
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Revised Edition, Hall, 1868, p. 414, pl. 24, figs. 6, 7.
Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Orthoceras anellum Hall = *Orthoceras anellus.*

Orthoceras anellus (Conrad.) Trenton (Ord.)

Orthoceras anellus, Proc. Acad. Nat. Sci., Phila., Conrad, 1843, Vol. 1, p. 334.

Orthoceras anellum, Geol of Wis., Whitfield, 1882, Vol. 4, p. 226, pl. 7, fig. 13.

Locality—Mineral Point, Wis.

Type—Am. Mus. of Nat. Hist.

Orthoceras clarkei Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 134, pl. 42, figs. 2, 2A.

Locality—Milwaukee, Wis.

Types—Collection of Edgar E. Teller.

Orthoceras columnare Hall = *Orthoceras ovus.*

Orthoceras (Actinoceras) beloitense Whitfield. Trenton (Ord.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 77.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 226, pl. 8, fig. 1, and pl. 10, figs. 9, 10.

Locality—Beloit, Wis.

Types—Fig. 1.—Univ. of Wisconsin. Figs. 9, 10.—Univ. of California.

Orthoceras carltonense Whitfield. Guelph (Sil.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 85.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 318, pl. 24, fig. 5.

Locality—Carlton, Wis.

Type—Univ. of Wisconsin.

Orthoceras crebescens Hall. Niagara (Sil.)

Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 354, pl. 19 (10.), figs. 1-3.

Locality—Racine, Wis.

Type—Am. Mus. of Nat. Hist.

Orthoceras gregarium Hall = *Orthoceras socialis.*

Orthoceras medullare Hall. Niagara (Sil.)

Geol. Surv. Wis., Rept. of Prog., Hall, 1860, p. 4.
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 353, pl. 20 (11.), figs. 1, 2.

Obs. *O. scammoni*, McChesney is probably identical with this species.

Locality—Waukesha, Wis.
Type—Am. Mus. of Nat. Hist.

Orthoceras niagarense Hall. Niagara (Sil.)

Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 356, pl. 20 (11.), fig. 3.

Locality—Waukesha, Wis.
Type—Am. Mus. of Nat. Hist.

Orthoceras orus (Hall.) Niagara (Sil.)

Orthoceras columnare, Geol. of Wis., Rept. of Prog., Hall, 1860, p. 4.
Orthoceras, *columnare*, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 351, pl. 19 (10.), figs. 4, 6, 8.
Orthoceras orus, Am. Pal. Fossils, Miller, 1877, p. 245.

Locality—Racine, Wis.
Types—Am. Mus. of Nat. Hist.

Orthoceras planoconvexum Hall. Trenton (Ord.)

Geol. of Wis., Rept. of Prog., Hall, 1861, p. 47.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 228, pl. 7, fig. 14.
Mem. Am. Mus. of Nat. Hist., Whitfield 1895, Vol. 1, Pt. 2, p. 72, pl. 8, figs. 24, 25 and pl. 9, figs. 1, 2.

Locality—Beloit and Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Orthoceras socialis (Hall.) Lorraine (Ord.)

Orthoceras gregarium, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 46.
Orthoceras socialis, Am. Pal. Fossils, Miller, 1877, p. 245.

Locality—?
Types—Am. Mus. of Nat. Hist.

Orthoceras wauwatosense Whitfield. Niagara (Sil.)
Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 66.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 297, pl. 19, fig. 2.
Obs. O crebristriatum, Meek and Worthen is identical with this species.
Locality—Wauwatosa, Wis.
Type—Univ. of Wisconsin.

Phragmoceras hoyi Whitfield. Niagara (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 86.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 300, pl. 19, figs. 4, 5.
Locality—Wauwatosa, Wis.
Types—Univ. of Wisconsin.

Phragmoceras hoyi var. **compressum** Whitfield. Niagara (Sil.)
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 301, pl. 20, fig. 3.
Locality—Racine, Wis.
Type—Univ. of Wisconsin.

Phragmoceras labiatum Whitfield. Niagara (Sil.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 86.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 302, pl. 20, figs. 1, 2.
Locality—Ashford, Wis.
Types—Univ. of Wisconsin.

Phragmoceras nestor Hall. Niagara (Sil.)
Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, p. 347, figs. 7, 8.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 301, pl. 19, fig. 3.
Locality—Wauwatosa, Wis.
Types—Am. Mus. of Nat. Hist.

Trochoceras costatum Hall. Niagara (Sil.)
Geol. of Wis., Hall, 1860, p. 3.
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 360, pl. 20A, fig. 1.
Obs. There is no such plate or figure in the work cited. See pl. 16 (7.), figs. 1, 2.
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Revised Edition, Hall, 1868, p. 402, pl. 25, fig. 15.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

CONULARIDA.

Clioderma attenuata Hall = *Pterotheca attenuata.*

Coleolus ? tenuis Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p| 130, pl. 26, fig. 11.
Locality—Lake Church, Wis.
Type—Mil. Pub. Museum.

Conularia cambria Walcott. Upper Cambrian.
Proc. U. S. Nat. Museum, Walcott, 1890, p. 270, pl. 20, fig. 10.
Locality—Pilot Knob, Wis.
Type—U. S. Nat. Museum.

Conularia congregata milwaukeensis Cleland. Hamilton (Dev.)
Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 130, pl. 26, figs. 4, 5, 6, 7.
Locality—Milwaukee, Wis.
Types—Figs. 4 and 6—Mil. Pub. Museum. Fig. 5—Williams College.

Hyolithes baconi Whitfield. Trenton (Ord.)
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 77.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 225, pl. 6, figs. 9-11.
Locality—Beloit, Wis.
Types—Univ. of Wisconsin.

Hyolithes primordialis (Hall.) Upper Cambrian.
Theca primordialis, Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 80.
Hyolithes primordialis, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 175, pl. 1, fig. 12.
Locality—Trempealeau, Wis.
Type—Am. Mus. of Nat. Hist.

Pterotheca attenuata Hall. Trenton (Ord.)
Clioderma attenuata, Fourteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1861, p. 98.
Pterotheca attenuata, Geol. of Wis., Hall, 1862, Vol. 1, p. 40, figs. 2, 3.
Locality—?
Types—?

Spirodentalium osceola Walcott. Cambrian.

Proc. U. S. Nat. Mus., Walcott, 1890, Vol. 13, p. 271, pl. 20, fig. 12.
Locality—Osceola Mills, Wis.
Types—U. S. Nat. Museum.

Theca parviusculus Hall. Trenton (Ord.)

Geol. of Wis., Hall, 1862, Vol. 1, p. 55, fig. 10.
Locality—?
Type—?

Theca primordialis Hall = *Hyolithes primordialis.*

VERMES.

Arabellites crescentum Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 45, pl. 4, fig. 1.
Locality—Milwaukee, Wis.
Type—Williams College.

Arenicolites woodi Whitfield. Potsdam.

Scolithus ? woodi, Ann. Rept. Geol. Surv. Wis., Whitfield, 1879, p. 45.
Arenicolites woodi, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 177, pl. 11, figs. 1-3.
Locality—Devil's Lake, Wis.
Types—Univ. of Wisconsin.

Autodetus apicatus Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 47, pl. 4, figs. 4, 4a.
Locality—Milwaukee, Wis.
Types—Collection of Edgar E. Teller.

Cornulites sp. Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 46, pl. 4, fig. 2.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Scolithus ? woodi Whitfield = *Arenicolites woodi.*

CRUSTACEA.

Acidaspis danai Hall. Niagara (Sil.)

Acidaspis danai, Geol. of Wis., Hall, 1862, p. 432.

Acidaspis danai, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 333, pl. 21 (12.), figs. 8, 9.

Acidaspis ida, Mem. Bos. Soc. of Nat. Hist., Winchell and Marcy, 1865, Vol. 1, p. 106, pl. 3, fig. 13.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Acidaspis ida Winchell and Marcy = *Acidaspis danai*.

Aglaspis barrandi Hall. Lower Cambrian.

Can. Nat. and Geol., Hall, 1862, Vol. 7, p. 445, fig. 1.

Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 181, pl. 2, figs. 7-16.

Locality—Mazomanie, Wis.

Types—Am. Mus. of Nat. Hist.

Aglaspis eatoni Whitfield. Upper Cambrian.

Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 54.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 192, pl. 10, fig. 11.

Locality—Lodi, Wis.

Type—Univ. of California.

Agnostus disparilis Hall. Upper Cambrian.

Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 179, pl. 10, figs. 25-27.

Locality—Osceola Mills, Wis.

Types—Am. Mus. of Nat. Hist.

Agnostus N. S. Hall. Potsdam.

Geol. of Wis., Hall, 1862, Vol. 1, p. 432.

Locality—?

Types—?

Agnostus josepha Hall. Upper Cambrian.

Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 178, pl. 6, figs. 54, 55.

Locality—Trempealeau, Wis.

Types—Am. Mus. of Nat. Hist.

Agraulos convexus Whitfield. Upper Cambrian.

Arionellus (Agraulos) convexus. Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 57.

Arionellus convexus, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 190, pl. 1, fig. 17.

Locality—Ironton, Sauk Co., Wis.

Type—Univ. of Wisconsin.

Agraulos ? thea Walcott. Upper Cambrian.

Proc. U. S. Museum, Walcott, 1890, Vol. 13, p. 21, fig. 15.

Locality—Osceola Mills, Wis.

Types—U. S. Nat. Museum.

Agraulos (Balhyurus ?) woosteri Whitfield. Middle Cambrian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 56.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 189, pl. 1, figs. 19-21.

Locality—Ettrick, Wis.

Types—Univ. of Wisconsin.

Amphion ? matutina Hall = *Amphion matutinus.*

Amphion ? matutinus Hall. Upper Cambrian.

Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 222, pl. 5a, fig. 6.

Obs. The generic name Amphion was preoccupied by Hulber in 1816 for a Sphingid Moth, Walcott's generic name is therefore subject to revision.

Locality—Trempealeau, Wis.

Type—Am. Mus. of Nat. Hist.

Anomocare wisconsensis (Owen.) Potsdam.

Crepicephalus ? wisconsensis, Rept. Geol. Surv. Wis., Iowa and Minn., Owen, 1852, pl. 1, fig. 13 only.

Dikelocephalus latifrons, Trans. Acad. of Sci., St. Louis, Shumard, 1863, Vol. 2, p. 101.

Crepicephalus wisconsensis, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 164, pl. 7, figs. 39-41 and pl. 8, figs. 22-24 and 27, 28.

Crepicephalus wisconsensis, Trans. Acad. of Sci., St. Louis, Shumard, Vol. 2, p. 103.

Anomocare wisconsensis, China (Richthofen). Dames, Vol. 4, p. 24.

Locality—Trempealeau, Wis.

Types—?

Arionellus (Agraulos) convexus Whitfield = *Agraulos convexus.*

Arionellus n. s. Hall. Potsdam.

Geol. of Wis., Hall, 1862. Vol. 1, p. 432.

Locality—?

Types—?

Asaphus barrandii Hall = *Ogygia barrandii.*

Asaphus homalonotoides Walcott. Trenton (Ord.)

Asaphus homalenoloides, Thirty-first Ann. Rept. N. Y. State Cab. of Nat. Hist., Walcott, 1879, p. 71.

Asaphus triangulatus, Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 59.

Asaphus homalonotoides, Geol. of Wis., Whitfield, 1882, Vol. 2, p. 237, pl. 5, fig. 4.

Locality—Sec. 5, T5, R5, West, Grant Co., Wis.

Type—Univ. of Wisconsin.

Asaphus triangulatus Whitfield = *Asaphus homalonotoides.*

Asaphus wisconsensis Walcott. Trenton (Ord.)

Twenty-eighth Ann. Rept. N. Y. State Mus. of Nat. Hist., Walcott, 1879, p. 97.

Locality—Mineral Point and Platteville, Wis.

Types—Mus. of Com. Zoology, Cambridge, Mass.

Bronteus acamas Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 332, pl. 21, figs. 19, 20.

Locality—Racine, Wis.

Types—Am. Mus. of Nat. Hist.

Bronteus laphami Whitfield. Niagara (Sil.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 83.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 310, pl. 22, figs. 1-4.

Locality—Kewaunee, Wis.

Types—Univ. of Wisconsin.

Calymene mamillata Hall. Trenton (Ord.)

Geol. of Wis., Hall, 1861, p. 50.

Geol. of Wis., Hall, 1862, Vol. 1, p. 432, figs. 1, 2.

Obs. The type specimens are marked as from Iowa but are known to have been collected near Dodgeville, Wis.

Locality—Dodgeville, Wis.

Types—Am. Mus. of Nat. Hist.

Ceratiocaris monroei Whitfield. Lower Helderberg.

Bull. Am. Mus. of Nat. Hist., Whitfield, 1896, Vol. 8, p. 301, pl. 13, figs. 1-5.

Locality—Waubeka, Wis.

Types—Am. Mus. of Nat. Hist.

Ceratiocaris poduriformis Whitfield. Lower Helderberg.

Bull. Am. Mus. of Nat. Hist., Whitfield, 1896, Vol. 8, p. 302, pl. 14, fig. 10.

Locality—Waubeka, Wis.

Types—Am. Mus. of Nat. Hist.

Ceraurus insignis Hall = *Ceraurus niagarensis.*

Ceraurus niagarensis Hall. Niagara (Sil.)

Ceraurus insignis, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 335.

Ceraurus niagarensis, Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 376, pl. 21 (12.), figs. 10-11.

Locality—Milwaukee, Wis.

Types—Am. Mus. of Nat. Hist.

Ceraurus rarus Walcott. Trenton (Ord.)

Advanced Sheets. Thirty-first Rept. N. Y. State Mus. of Nat. Hist., Walcott, 1873, p. 15.

Thirty-first Ann. Rept. N. Y. State Mus. of Nat. Hist., Walcott, 1879, p. 65.

Locality—Beloit, Wis.

Types—Mus. of Comp. Zoology, Cambridge, Mass.

Chariocephalus whitfieldi Hall. Potsdam.

Ptychaspis miniscaensis, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 171, pl. 16, figs. 41-47. and ply 10, figs. 21, 22.

Ptychaspis miniscaensis, Sixteenth Ann. Rept. N. Y. State Cab. of of Nat. Hist., Hall, 1863, p. 175, pl. 6, figs. 49-53, and pl. 10, fig. 20.

Locality—Trempealeau, Wis.

Types—Am. Mus. of Nat. Hist.

Conaspis eos Hall = *Ptychoparia eos.*

Conocephalites anatinus Hall = *Ptychoparia anatina.*

Conocephalites binodosus Hall = *Ptychoparia binodosa.*

Conocephalites calymenoides Whitfield = *Ptychoparia calymenoides.*

Conocephalites diadematus Hall = *Ptychoparia diademata.*

Conocephalites (Arionellus ?) dorsalis Hall = *Ptychoparia dorsalis.*

Conocephalites eos Hall = *Ptychoparia eos.*

Conocephalites eryon Hall = *Ptychoparia eryon.*

Conocephalites (Ptychaspis ?) explanatus Whitfield = *Ptychaspis explanatus.*

Conocephalites hamulus Shumard = *Anomocare hamulus.*

Conocephalites hamulus Hall = *Anomocare hamulus.*

Conocephalites iowensis Shumard = *Crepicephalus iowensis.*

Conocephalites iowensis Hall = *Crepicephalus iowensis.*

Conocephalites minor Shumard = *Ptychoparia minor.*

Conocephalites nactus Hall = *Ptychoparia nacta.*

Conocephalites nasutus Hall = *Ptychoparia nasuta.*

Conocephalites optatus Hall = *Conocoryphe optata.*

Conocephalites perseus Hall = *Ptychoparia perseus.*

Conocephalites quadratus Whitfield = *Ptychoparia quadrangularis.*

Conocephalites shumardi Hall = *Ptychoparia shumardi.*

Conocoryphe optata (Hall.) Upper Cambrian.

Conocephalites optatus, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 222, pl. 5a, fig. 7.

Conocoryphe optata, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 8.

Locality—Trempealeau, Wis.

Types—Am. Mus. of Nat. Hist.

Crepicephalus ? gibbsi Whitfield. Potsdam.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 67.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 184, pl. 10, figs. 12, 13.
Locality—Berlin, Wis.
Types—Univ. of Wisconsin.

Crepicephalus iowensis (Owen.) Potsdam.

Undetermined Trilobite, Rept. Geol. Rec., Chippewa Land Dist., Owen, 1848, p. 14, pl. 7, fig. 1.
Dikelocephalus ? iowensis, Rept. Geol. Wis., Iowa and Minn., 1852, p. 575, pl. 1, fig. 4, pl. 1a, fig. 13.
Conocephalites iowensis, Trans. Acad. Sci., St. Louis, Shumard, 1863, Vol. 2, p. 102.
Crepicephalus iowensis, Bull. U. S. Geol. Surv., Walcott, 1884, No. 10, p. 36.
Locality—Near mouth of Black River, Wis.
Types—?

Crepicephalus onustus Whitfield. Potsdam.

Ann. Rept. Geol. Surv. Wis., Whitfiell, 1877, p. 53.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 182, pl. 1, figs. 22, 23.
Locality—Ettrick, Wis.
Types—Univ. of Wisconsin.

Crepicephalus wisconsensis Hall = *Anomocare wisconsensis.*

Crepicephalus wisconsensis Owen = *Anomocare wisconsensis.*

Crepicephalus wisconsensis Shumard = *Anomocare wisconsensis.*

Cytherina fabulites Conrad = *Leperditia fabulites.*

Dalmania meta Hall = *Dalmanites meta.*

Dalmania vigilaus Hall = *Dalmanites vigilans.*

Dalmanites intermedius Walcott. Trenton (Ord.)

Advanced Sheets, Thirty-first Ann. Rept. N. Y. State Mus. of Nat. Hist., Walcott, 1877, p. 17.
Thirty-first Ann. Rept. N. Y. State Mus. of Nat. Hist., Walcott, 1879, p. 69.
LocalityClifton and Platteville, Wis.
Types—Museum of Comparative Zoology, Cambridge, Miss.

Dalmanites meta (Hall.) Trenton (Ord.)

Dalmania meta, Geol. of Wis., Hall, 1862, Vol. 1, p. 433.

Obs. The generic name having been used in 1830, for a genus of *Diptera*. J. Barrande suggested that of *Dalmanites*.

Locality—?

Type—?

Dalmanites vigilans Hall. Niagara (Sil.)

Dalmania vigilans, Geol. of Wis., Hall, 1861, p. 51.

Dalmania vigilans, Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 335, figs. 1, 2, and pl. 21 (12.), figs. 16-18.

Dalmanites vigilans, Twenty-eighth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1879, p. 193, pl. 33, figs. 1-4.

Locality—Waukesha, Wis.

Types—Am. Mus. of Nat. Hist.

Dicranopeltis nasuta Weller. Niagara (Sil.)

Bulletin. The Chicago Academy of Science, Weller, 1907, No. 4, Pt. 2, p. 240, pl. 22, figs. 5-7.

Locality—Racine, Wis.

Types—Collection of Edgar E. Teller.

Dicranopeltis telleri Weller. Niagara (Sil.)

Bulletin. The Chicago Academy of Science, Weller, 1907, No. 4, Pt. 2, p. 241, pl. 22, figs. 8, 9.

Locality—Racine, Wis.

Types—Collection of Edgar E. Teller.

Dikelocephalus barabuensis Whitfield. Lower Magnesian.

Ann. Rept. Geol. Surv. Wis., Whitfienld, 1877, p. 63.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 201, pl. 4, figs. 6-9.

Locality—Baraboo, Wis.

Types—Univ. of California.

Dikelocephalus crassimarginatus Whitfield. Potsdam.

Dikellocephalus pepinensis ?, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 142, pl. 9, figs. 1-4, pl. 2, fig. 2.

Dikellocephalus crassimarginatus, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 344, pl. 27, fig. 14.

Locality—Lodi, Wis.

Type—Univ. of California.

Dikelocephalus eatoni Whitfield. Lower Magnesian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 65.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 202, pl. 14, figs. 11-17, pl. 10, figs. 4, 5.
Locality—Baraboo, Wis.
Types—Univ. of California.

Dikelocephalus granulosus Owen = *Ptychaspis striata.*

Dikelocephalus ? iowensis Owen = *Crepicephalus iowensis.*

Dikelocephalus latifrons Shumard = *Anomocare wisconsensis.*

Dikelocephalus latifrons (Shumard) Hall = *Anomocare wisconsensis.*

Dikelocephalus lodensis Whitfield. Upper Cambrian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1879, p. 51.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 188, pl. 10, fig. 14, and p. 341, pl. 27, figs. 12, 13.
Locality—Prairie du Sac, Wis.
Types—Univ. of California.

Dikelocephalus miniscænsis Owen = *Ptychaspis miniscænsis.*

Dikelocephalus misa Hall. Upper Cambrian.

Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 144, pl. 10, figs. 4-8.
Locality—Trempealeau, Wis.
Types—Am. Mus. of Nat. Hist.

Dikelocephalus osceola Hall. Upper Cambrian.

Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 146, pl. 10, figs. 18, 19 and pl. 7, fig. 49?
Locality—Osceola Mills, Wis.
Types—Am. Mus. of Nat. Hist.

Dikellocephalus pepinensis ? Hall = *Dikelocephalus crassimarginatis.*

Dikelocephalus spiniger Hall. Upper Cambrian.

Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 143, pl. 10, figs. 1, 2 and 3?
Locality—Trempealeau, Wis.
Types—Am. Mus. of Nat. Hist.

Ellipsocephalus curtus Whitfield. Upper Cambrian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 58.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 191, pl. 1, fig. 18.
Locality—Hudson Wis.
Type—Univ. of Wisconsin.

Encrinurus nerveus Hall. Niagara (Sil.)

Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 375, pl. 21 (12.), fig. 15.
Locality—Racine, Wis.
Type—Am. Mus. of Nat. Hist.

Encrinurus raricostatus Walcott. Trenton (Ord.)

Advanced Sheets. Thirty-first Ann. Rept. N. Y. State Cab. of Nat. Hist., Walcott, 1877, p. 16.
Thirty-first Ann. Rept. N. Y. State Cab. of Nat. Hist., Walcott, 1879, p. 69.
Locality—Mineral Point, Beloit, and North of Janesville, Wis.
Types—Museum of Comparative Zoology, Cambridge, Mass.

Encrinurus trentonensis Walcott. Trenton (Ord.)

Advanced Sheets. Thirty-first Ann. Rept. N. Y. State Cab. of Nat. Hist., Walcott, 1877, p. 15.
Thirty-first Ann. Rept. N. Y. State Cab. of Nat. Hist., Walcott, 1879, p. 68.
Localit—Clifton, Grant Co., Wis.
Types—Museum of Comparative Zoology, Cambridge, Mass.

Entomocaris telleri Whitfield. Lower Helderberg (Dev.)

Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 8, p. 300, pl. 12, fig. 1, and pl. 14, fig. 1, 2 and 9.
Locality—Waubeka, Wis.
Types—Am. Mus. of Nat. Hist.

Harpes telleri Weller. Niagara (Sil.)

Bull. Chicago Academy of Science, Weller, 1907, Vol. 4, Pt. 2, p. 213, pl. 20, fig. 2.
Locality—Milwaukee, Wis.
Type—Collection of Edgar E. Teller.

Illænurus convexus Whitfield. Lower Magnesian.
Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 66.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 203, pl. 4, figs. 3-5.
Locality—Baraboo, Wis.
Types—Univ. of California.

Illænurus quadratus Hall. Upper Cambrian.
Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 176, pl. 7, figs. 52-57.
Locality—Osceola Mills, Wis.
Types—Am. Mus. of Nat. Hist.

Illænus cuniculus Hall. Niagara (Sil.)
Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 377, pl. 22, (13.), fig. 12.
Locality—Wauwatosa, Wis.
Type—Am. Mus. of Nat. Hist.

Illænus imperator Hall. Niagara (Sil.)
Geol. Surv. Wis., Rept. of Prog., Hall, 1861, p. 49.
Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 332, pl. 22 (13.), figs. 15-17, and pl. 23, (14.), figs. 2, 3.
Locality—Burlington, Wis.
Types—Am. Mus. of Nat. Hist.

Illænus indeterminatus Walcott. Trenton (Ord.)
Advanced Sheets. Thirty-first Ann. Rept. N. Y. State Cab. of Nat. Hist., Walcott, 1877, p. 19.
Thirty-first Ann. Rept. N. Y. State Cab. of Nat. Hist., Walcott, 1879, p. 70.
Locality—Platteville, Wis.
Types—Museum of Comparative Zoology, Cambridge, Mass.

Illænus insignis Hall. Niagara, (Sil.)
Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 331, figs. 5, 6 and pl. 22, (13.), figs. 13, 14.
Geol. of Wis., Whitfield, 1882, Vol. 4, p. 305, pl. 21, figs. 6-10.

Obs. The specimen from which figures 5 and 6 were drawn must have been collected at Bridgeport, Ill., as the Wisconsin specimens of this species are not so accurate.

Locality—Milwaukee, Wis.
Types—Am. Mus. of Nat. Hist.

Illænus ioxus Hall. Niagara (Sil.)

Twentieth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1867, p. 378, pl. 22 (13.), figs. 4-10.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 304, pl. 21, figs. 11, 12.

Obs. Among the types are two specimens said to have been collected at Wauwatosa, Wis. In over thirty years collecting at that locality, we have never seen or heard of a specimen of this species collected there.

LocalityRacine and Waukesha, Wis.

Types—Am. Mus. of Nat. Hist.

Illænus madisonianus Whitfield. Niagara (Sil.)

Illænus niagarensis, Ann. Rept. Wis. Geol. Surv., Whitfield, 1879, p. 68.

Illænus niagarensis, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 307, pl. 20, figs. 8, 9.

Prof. Whitfield says: The specific name of this species was changed by request of the Wisconsin Geological Survey.

Obs. It is known that the type specimen of this species was collected by the late Dr. Fisk H. Day of Wauwatosa, Wis., at that locality.

Locality—Wauwatosa, Wis.

Type—Univ. of Wisconsin.

Illænus niagaresnsis Whitfield = *Illænus madisonianus.*

Illænus ovatus (Conrad.) Trenton (Ord.)

Thalops? ovatus, Proc. Acad. Nat. Sci., Phila., Conrad, 1843, Vol. 1, p. 332.

Illænus ovatus, Pal. of N. Y., Hall, 1843, Vol. 1, p. 259, pl. 67, figs. 6a, b.

Illænus ovatus, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 238, pl. 5, figs. 1, 2.

Locality—Mineral Point, Wis.

Types—Am. Mus. of Nat. Hist.

Illænus pterocephalus Whitfield. Niagara (Sil.)

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 87.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 309, pl. 20, figs. 10-12.

Locality—Pewaukee, Wis.

Types—Univ. of Wisconsin.

Illænus taurus Hall. Trenton (Ord.)

Geol. of Wis., Rept. of Prog., Hall, 1861, p. 49.
Mem. Am. Mus. of Nat. Hist., Whitfield, 1895, Vol. 1, Pt. 2, p. 73, pl. 12, figs. 4-9.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist.

Leperditia fabulites (Conrad.) Trenton (Ord.)

Cytherina fabulites, Proc. Acad. Nat. Sci., Phila., Conrad, 1843.
Leperditia fabulites, Am. Pal. Fossils, Miller, 1877, p. 219.
Locality—Mineral Point, Wis.
Types—Am. Mus. of Nat. Hist. ?

Leperditia germana Ulrich = *Leperditella germana.*

Leperditia fonticola Hall. Niagara (Sil.)

Eighteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1864, p. 335, pl. 21 (12.), figs. 1-3.
Locality—Fond du Lac, Wis.
Types—?

Leperditella germana Ulrich. Trenton (Ord.)

Leperditia germana, American Geologist, Ulrich, 1892, Vol. 10, p. 266.
Leperditella garmana, Geol. and Nat. Hist. Surv., Minn. Ulrich, 1897, Vol. 3, P. 2, p. 638, pl. 45, figs. 24-26.
Locality—Mineral Point, Wis.
Types—U. S. National Musenm.

Lonchocephalus chippewaensis Owen = *Ptychoparia chippewaensis.*

Lonchocephalus hamulus Owen = *Anomocare hamulus.*

Microdiscus ? bullatus (Hall.) Upper Cambrian.

Pemphigaspis bullata, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 221, pl. 15a, figs. 3-5.
Microdiscus ? bullatus, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 2, Pt. 1, p. 10.
Locality—Trempealeau, Wis.
Types—Am. Mus. of Nat. Hist.

Ogygia barrandii (Hall.) Trenton (Ord.)

Asaphus barrandi, Rept. Geol., Lake Superior Land District, Hall, 1851, Pt. 2, p. 210, pl. 27, figs. 1a-d.

Asaphus barrandi, Geol. of Wis., Hall, 1862, Vol. 1, p. 41, fig. 4.

Ogygia barrandii, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 70.

Locality—Platteville, Wis.

Types—Am. Mus. of Nat. Hist.

Pemphigaspis bullata Hall = *Microdiscus ? bullatus*.

Ptychaspis explantus Whitfield. Potsdam.

Conocephalites (Ptychaspis ?) explanatus, Ann. Rept. Geol. Surv. Wis., Whitfield, 1879, p. 48.

Conocephalites (Ptychaspis ?) explanatus, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 181, pl. 1, figs. 27, 28.

Locality—Hudson, Wis.

Types—Univ. of Wisconsin.

Ptychaspis granulosa Hall = *Ptychaspis striata*.

Ptychaspis miniscænsis (Owen.) Upper Cambrian.

Dikelocephalus miniscænsis, Geol. Rept. Wis., Iowa and Minn., Owen, 1852, p. 574, pl. 1, figs. 3 and 12, and pl. 1A, figs. 4, 5.

Ptychaspis miniscænsis, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 171, pl. 6, figs. 41-46, and pl. 10, figs. 21, 22.

Obs. Probably the same as *Chariocephalus whitfieldi*.

Locality—Trempealeau, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychaspis minuta Whitfield. Upper Cambrian.

Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 55.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 186, pl. 1, figs. 25, 26.

Locality—Roberts Store, St. Croix Co., Wis.

Types—Univ. of Wisconsin.

Ptychaspis striata Whitfield. Upper Cambrian.

Dikelocephalus granulosus, Geol. Rept. Wis., Iowa and Minn., Owen, 1852, p. 575, pl. 1, figs. 5, ?, and 7.

Ptychaspis granulosa, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., 1863, p. 173, pl. 6, figs. 33-40.

Ptychaspis striata, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 12.

Locality—Trempealeau, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychoparia anatina (Hall.) Upper Cambrian.

Conocephalites anatinus, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 158, pl. 7, figs. 34, 35, pl. 8, fig. 29.

Ptychoparia anatina, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 12.

Locality—Trempealeau, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychoparia binodosa (Hall.) Upper Cambrian.

Conocephalites binodosus, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 160, pl. 7, figs. 47, 48.

Ptychoparia binodosa, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 12.

Locality—Osceola Mills, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychoparia calymenoides (Whitfield.) Upper Cambrian.

Conocephalites calymenoides, Ann. Rept. Geol. Surv. Wis., Whitfield, 1877, p. 52.

Conocephalites calymenoides, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 179, pl. 3, figs. 2-5.

Ptychoparia calymenoides, Monograph, U. S. Geol. Surv., Walcott, 1884, Vol. 8, p. 48.

Locality—Eau Claire, Wis.

Types—Univ. of Wisconsin.

Ptychoparia chippewænsis (Owen.) Potsdam.

Lonchocephalus chippewaensis, Rept. Geol. Surv. Wis., Iowa and Minn., Owen, 1852, p. 576, pl. 8, fig. 6, 14; and pl. 1a, fig. 9.

Ptychoparia chippewaensis, Bull. U. S. Geol. Surv., Vogdes, 1890, No. 63, p. 141.

Locality—Chippewa River, Wis.

Types—?

Ptychoparia connata Walcott. Upper Cambrian.

Proc. U. S. National Museum, Walcott, 1890, Vol. 13, p. 272, pl. 21, fig. 2.

Locality—Eau Claire, Wis.

Type—U. S. National Museum.

Ptychoparia diademata (Hall.) Upper Cambrian.

Conocephalites diadematus, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 167, pl. 7, figs. 36, 38a, and pl. 8, figs. 18, 21.

Ptychoparia diademata, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 12.

Locality—Marine Mills, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychoparia dorsalis (Hall.) Potsdam.

Conocephalites (Arionellus ?) dorsalis, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 222.

Ptychoparia dorsalis, Bull. U. S. Geol. Surv., Vodges, 1890, Vol. 63, p. 141.

Locality—Trempealeau, Wis.

Types—?

Ptychoparia eos (Hall.) Upper Cambrian.

Conocephalites eos, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 151, pl. 7, figs. 24, 25 and pl. 8, figs. 8, 9.

Conaspis eos, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 8.

Ptychoparia eos, Bull. U. S. Geol. Surv., Vodges, 1890, Vol. 63, p. 141.

Locality—Trempealeau, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychoparia eryon (Hall.) Upper Cambrian.

Conocephalites eryon, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 157, pl. 7, figs. 10-16, and pl. 8, figs. 16 and 31.

Ptychoparia eryon, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 12, Pt. 1, p. 12.

Locality—Trempealeau, and near La Crosse, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychoparia minor (Hall.) Potsdam.

Undetermined Trilobite, Geol. Recon., Chippewa Land Dist., Owen, 1848, p. 15, pl. 7, fig. 4.

Conocephalites minor, Trans. Acad. Nat. Sci., St. Louis, Shumard, 1863, Vol. 2, p. 105.

Conocephalites minor, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 149, pl. 8, figs. 1-4.

Ptychoparia minor Mono. U. S. Geol. Surv., Walcott, 1884, Vol. 8, p. 91.

Locality—Near Black River Falls, Wis.

Types—?

Ptychoparia nacta (Hall.) Upper Cambrian.

Conocephalites nactus, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863. p. 200, pl. 7, fig. 58.

Ptychoparia nacta, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 12.

Locality—Mouth of Black River, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychoparia nasuta (Hall.) Upper Cambrian.

Conocephalites nasutus, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 155, pl. 7, figs. 3-9.

Ptychoparia nasuta, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 12.

Locality—Kickapoo, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychoparia pero Walcott. Upper Cambrian.

Proc. U. S. Nat. Museum, Walcott, 1890, Vol. 13, p. 274, pl. 21, fig. 6.

Locality—Trempealeau, Wis.

Type—U. S. National Museum.

Ptychoparia perseus (Hall.) Upper Cambrian.

Conocephalites perseus, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 153, pl. 7, figs. 7-23, and pl. 8, fig. 33.

Ptychoparia perseus, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, p. 12.

Locality—Kickapoo, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychoparia quadrangularis (Whitfield.) Potsdam.

Conocephalites quadratus, Ann. Rept. Wis. Geol Surv., Whitfield, 1879, p. 47.

Conocephalites quadratus, Geol. of Wis., Whitfield, 1882, Vol. 4, p. 180, pl. 1, figs. 15, 16.

Ptychoparia quadrangularis, Bull. U. S. Geol. Surv., Vodges, 1890, Vol. 63, p. 144.

Locality—Eau Claire, Wis.

Types—Univ. of Wisconsin.

Ptychoparia shumardi (Hall.) Upper Cambrian.

Conocephalites shumardi, Sixteenth Ann. Rept. N. Y. State Cab. of Nat. Hist., Hall, 1863, p. 154, pl. 7, figs. 1, 2, and pl. 8, figs. 19 and 32.

Ptychoparia shumardi, Bull. Am. Mus. of Nat. Hist., Whitfield, 1898, Vol. 11, Pt. 1, p. 12.

Locality—Kickapoo and Marine Mills, Wis.

Types—Am. Mus. of Nat. Hist.

Ptychopyge ulrichi Clarke. Upper Cambrian.

Geol. and Nat. Hist. Surv., Minn., Clarke, 1897, Vol. 3, Pt. 2, p. 709, figs. 12, 13.

Locality—Mineral Point, Wis.

Types—Minn. State Museum.

Schmidtella crassimarginata Ulrich. Trenton (Ord.)

Amer. Geol., Ulrich, 1892, Vol. 10, p. 269.

Geol. and Nat. Hist. Surv., Minn., Ulrich, 1897, Vol. 3, Pt. 2, p. 640, pl. 43, figs. 42-44.

Locality—Mineral Point, Wis.

Types—U. S. National Museum.

Sphaerexochus romingeri Hall. Niagara (Sil.)

Geol. of Wis., Hall, 1862, p. 434.

Geol. of Wis., Whitfield, 1882, Vol. 4, p. 311, p. 21, figs. 1-3.

Locality—Racine and Wauwatosa, Wis.

Types—Am. Mus. of Nat. Hist.

Thaleops ovatus Conrad = *Illaenus ovatus.*

Tropidicaris sp. Cleland. Hamilton (Dev.)

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 146, pl. 44, fig. 9.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

Undetermined Trilobite Owen 1848 = *Anomocare hamulus.*

Undetermined Trilobite Owen 1848 = *Crepicephalus iowensis.*

Undetermined Trilobite Owen 1848 = *Ptychoparia minor.*

PISCES.

Cladodus sp. Eastman = *Cladodus monroei.*

Cladodus monroei Eastman. Hamilton (Dev.)

Cladodus sp., Journal of Geology, Eastman, 1899, Vol. 7, Pt. 3, p. 282.

Cladodus monroei, Journal of Geology, Eastman, 1900, Vol. 8, p. 36, fig. 2.

Locality—Milwaukee, Wis.

Type—Mil. Public Museum.

Dinichthys pustulosus Eastman. Hamilton (Dev.)

Bull. Museum of Camparative Zoology, Eastman, 1897, Vol. 31, Pt. 2, p. 38, pl. 3, fig. 4.

Obs. From the collection of the late Dr. F. H. Day, Wauwatosa, Wis.

Locality—Milwaukee, Wis.

Type—Museum of Comparative Zoology, Cambridge, Mass.

Gamphacanthus politus (Newberry.) Hamilton (Dev.)

Heteracanthus politus, Pal. Fishes of North America, Newberry, 1889, p. 66 pl. 21, figs. 4, 4a.

Gamphacanthus politus, First Appendix, North American, Geol. and Pal., S. A. Miller, 1892, p. 715.

Locality—Milwaukee, Wis.

Types—Univ. of Wisconsin.

Heteracanthus politus Newberry = *Gamphacanthus politus.*

Onychodus sp. Eastman. Hamilton (Dev.)

Jour. of Geol., Eastman, 1899, Vol. 7, Pt. 3, p. 283.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

Palæomylus greenei (Newberry.) Hamilton (Dev.)

Rhynchodus greenei, Mon. U. S. Geol. Surv., Newberry, 1889, Vol. 16, p. 51.

Palæomylus greenei, The American Naturalist, Eastman, 1898, Vol. 32, p. 545, fig. 48.

Locality—Milwaukee, Wis.

Type—Am. Mus. of Nat. Hist.

Phlyctænacanthus telleri Eastman. Hamilton (Dev.)

The American Naturalist, Eastman, 1898, Vol. 32, p. 550, fig. 49.

Bull. Wis. Nat. Hist. Soc., Teller, 1906, Vol. 4, Pt. 4, p. 162, figs. 1, 2, 3, 4, 5.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

Ptyctodus ferox Eastman. Hamilton (Dev.)

The American Naturalist, Eastman, 1898, Vol. 32, p. 480, figs. 35-40.

Obs. The specimen fig. 35 was loaned the Museum of Anatomy and retained by them without the consent of the collector.

Locality—Milwaukee, Wis.

Types—Fig. 35—Museum of Comparative Anatomy, Cambridge, Mass. Fig. 36—Mil. Public Museum. Figs. 37, 38, 39 40—Collection of Edgar E. Teller.

Rhynchodus sp. Eastman. Hamilton (Dev.)

Memoir. N. Y. State Museum, Eastman, 1907, No. 10, p. 72, pl. 1, fig. 6.

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 148, pl. 47, fig. 6.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

Rhynchodus excavatus Newberry. Hamilton (Dev.)

Rhynchodus excavatus, Geol. of Wis., Newberry, 1878, Vol. 2, p. 397.

Rhynchodus occidentalis, N. Y. Acad. of Science, Newberry, 1878, Vol. 1, p. 192.

Rhynchodus excavatus, Memo. U. S. Geol. Surv., Newberry, 1889, Vol. 16, p. 50, pl. 29, figs. 1, 1a.

Locality—Brown Deer, Wis.

Types—Am. Mus. of Nat. Hist.

Rhynchodus greenei Newberry = *Palæomylus greenei.*

Rhynchodus occidentalis Newberry = *Rhynchodus excavatus.*

Sphenophorus sp. Eastman. Hamilton (Dev.)

American Naturalist, Eastman, 1898, Vol. 32, p. 556.

Wis. Geol. and Nat. Hist. Surv., Cleland, 1911, Bull. 21, p. 157.

Locality—Milwaukee, Wis.

Type—Collection of Edgar E. Teller.

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