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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

EDITED BY THE SECRETARY

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The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6. 1857.

OFFICERS AND DIRECTORS.

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

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Chas. E. Monroe.

REGULAR MEETINGS.

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

PUBLICATION.

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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 5, New Series. **JANUARY, 1907.** **No. 1.**

PROCEEDINGS.

Milwaukee, Oct. 25, 1906.

Regular monthly meeting of the Society.

President Teller in the chair and 73 persons present.

Mr. Teller stated that there had been considerable comment on the part of various members of the Society regarding the advisability of holding monthly section meetings, and asked for expressions of opinion.

Dr. Barth moved that a section meeting be held on the second Thursdays of the months when regular meetings are held, and that these meetings be set aside for scientific discussion and restricted to such. Motion seconded and passed.

The following persons were named for membership:

Miss Ellen Torelle.

Mr. George Wetmore Colles.

Dr. Albert H. Brundage.

Mrs. A. Bernhardt.

These names were referred to the Board of Directors, who subsequently passed on them.

There being no further business, Dr. R. M. Strong, of the University of Chicago, spoke on the Colors of Birds.

The speaker said that in addition to their importance as characters in taxonomic work and in studies of evolution and heredity, the colors of birds are interesting because of numerous problems in physics that they present. Two categories of colors are recognized, viz: pigmental and structural. To the former belong black, red, orange, yellow, and green (occasionally). Structural colors include white, blue (except for one case of pigmental blue described by Häcker), and iridescent effects. White feathers owe their color to the entire absence of pigment. The whiteness of feathers is produced in the same way as the

whiteness of snow or of other transparent substances in a fine state of division. Iridescent effects and blues are due to obscure physical phenomena which are not entirely understood. Grays are produced by combinations of the conditions which produce black and white.

President Teller thanked Dr. Strong in behalf of the Society for his entertaining address and for his kindness in coming to Milwaukee to lecture before the Society.

The meeting then adjourned.

Milwaukee, Nov. 8, 1906.

Combined meeting of the Biological sections.

President Teller in the chair and 12 members present.

As no topics for discussion had been announced and no program prepared, those present were loathe to start the proceedings, Finally, Dr. Graenicher called attention to two interesting cases of variation or mutation of instinct among bees. The first was *Alcidamea producta*, a species which hollows out stems, and the second a specimen belonging to a species of *Megachile*. Both of these normally close the nest with a plug of malaxated leaf pulp, but in these two cases, out of a large number of nests observed, the female bees had used pieces of stone or gravel mixed in the pulp. He suggested that this was perhaps a mutation in habits, but that it was more likely an atavism, since the use of stones as building material was probably more primitive than the employment of leaves cut from plants.

Mr. Brues said he agreed that this might be looked at as a mutation of habit, but believed it was undoubtedly a reversion. He called attention to the bee genus *Anthidium*, certain species of which use plant material for their nests, while other very closely related ones utilize stone or gravel entirely, suggesting that the variation was perhaps not as profound as it would seem at first sight. Mr. Ward said that variations in nest-building among birds were common and often as striking as the cases among bees mentioned by Dr. Graenicher. He cited the Caspian Tern, a species which he had seen utilizing shells to line its nests, a very unusual habit, since it usually uses no lining except a little plant matter. At the same time, he said, the species had departed from its usual solitary habits and was nesting in great numbers, and with a second regularly gregarious species, the Herring Gull.

Mr. Teller then exhibited some specimens of the fossil fish-spine, *Phlyctænacanthus telleri* Eastman. He called attention to the way in which the two spines fitted together and to the beautiful way in which the structure was preserved. Mr. Colles asked if any of the original organic matter was still present in such specimens, and Mr. Teller seemed inclined to believe that there was still some of it present. Mr. Colles thought it extremely doubtful, and believed that the original organic molecules were gone in their entirety to be replaced by those of inorganic origin. Mr. Brues mentioned a section of muscle taken from a fossil shark which he had seen, that when microscopically examined could scarcely be distinguished from poor sections which he had seen prepared in the laboratory by students unfamiliar with histological methods. He also said that organic matter and quite probably organic pigments and chitin were frequently preserved as fossils, citing a number of fossil Hymenoptera from the Tertiary rocks of Colorado. Here browns, pale colors and blacks are often distinctly differentiated and even the metallic blue characteristic of some species. Mr. Colles doubted the presence of the easily disintegrated chitin or organic pigments as such, but agreed that carbon at least must be present, but probably uncombined, and believed that the colors were due to some secondary cause.

After some discussion of a more general nature the meeting adjourned with the hope expressed that a special program might be prepared for the next section meeting.

November 22, 1906.

Regular meeting of the Society.

President Teller in the chair and 40 persons present.

Dr. E. C. Case lectured on the "Geological Development of Scenery," illustrated by stereopticon slides. Dr. Case described the several successive stages in erosion by rivers, aided by diagrams and photographs of natural scenery. Weathering and chemical disintegration as factors were also considered.

The general discussion was followed by a more detailed consideration of each individual factor, a series of slides illustrating their action and the various forces that may modify them.

The meeting then adjourned.

December 13, 1906.

Combined meeting of the Biological sections.

President Teller in the chair, and Messrs. Barth, Brues, Colles, Doerflinger, Finger, Graenicher, Russell and Ward present.

Dr. Barth opened the discussion with his observations during the past year on the habits of wasp of the genus *Crabro* observed in the vicinity of Milwaukee. The species collected were wood boring in habits, but Dr. Barth stated that very satisfactory breeding tubes could be made from small glass vials, a trifle longer than the natural cell, but of the same diameter. The larvæ are not easy to raise in captivity as the change of environment seems to affect them greatly. The number of flies carried in varies among individuals of the same species, the number being to some extent proportionate to the size of the flies. Some wasps seem to prefer large flies which they pack loosely in the brood-cell, while others select small ones which they store tightly together. He found that the duration of the egg stage was not always the same nor the time required for forming the cocoon. In carrying the captured flies the Crabros usually grasp them between the hind legs with some assistance from the middle pair of legs. They hold the prey very tightly, going with it into the nest head first. On a number of occasions after opening nests he found that the flies were able to move about and even crawl away. The fly upon which the Crabro's egg is placed was, however, never found to be alive. Dr. Barth also gave a list of the species of flies carried in, mentioning especially a Tachina fly (*Winthemia 4-pustulata*), and two species of Acroceridæ belonging to the genus *Oncodes*. Regarding the arrangement of the cells and galleries in the wood, Dr. Barth said that they were usually spiral, not always following the line of least resistance. There is usually a main gallery with smaller branches leading to the cells. The stinging habits of the Crabros were found to be simple, the fly being stung on the ventral surface of the thorax. When stuck by a needle in the same place, the speaker found that they were affected in nearly the same way, later reviving. When returning with their flies, the Crabros are never in a hurry to enter the nest, thus giving ample time for parasites to lay their eggs. In some cases Dr. Barth was sure the parasite must enter after the Crabro egg had been already laid. He had a number of parasites obtained from the various Crabros studied.

After the speaker had finished his remarks, Dr. Graenicher said that he had been rather surprised to hear that species of Tachina flies were captured by the Crabros, as he had often observed how easily

certain of them eluded the sand-wasps belonging to the genus *Bembex*. Mr. Brues remarked that *Winthemia 4-pustulata* was an unusually weak and soft-bodied Tachinid. Mr. Colles asked if it were always the case that parasites were never regularly captured or destroyed by their hosts. This occasioned some discussion. The general opinion was that Tachinids and other parasites as well were never, or at least very rarely captured by the host species, no matter how annoying they might be, or how many attempts were made. Mr. Brues suggested that this was a necessary provision for the perpetuation of the parasitic species and that it must be very strongly accentuated by natural selection.

Dr. Graenicher next described a peculiar variation of instinct in a species of Crabro that he had observed several years ago late in the season. The female in question had built several nests, one on top of another in a hollow stem without laying any eggs in any of the cells. He also spoke of certain experiments by the French naturalist Fabre who had succeeded in getting certain bees to build nests in glass tubes in his study. He suggested that this would be an interesting way to study the habits of Dr. Barth's Crabros, if they could be induced to nest under such conditions.

Mr. Ward then asked if as a general rule the time required for the eggs to hatch, when incubated by the parent birds and in artificial incubators, was the same. Messrs. Barth, Graenicher, Colles, Russell and Brues joined in the discussion which followed. The general agreement was that only slight differences in the incubation period were produced by variable temperature.

The meeting then adjourned.

Milwaukee, December 20, 1906.

Regular monthly meeting of the Society.

President Teller in the chair and about 60 persons present.

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

Professor C. O. Whitman, of the University of Chicago, gave the lecture of the evening on "The Evolution of Species," the text of which appears on the later pages of the Bulletin.

After the lecture President Teller thanked Professor Whitman in behalf of the Society for his kindness in presenting his interesting talk.

The meeting then adjourned.

The following papers were ordered printed by the board of directors:

THE ORIGIN OF SPECIES.*

By Charles Otis Whitman.

Much has been said and written on the subject of the origin of species, but tradition was first to claim possession of the secret, and to veil it with such unapproachable guile of devination, that the world waited until the middle of the nineteenth century for a Darwin to vindicate the right of investigation. The many-sided problem was at length revealed in 1859. It was a problem to challenge at once the most lively interest not only among biological investigators, but in every department of science and thought. The half century since the appearance of Darwin's great work on the "Origin of Species," has effected a more wonderful revolution in our modes of thought and investigation than anyone can realize who has not lived in close touch with every year's progress.

The dogma of special creations has exhibited most stubborn tenacity, but it has slowly yielded to the principle of progressive evolution guided by the operation of natural laws. The violent shock experienced by theologists at seeing natural selection set in the place of Creative power, the revulsion at the thought of universal kinship in the organic world, especially at the doctrine of man's descent from lower forms of life—all this lingers only as reminiscence, and we now find satisfaction in viewing the history of our race as a grand series of ascending stages, and take more pride in a rising ancestry than in a fallen one.

The revolution in sentiment has well-nigh freed us from supernaturalism. Investigation has multiplied and intensified at an increasingly rapid rate, but the problem of the origin of species has not been more than partially solved. In fact, it seems as if Darwin and Wallace, Nägeli, Haeckel, Dohrn, Weismann, De Vries and a host of other investigators, had grappled with an all-embracing problem—a problem of problems that must engage the best energies of all the sciences for centuries yet to come.

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*The introduction and abstract of a lecture delivered before the Wisconsin Natural History Society by Professor Whitman at the meeting of December 20, 1906.

The era now dawning presents us with two leading rival theories. From Darwin and Wallace we have received the theory of *Natural Selection,* which has been powerfully supported by Spencer, Huxley, Haeckel, Weismann, Dohrn, and many others. This theory and its triumphs are familiar history.

In 1901, Hugo De Vries, a distinguished botanist of Amsterdam, brought forward his famous Mutation-theory, based upon *"Experiments and Observations on the Origin of Species in the Plant Kingdom."*

This work of De Vries is truly a great achievement, rising above any other that has appeared since Darwin's "Origin of Species." It is not only comprehensive in scope, consistent in its logic, and charming in style, but it is also epoch-making in its method of research. In this latter respect it sets an example which is having a world-wide influence—emphasizing as it does the supreme importance of *studying living organisms and of keeping observations and experiments running continuously through a long sequence of generations.*

This is the method of the new era in biology—steady unbroken continuity in experiment under controlled culture. Here the example of Mendel, De Vries, and a few others, will be potent for many years to come.

As to the real merit of the theory of mutation, only extended research can bring a final decision. In dealing with such a theory, we must grasp clearly its fundamental conceptions. The whole superstructure stands or falls with them. The central foundation-idea of this Mutation-theory is that of *unit-characters.* The species represents always a definite number of distinct unit-characters, each as distinct and independent as are the elements of a chemical compound. Consequently all upward progress in the organic world depends upon *adding new unit-characters.* Furthermore, these unit-characters are held to be essentially unchangeable, and hence the species compounded of them are viewed also as essentially immutable. A unit-character, it is true, may undergo transmutation, i. e., it may become a wholly new unit-character. Such transmutation, however, is always *sudden,* never by slow *intermediate* degrees. Any slow and gradual transition, such as Darwin and Wallace maintained, never under any circumstances, according to De Vries, could lead to the formation of a new species. The utmost that could be attained by such variation

would be only an improved race, i. e., merely a better kind of the same species—a kind that remains better only so long as cultivated under favored conditions, reverting to the common level as soon as left to itself under normal conditions.

To remove any doubt as to these points, let me cite a few passages from De Vries:

(1) "I designate as mutation-theory the proposition that the characters of organisms are built up of units sharply differentiated one from another. These units may be combined in groups, and the same units and groups occur in allied species. *Transitions, such as we so often see in the external forms of plants and animals,* do not exist between these units any more than between the molecules of chemistry." Vol. 1, p. 3.

(2) "In the field of the doctrine of descent, this principle leads to the conviction that species have not arisen one from another by *flowing transitions,* but by distinct steps. Every new unit added to the older units, forms a step, and separates the new form, as an independent species, sharply and completely from the species out of which it arose. The new species thus comes into being at a single stroke. *It arises from the earlier form without any visible preparation, without transitions.*"

(3) "The mutation-theory, in my opinion, is supreme not only in the doctrine of the origin of species, but also in the whole field of hybridisation. Here it conducts us to the principle, that not the species, but *the simple specific characters,* the so-called elements of the species, *are the units with which we deal in hybridisation.*"

(4) "Every character, it is true, arises from one already present, not however from its *normal variation,* but through a change which, however small, is yet sudden. Provisionally, this change may be most simply likened to *a chemical substitution.*"

In his preface, p. IV., as follows:

(5) "These jumps, or mutations, of which sport-variations are the best-known examples, form a special part of the subject of variation. They occur *without transitions,* and are *relatively rare,* while ordinary variations are *continuous and always present.*

(6) "The whole subject of variation thus divides into two parts, one of which deals with the ever present, individual, or fluctuating variation, the other, with mutation. Phenomena of the first class obey the well-known laws of probability and depend

essentially upon food-conditions; upon them depends the formation of improved races, especially in agriculture. Not only *species,* but also *varieties* arise by mutation."

(7) "Species have not arisen through gradual selection, continued for hundreds or thousands of years, but by jumps (*stufenweise*) through sudden though small, transformations. In contrast with variations which are changes advancing in a linear direction, the transformations to be called mutations diverge in new directions. They take place, then, so far as experience goes, *without definite direction.*" (Vol. 1, p. 150).

(8) "Species-forming variability must be orderless. The assumption of a definite variation-tendency which would condition, or even favor, the appearance of adaptive modifications, lies outside the pale of the natural science of to-day. In fact, the great advantage of Darwin's doctrine of selection lies in this, that it strives to explain the whole evolution of the animal and plant kingdoms without the aid of supernatural presuppositions. According to this doctrine, species-forming variability goes on without regard to the qualification of the new species for maintaining themselves in life. It simply supplies the struggle for existance with the material for natural selection. Whether this selection takes place betwen individuals, as Darwin and Wallace supposed, or decides between whole species, as the mutation-theory demands, ultimately it is, in either case, simply the ability for existence under given external conditions that decides upon the permanence of the new form." (p. 180).

The fundamentals in the mutation theory, then, are:

1. Every species consists of a *fixed number* of *unit-characters.*
2. The species and the component units are alike sudden in origin and unchanging in type.
3. Old characters may be suddenly transmuted into new ones, but between the two there is always a gulf of absolute discontinuity, with no possible bridge of gradual modification.
4. Continuous intergradations may connect a species with an improved race, but never one species with another species.
5. Species-formation is kaleidoscopic, i. e., chance-wise in direction, never resulting from a tendency to vary in any one determinate direction.
6. Natural selection can not give origin to new species; it can only weed out from those already in existence such as are incapable of sustaining themselves.

Perhaps it may seem rash to assert that in no one of these six points does the mutation-theory hit the mark; nevertheless, that is the conviction from which I see no escape.

The one error that vitiates all these contentions is that of unit-characters, each of which is supposed to enjoy a sort of independent existence, although in correlation with the other units of the organism. Such a conception implies that every character of the adult organism pre-exists in some rudimentary form in the germ-cell from which the organism develops. These assumed rudiments of unit-characters must be as fixed in number and constitution in the fertilized egg as in the adult. Moreover, unless we assume that these units may mutate at any stage of development, we must suppose that all mutations destined to appear in the adult must originate in the very first stage of existence of the primordial units. Thus mutation would be carried back to the pre-mutation forever beyond the reach of investigation. Such conceptions, help us in no wise to understand the origin of species. To claim that we can actually see mutation performed, is the climax of absurdity.

De Vries has seen offspring differing more or less constantly from the mother plants. These visible differences are referred to invisible differences in one or more of the invisible unit-characters conjectured to exist in the seed before germination. The initial differences, in which, *ex hypothesi*, the whole mutation is given, De Vries has never seen and of course never expects to see. If there be any such thing as mutation, as conceived by De Vries, it is safely beyond human ken, and unapproachable through experimental investigation.

This theory of mutation coincides well with Bateson's doctrine of *discontinuity* in evolution and development. Discontinuity in evolution has all the elusiveness of mutation. The discovery of such a negative is tantamount to a failure to discover anything. A new form appears; it differs in one or more respects from its parents. The difference is labelled a discontinuity, i. e., the offspring is assumed to have obeyed the law of heredity in so far as it resembles the parental stock, and to have jumped hereditary bonds in so far as it departs from such resemblance. The jump is a break in the chain—a void where eyesight fails and all sorts of ghost-stories are accepted in lieu of reliable knowledge of all the antecedent conditions represented in the ancestry.

The less we know of the previous history of new forms, the

more we rely upon the testimony of casual observers who merely report what they stumble upon without knowing the requirements of thorough investigation, the more "discontinuities" and mysterious saltations we encounter. One continuity properly demonstrated, outweighs myriads of mythical discontinuities.

It is well to bear in mind always that there is no evolution of organisms apart from the development of individuals. *The evolution of a species is but the summation of achievements in individual development.* Consequently, if we would know whether evolution is discontinuous or continuous, we must get our direct evidence from development as we now find it going on. If in any series of developmental stages, we find a single stage that is not causally connected with preceding stages, we may pause and ask, what is the use of investigating amid miracles of discontinuity?

In embryological development we find continuity and order of sequence regnant throughout. There are no kaleidoscopic leaps to interrupt the sequence. The course followed is, in the main, the one anticipated in the hereditary foundations of the germ. The flow of events may swerve this way or that, but nowhere is there a gulf breaking the connection between antecedents and consequents.

Of course species are sooner or later separated by gaps. But are these gaps present *ab initio?* The claim of initial discontinuity is usually founded on so-called "sports," the preparatory stages of which were overlooked, or very imperfectly investigated. This is not the kind of evidence on which to establish a general theory. If discontinuity or mutation were the law in the origin of species, *continuity should not be expected in a single case,* as De Vries has clearly perceived. Hence he has taken care to deny the possibility of getting new species through ordinary variation. In such variation continuity is undeniable. Hence the whole reliance is placed on "Sports," and "improved races," however true they breed, are not admitted to the rank of species.

We see then how very important it is to make our investigation of the origin of species exhaustive. We have to select well our material for study, and then attend closely to some one character at a time. This means that we must work with living forms, which we can keep under unbroken control from generation to generation.

Then we must not stop here, but extend our observation over

as many allied species as possible, and endeavor to get the past history of the character. To experiments in breeding we must add those of crossing, as in this way we can best see whether a character is an indivisible unit, that admits of no transmutation by continuous modification. It is by such study that we may arrive at most important laws of heredity. In fact we study the origin of species, not as a curiosity, but as a practical problem, the solution of which must contribute eventually to human progress.

With these introductory remarks, the lecturer turned to the consideration of a few specific characters which are found in various species of pigeons.

The wing-bars found in domestic races and in the wild Rock Pigeons, were taken as an example to illustrate orthogenetic evolution by *gradual progressive modification.* It was shown first of all that the *two-barred* condition seen in the typical *Columba livia* is derived from the *checkered* condition seen in the wild *C. affinis.* It was then shown that this mode of derivation is wide-spread among wild species of pigeons, the bars always resulting from a reduction of the checkers, proceeding from before backward, the direction being the same as that of embryonic development.

Experiments with domestic pigeons demonstrate that it is easy to reduce the checkered type to four bars, then to three, two, one, and finally, to a uniform gray color without a single bar. Another set of experiments, to test the possibility of reversing the process, by advancing from the two-barred condition to the uniformly checkered type, showed that the direction could not be reversed.

It was next shown that among wild species of pigeons, we have the same law of orthogenesis illustrated over and over again, in almost endless variety of conditions. The Wild Passenger Pigeon, the Mourning Dove, the Zenaida, the Ground Dove of Florida, and a number of Old World species, were shown in colored drawings on charts.

After tracing wing-bars of the most diverse kinds to checkers, the origin of the latter from a still earlier and *universal avian character,* was explained. This earlier color-mark still persists in many pigeons, and other avian types, and is well preserved in the oriental Turtle Dove of Japan and China.

It consists of a single dark spot occupying the centre of the exposed part of each feather. In the course of evolution, this spot has been divided into two lateral spots by the disappearance of

pigment along the shaft, beginning at the apex of the feather and advancing gradually inward. The old Turtle-Dove character thus passes by a continuous process of division into the Rock Pigeon pattern, consisting of two checkers on each feather, more or less completely separated. The evidences showing such a gradual transmutation are still to be seen, and in such profusion as to wholly exclude doubt. Hundreds of species have been formed in this simple way, leaving no room for the claim of sudden, non-transitional mutations.

The *transitional* stages between the Turtle-dove pattern and the checkered pattern of the Rock pigeons, are exhibited not only as we pass from one species to another, but often as we advance from the juvenal to the adult plumage; and frequently they may be seen in different parts of one and the same individual plumage.

A still older character than the Turtle-dove spot is seen in the cross-bars, or *fundamental bars*, that appear to mark all feathers of all species of birds. These bars were first noticed in pigeons in the summer of 1903, and were soon found to be common to all species of pigeons and birds in general. From these fundamental feather-bars or their secondary derivatives, a multitude of specific characters have been evolved by gradual modification. The continuity in the evolution of some of these characters can be experimentally demonstrated. The little Diamond Dove (*Geopelia cuneata*) of Australia, owes its small white spots (two in each feather) to these bars. The transitional stages connecting the spots with the bars are not wholly given in passing from the juvenal to the adult plumage. But if we pluck a few of the juvenal feathers at suitable intervals, their places will be filled by new feathers of different ages, and in this way we may get the stages *intermediate between the bars of the young and the spots of the adult.* Thus we see that *the adult pattern, which normally appears to come in as a striking mutation, by a single jump, is only an end-stage in a continuous process of differentiation.* So it is everywhere. Suppression of stages in ontogeny looks like saltations; but whenever we can get at the *history of the character,* we find the continuity comes to light.

The characteristic secondary cross-bars of many races of the common fowl, pheasants, Guinea-fowl, ducks, woodpeckers, etc., have been moulded more or less directly out of, or upon these fun-

damental cross-bars,* which appear to underlie all avian color-marks even the "universal avian character" before mentioned, and its latest derivatives.

The passage from the juvenal to the adult plumage often presents us with two or more quite strongly contrasted color-patterns. The mutationist might see in this a striking illustration of discontinuity in the evolution of species.

In the normal course of events, the gap is often very wide between two successive patterns, but closer study and experiment teach us that, while the visible stages may seem entirely disconnected, they are in reality genetically bound together by a continuous differentiating process, or a system of processes. In most cases, perhaps in all, the apparent discontinuity in the phenomena means nothing more than a discontinuity in our knowledge.

Several other specific characters, usually regarded as "sports" or "mutations" were considered, and the continuity of their development from minute incipient stages are clearly established.

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*The discovery of the universality of this character and its far-reaching significance as an initial foundation for numerous specific characters, suggested the need of a thorough investigation to determine its nature and mode of development. This task has been undertaken by Mr. Oscar Riddle, who has not only reached a physiological explanation of the character, but has fully confirmed and established the following anticipation I ventured to make in 1903:

"Allowing that the feathers of the common pigeon get their full length in four weeks, and that the terminal half of the feather (on which the bars are distinct enough to be counted) is formed in fourteen days, it is found that *the number of bars corresponds nearly to the number of days of growth.* If this be so, then the bars would be zones of daily growth (light = day; dark = night, or *vice versa*)."

WISCONSIN FLOWERS AND THEIR POLLINATION.

By S. Graenicher.

MELANTHACEÆ, LILIACEÆ AND CONVALLARIACEÆ.

The plants dealt with in this paper belong to the order of Liliaceæ as defined by Gray in his Manual of Botany, but according to the classification adopted by Britton and Brown they have been distributed among the three families named above. The genera are treated in the same sequence as they appear in "Britton's Manual of the Flora of the Northern States and Canada," and the same nomenclature has been adopted.

Before considering the pollination of each species I shall outline in advance some of the results obtained.

An arrangement of the twenty-three species according to the order in which the flowers make their appearance furnishes the following list.*

1. Trillium nivale, March 26—April 27.
2. Erythronium albidum, April 20—May 15.
3. Erythronium Americanum, April 25—May 19.
4. Uvularia grandiflora, May 5—June 5.
5. Trillium grandiflorum, May 6—June 3.
6. Vagnera stellata, May 13—June 8.
7. Trillium recurvatum, May 15—June 1.
8. Salomonia biflora, May 17—June 10.
9. Trillium erectum, May 19—June 1.
10. Asparagus officinalis, May 20—October 1.
11. Trillium cernuum, May 22—May 27.
12. Streptopus roseus, May 23—June 7.

*In cases of insufficient observation the few dates on which the flowers were observed are given.

13. Unifolium Canadense, May 27—June 21.
14. Vagnera racemosa, June 2—June 29.
15. Vagnera trifolia, June 3 and June 5.
16. Clintonia borealis, June 3 and June 5.
17. Salomonia commutata, June 7—July 3.
18. Tofieldia glutinosa, June 15—July 18.
19. Allium Canadense, June 19—July 17.
20. Lilium umbellatum, June 20—July 16.
21. Lilium Canadense, July 2—July 28.
22. Allium tricoccum, July 11—August 15.
23. Allium cernuum, July 15—August 29.

In the early part of April the season of our entomophilous flora is ushered in by the appearance of the small-flowered and low-stemmed *Trillium nivale,* and from this time on there is a gradual increase in the number of the above named species in blossom until about May 27, when ten species have their flowers open together. After this maximum has been reached a gradual decrease in the number sets in until around the middle of July, when *Allium cernuum,* the latest of our native species, makes its appearance. The maximum just referred to corresponds with the maximum of the spring group of Andrenine bees (1) at the end of May and the beginning of June. By consulting the lists of visitors appearing further on in the account given of the pollination of the respective flowers we find that a number of the species representing the maximum of the spring group of those short-tongued bees appear as visitors of *Uvularia grandiflora, Vagnera stellata, V. racemosa* and *Streptopus roseus,* all of them in blossom at the beginning of June.

In the following table the flowers are placed in the classes of entomophilous flowers, as proposed by Hermann Mueller (2), and the number of insect visitors representing the different types is given.

1. S. Graenicher. The relations of the Audrenine bees to the entomophilous flora of Milwaukee County. Trans. Wis. Acad. Sc. A. and L. Vol. XV. Part I. pp. 92-93—(1905).

2. Herman Mueller. Alpenblumen, pp. 479-511.

	Bees.	Flies.	Butter-flies.	Other Insects.	Total
Pollen-flowers—					
Trillium nivale	.....	.....	.....	.....	.....
" erectum	1	.....	.....	.....	1
" recurvatum	....	1	.....	.....	1
Vagnera racemosa	8	11	.....	9	28
Unifolium Canadense	2	5	.....	2	9
Flowers with exposed nectar—					
Vagnera stellata	18	22	2	2	44
" trifolia	.....	.....	.....	2	2
Tofieldia glutinosa	2	9	2	2	15
Flowers with concealed nectar—					
Trillium grandiflorum	2	.....	.....	.....	2
" cernuum	.....	.....	.....	.....	.....
Allium Canadense	16	15	.....	8	39
" tricoccum	9	3	.....	.....	12
" cernuum	12	1	1	.....	14
Bee-flowers—					
Erythronium albidum	4	.....	.....	.....	4
" Americanum	4	.....	.....	.....	4
Uvularia grandiflora	9	1	.....	.....	10
Salomonia biflora	4	.....	.....	.....	5 (1 bird)
" commutata	3	.....	.....	.....	4 (1 bird)
Asparagus officinalis	8	.....	.....	.....	8
Streptopus roseus	1	.....	.....	.....	1
Clintonia borealis	4	.....	.....	.....	4
Butterfly-flowers—					
Lilium umbellatum	1	.....	3	.....	4
" Canadense	2	.....	1	.....	3

POLLEN FLOWERS.

This class comprises the flowers which, on careful examination do not reveal a trace of nectar, and are therefore visited on account of their pollen only.

Three species of *Trillium* figure in this class while the two remaining ones of our flora are nectar-producing, and are referred to the flowers with concealed nectar. The flowers of all of these species are more or less showy, and well supplied with pollen, and still they are so rarely visited as to cause us great surprise. The

large-flowered and sweet-scented *T. grandiflorum* with a fair supply of nectar does not make an exception in this respect, not even in localities where the flowers appear in such number as to make them conspicuous to the human eye from a considerable distance. While discussing the variation in color of the flowers of *T. erectum* Robertson (3) expresses the opinion that the greenish variety is more or less degraded, and he states that "the flower seems to be losing its hold on insects and to form a transition between the other entomophilous species of *Trillium* and the still more degraded *T. sessile* and *recurvatum*." Judging from the observations made in our region as elsewhere it might appear as if our white species of *Trillium* were altogether either repulsive or at least poorly attractive to insects, possibly on account of some peculiarity of odor. At any rate they do not seem to depend to any extent on cross-pollination, and are all well prepared to insure spontaneous self-pollination.

In *Vagnera racemosa* and *Unifolium Canadense,* the two other species of pollen-flowers the absence of the higher bees (Apidæ) among the visitors is noticeable. Pollen-collecting short-tongued bees (Andrenidæ) and pollen-eating flies are the principal pollen-distributors, these insects furnishing about 68 per cent of the entire number of visitors of both flowers considered together.

FLOWERS WITH EXPOSED NECTAR.

We have here, as usually in flowers of a simple structure and with exposed nectar a rather varied gathering of insects with a strong preponderance of short-tongued bees and flies, 72 per cent. of the totality of the visitors of the three species belonging to these two groups of insects.

FLOWERS WITH CONCEALED NECTAR.

The two species of *Trillium* have been considered above together with the species of this genus among the pollen-flowers.

In our three species of *Allium* we are dealing with three flowers differing in structure, and accordingly attracting a somewhat different set of visitors. *A. Canadense* the earliest among them represents the lowest type in which the nectar is not deeply concealed,

3. Chas. Robertson. Flowers and insects. XVI. Bot. Gaz. XXI. p. 272 (1896).

while in *A. cernuum* we have at the same time the latest and the more specialized flower with the nectar hidden at the bottom of a narrow tube. *A. tricoccum* is intermediate between the other two. The percentage of bees for the three species is as follows:

A. Canadense 41%
A. tricoccum 75%
A. cernuum 86%

The reddish-purple color and the nodding position of the flowers of *A. cernuum* together with the presence of a tube leading down to the nectar all suggest an adaptation to bees, and correspondingly we have a high percentage of bees attending them. The tube is rather short and this species seems to be transitional between the flowers with concealed nectar and typical bee-flowers.

BEE-FLOWERS.

They are eight in number, all of them with pendulous flowers, and they show a great difference in color, greenish, white, yellow and rose being represented. A glance at the table shows to what extent these flowers receive the attention of bees, other visitors being nearly excluded. The large flowers of *Erythronium, Uvularia, Salomonia* and *Clintonia* are bumble-bee flowers, while *Asparagus officinalis* and *Streptopus roseus* may be regarded as adapted to the smaller bees.

The visits of our humming bird to the flowers of *Salomonia biflora* and *S. commutata* are noteworthy. Birds are known to be attracted especially by bright red colors, and in our region *Castilleja coccinea, Aquilegia Canadensis, Impatiens biflora* and *Lobelia cardinalis* are considered characteristic bird-flowers, but our humming bird (*Trochilus colubris L.*) also visits various flowers of other color than red, and its presence at the green flowers of *Salomonia* seems to indicate that in this respect a tubular or similar structure of a flower is of as much importance as the color.

BUTTERFLY-FLOWERS.

The lilies of our region are undoubtedly adapted to butterflies, and *Argynnis cybele* one of our most common butterflies seems to be the most frequent visitor of both of the species. In these flowers a great quantity of pollen is produced by the large anthers, and this explains the comparatively frequent visits of pollen-collecting bees of the genera *Augochlora* and *Halictus.*

FAM. MELANTHACEÆ.

Tofieldia glutinosa (Mich.) Pers. Glutinous Tofieldia.

We encounter this species forming patches in damp places on the clay-bluffs along Lake Michigan north of Whitefish Bay, and blooming from about June 15 to July 18. The inflorescence is a raceme of 3 to 4 cm. length at the end of a scape which is 3 to 4 dm. long, and which is covered nearly for its entire length with viscid glands. The white flowers with a diameter of 9 mm. are directed somewhat laterally. They are arranged in groups of three, and those at the top of the inflorescence are the first to open. The perianth-leaves do not spread entirely in the open flower, and the six stamens which are 4 mm. long occupy an intermediate position between the pistil and the perianth-leaves. The yellow anthers open introrsely one by one. They are slightly surpassed by the three short branches of the style which by bending outwards to some extent place their stigmatic surfaces in the way of insect visitors. These flowers are homogamous. A drop of nectar is secreted near the base of the ovary in each of the septal furrows, and when the amount increases it gathers between the ovary and the broadened base of the opposite filament. After fertilization has been accomplished the pedicel undertakes an inward movement and presses the ovary against the stem. Along with this movement a reddish-purple coloration of the upper parts of the ovary, branches of the style and tips of the persistent perianth-leaves sets in resulting in a color-contrast between the top of the inflorescence and its lower region where the flowers are still or hardly in bloom. The flowers are sufficiently visited by insects to insure either self or cross-pollination, and spontaneous self-pollination from the falling of pollen on the stigma is barely probable since the latter is usually not situated directly below an anther. A small-sized insect when sucking nectar is liable to bring one side of its head or thorax in contact with an anther, and the other side with a stigma, and a subsequent visit to another flower may result in cross-pollination. The following visitors were observed on the flowers:

A. Hymenoptera

Apidæ: (1) *Apis mellifera* L. worker, s.; Andrenidæ: (2) *Halictus zephyrus* Sm. female, s.; Vespidæ: (3) *Polistes pallipes* St. Farg., s.

B. Diptera

Bombyliidæ: (4) *Anthrax sinuosa* Wied.; Syrphidæ: (5) *Syrphus americanus* Wied.; (6) *Allograpta obliqua* Say; (7) *Mesogramma marginata* Say; Tachinidæ: (8) *Exorista nigripalpis* Town.; (9) *Archytas analis* Fabr.; Sarcophagidæ: (10) *Sarcophaga helicis* Town.; Muscidæ: (11) *Lucilia sylvarum* Meig.; (12) *L. sericata* Meig.;—all s. or f. p.

C. Lepidoptera

Rhopalocera: (13) *Pontia rapæ* L.; (14) *Phyciodes tharos* Dru.—all s.

D. Coleoptera

Mordellidæ: (15) *Mordellistena comata* Lec. s.

This list is similar to that obtained by H. Mueller (4) for *Tofieldia calyculata* Wahlenberg in the Alps, viz: 1 bee, 6 flies, 3 beetles, 3 butterflies and 1 ant. As regards the latter insect it is interesting to note that in our species of Tofieldia the viscid glands along the stem do not prevent the ants from reaching the flowers, although such arrangements are generally supposed to protect the flowers from these and similar intruders. Two species of ants *Formica fusca* L. var. *subsericca* (Say) Emery and *Cremastogaster lineolata* (Say) Emery were seen crawling on the flowers, and feeding on nectar.

Uvularia grandiflora J. E. Smith. Large-flowered Bellwort.

The blooming period extends from May 5 to June 5. Robertson (5) has made us acquainted with the mode of pollination of this species in southern Illinois, and little is to be added from observations on flowers of our region. The one or two pendulous flowers have a length of 4 cm. In the newly opened ones the twisted perianth-leaves are close together and only bees of large size (bumble-bees) are able to force their way in, but later on especially in warm weather, the flower through the loosening of

4. Herm. Mueller. Alpenblumen pp. 39-40. See also P. Knuth. Handbuch der Bluetenbiologie. Vol. II, p. 516.

5. Chas. Robertson. Flowers and insects. XVI. Bot. Gaz. Vol. XXI. pp. 270-271. (1896).

the perianth-leaves becomes more bell-shaped, and allows smaller bees to gain access to the pit-shaped nectaries, one of which is situated at the base of each of the perianth-leaves. As a rule the three branches of the style are about 5 mm. shorter than the six stamens with their anthers of 15 mm. length, and they bend outward between the latter so as to place their stigmas in the path of the insects that are pushing their mouth parts up towards the nectaries.

When emptying their pollen the anthers begin to open at the base, and the slit gradually progresses downwards (in the pendulous flower) and reaches the branches of the style. At this juncture spontaneous self-pollination can take place in the homogamous flower, but previous to this an insect may have effected cross-pollination. In exceptional cases the branches of the style are longer and surpass the anthers entirely, and spontaneous self-pollination is rendered less probable. The flowers are without any odor.

The principal pollinator in our region is the female bumblebee *Bombus americanorum Fabr.*, but the visits of the smaller bees, especially those of the genera *Osmia* and *Andrena* are undoubtedly also effective. Two specimens of a Syrphid-fly *Chilosia cyanescens Loew* differed in their behavior on the flowers. One of them inserted its proboscis from the outside between two perianth-leaves at their bases, and obtained nectar without rendering any services to the flower. This was done repeatedly. The other one was feeding on pollen while hanging on to the anthers, and probably coming in contact with the stigmas. In this manner different flowers were visited whereby self-or cross-pollination may have been the result. The list of visitors is as follows:

A. Hymenoptera

Apidæ: (1) *Bombus americanorum* Fabr. female, s. and c. p.; (2) *Osmia pumila* Cr. male and female, s.; Andrenidæ: (3) *Andrena cressonii* Rob. female, s. and c. p.; (4) *A. rufosignata* Ckll. female, s. and c. p.; (5) *Andrena* sp. female, s.; (6) *Halictus provancheri* D. T. female. s.; (7) *H. cressonii* Rob. female, s. and c. p.; (8) *H. versatus* Rob. female, s.; (9) *H. pilosus* Sm. female, s.

B. Diptera

Syrphidæ: (10) *Chilosia cyanescens* Loew, s. and f. p.

FAM. LILIACEÆ.

Allium tricoccum Ait. Wild Leek.

This plant is remarkable from the fact that the rather large leaves make their appearance quite early in the spring, but dry up and disappear before the blooming time sets in. The latter lasts from July 11 to August 15. There are about fourteen greenish-white inconspicuous flowers on short pedicels forming an umbel at the end of a scape of about 22 cm. in length. The perianth-leaves are only 4 to 5 mm. long, they remain in an erect position with their tips inclining towards the stamens, the light yellow anthers of which are just lifted above the perianth-leaves. From the middle of the 3-parted ovary arises the erect slender white style with its simple stigma. The flowers are proterandrous. At first the three anthers of the inner row shed their pollen, and at this time the style has reached only two-thirds of its length. Later on while the outer anthers are dehiscing the style becomes fullgrown and the receptive stigma is on the same level with the anthers. The first flower of an umbel is located centrally, the process of blooming therefore progresses from the center to the margin. Nectar is secreted by septal glands and appears as a drop in each of the furrows about half way up. It is concealed between the furrow and the broadened base of the corresponding filament and, besides, the erect position of the perianth-segments also assists in hiding it from view. No odor is emitted by these flowers.

Although in an older flower a receptive stigma may be present together with pollen on the outer anthers there is hardly a possibility of spontaneous self-pollination on account of the upright position of the flower and the distance between the stigma and the outer anthers.

Insects engaged in sucking nectar push their heads in between the stigma and the introrse anthers, and become dusted with pollen on the sides of their heads. Their visits to different flowers result in most instances in cross-pollination. Bees are the main visitors, as seen from the following list:

A. Hymenoptera

Apidæ: (1) *Apis mellifera* L. worker, s.; (2) *Bombus consimilis* Cr. worker, s.; (3) *Alcidamea producta* Cr. female, s.;

Andrenidæ: (4) *Halictus provancheri* D. T. female, s. and c. p.; (5) *H. connexus* Cr. female, s. and c. p.; (6) *H. zephyrus* Sm. female, s. and c. p.; (7) *H. pilosus* Sm. female, s.; (8) *Prosopis modesta* Say female, s.; (9) *P. affinis* Sm. female, s.

B. Diptera

Syrphidæ: (10) *Mesogramma geminata* Say; (11) *Sphærophoria cylindrica* Say; Muscidæ: (12) *Lucilia cæsar* L.—all s. or f. p.

Allium Canadense L. Meadow Garlic.

The flowering period is from June 19 to July 17. There are 4 to 18 pinkish flowers arranged in a terminal umbel of 4 dm. length, and in addition to these the inflorescense contains about a dozen ovoid bulblets. The perianth-leaves are 7 mm. long. and they spread sufficiently to give the flower a diameter of 12 to 15 mm. In the middle of each of these pinkish leaves, especially on those of the inner row, a light violet line, the so-called nectar-guide, points towards the middle of the flower. Nectar appears near the base of the ovary in the septal furrows and accumulates between the latter and the bases of the inner filaments. The flowers have a faint sweet scent.

Proterandry is well marked. In the first or male stage the anthers dehisce one after the other, and the style has at the beginning of this stage a length of only 1½ mm. with scarcely a trace of a stigma. The introrse anthers gradually become extrorse. In the second or female stage the style attains its entire length of 4 mm., and the stigma reaches maturity after all of the anthers are empty, rarely before. The stigma surpasses the anthers. The style assumes a pink color and the stamens also (with the exception of the light-yellow pollen) agree in color with the perianth.

Numerous insects pay their attention to the flowers, and cross-pollination is insured through the high degree of proterandry. Visitors were taken as follows:

A. Hymenoptera

Apidæ: (1) *Clisodon terminalis* Cr. female, c. p.; (2) *Alcidamea producta* Cr. female, s.; (3) *Andronicus cylindricus* Cr. male, s.: (4) *Osmia pumila* Cr. female, s.; (5) *Stelis 6-maculata* Ashm. female, s.; (6) *S. subemarginata* Cr. female, s.; (8) *Coelioxys moesta* Cr. female, s.; (9) *Calliopsis andreniformis* Sm.

female, s. and c. p.; Andrenidæ: (10) *Halictus provancheri* D. T. male, s.; (11) *H. coriaceus* Sm. female, s. and c. p.; (12) *H. albipennis* Rob. male, s.; (13) *H. cressonii* Rob. female, s.; (14) *H. versatus* Rob. female, s.; (15) *Prosopis pygmœa* Cr. male, s.; (16) *P. modesta* Say female, s.; Crabronidæ: (17) *Oxybelus 4-notatus* Say, s.; Philanthidæ: (18) *Cerceris nigresceus* Sm., s.; Sphegidæ: (19) *Ammophila vulgaris* Cr., s.; Eumenidæ: (20) *Eumenes fraternus* Say; (21) *Odynerus pennsylvanicus* Sauss.; (22) *O. conformis* Sauss.—all s.

B. Diptera

Bombyliidæ: (23) *Bombylius atriceps* Lw.; Syrphidæ: (24) *Paragus tibialis* Fall.; (25) *Syrphus americanus* Wied.; (26) *Mesogramma marginata* Say; (27) *M. geminata* Say; (28) *Sphœrophoria cylindrica* Say; Agromyzidæ: (29) *Ochthiphila polystigma* Meig.; Tachinidæ: (30) *Gymnosoma fuliginosa* Desv.; (31) *Senotainia trilineata* v. d. W.; (32) *Ocyptera dosiades* Walk.; (33)*Peleteria tessellata* Fabr.; Muscidæ: (34) *Lucilia sylvarum* Meig.; (35) *L. sericata* Meig.; Anthomyidæ: (36) *Phorbia fusciceps* Zett.; (37-38) *Phorbia* spp.—all s. or f. p.

C. Coleoptera

Coccinellidæ: (39) *Coccinella sanguinea* L, s.; Mordellidæ: (40) *Mordellistena comata* Lec. s.

Allium cernuum Roth. Nodding wild onion.

Foerste (6) has given an account of the pollination of this species in which he called attention to the proterandry of the flowers. Around Milwaukee this plant is in bloom from about July 15 to August 29. Through the bending of the scape of 3 to 4 dm. length just below the umbel the very numerous flowers become nodding. At the time of the opening of the first flowers along the margin of the inflorescence those in the middle are still far behind in their development. The reddish-purple perianth-segments contrast rather strongly with the yellow anthers that protrude from the mouth of the flower. While the three outer perianth-segments are directed outwards, each of the three inner ones is erect, and with its wing-shaped margins it encloses the

6. A. F. Foerste. Fertilization of the wild onion. Am. Nat. Vol. XIX. p. 601. (1885).

opposite filament of the inner row. Corresponding projections of the upper margin of the ovary surround these filaments from within, and in this manner tubes are formed leading down to the nectar between the base of these filaments and the ovary. There is a rich supply of nectar coming from the septal glands. The stamens with their pinkish filaments have, when fully developed, a length of 12 mm., one-half of which extends outside of the perianth. One by one they grow in length and empty their pollen, those of the inner row in advance of the others. In this respect the specimens of our surroundings do not agree with those studied by Foerste who states that the outer stamens are the first to dehisce. In the first stage of these proterandrous flowers when the three inner stamens have reached their entire length the stigmatic region of the style is situated in the mouth of the flower. By the time the outer stamens have shed their pollen the style has become as long as the anthers, and the stigma has reached maturity. This represents the second or female stage. Proterandry is so distinct in this species of Allium as to render cross-pollination a certainty. The faintly sweet-scented flowers are rather attractive to bees as shown by the following list:

A. Hymenoptera

Apidæ: (1) *Apis mellifera* L. worker, s.; (2) *Bombus pennsylvanicus* De G. female and worker, s.; (3) *B. virginicus* Oliv. worker, s.; (4) *B. ternarius* Say, female and worker, s.; (5) *Clisodon terminalis* Cr. female, s.; (6) *Anthophora walshii* Cr. female, s.; (7) *Megachile infragilis* Cr. female, s.; Andrenidæ: (8) *Halictus forbesii* Rob. female, s. and c. p.; (9) *H. zephyrus* Sm. female, c. p.; (10) *H. albipennis* Rob. female, c. p.; (11) *H. sparsus* Rob. female, c. p.; (12) *Colletes eulophi* Rob. female, s.

B. Diptera

Syrphidæ: (13) *Tropidia quadrata* Say, s.

C. Lepidoptera

Rhopalocera: (14) *Pontia rapæ* L, s.

Lilium Canadense L. Wild yellow Lily.

The blooming time is from July 2 to 28. On the outside the nodding flowers are red with a yellowish tinge while the inner surface is mainly yellow with numerous small brown spots. Shortly

after opening the perianth-segments spread horizontally so as to give the flower a diameter of 10 to 11 cm., but later the tips of the segments become reflexed. At the base the segments are closely approximated for a length of about 3 cm., and form a bell-shaped portion of 5 mm. diameter at the bottom. This space is nearly entirely occupied by the ovary and the filaments, and consequently only long-tongued insects can gain access to the nectar which is secreted in a depression at the base of each segment. No odor is perceptible. The extrorse anthers are 12 mm. long, they produce a great amount of reddish-brown pollen, and are lightly attached to the long (4 cm.) filaments. On account of the bending of the upper part of the filaments the anthers are carried outwardly, and finally they form a circle of 2 to 3 cm. diameter around the capitate dark brown stigma, which is situated on the same level. On the second day the upper part of the style curves outwards and brings the stigma either in contact with one of the anthers or in a position between two of them. In this new position the stigma is more apt to be struck by large insects approaching the flower from the side, butterflies or hawk-moths for example.

According to Meehan (7) this lily is self-sterile. The dusting of the stigma with pollen from the same plant (self-pollination) would therefore be of no use to the plant. This mode of pollination, although ineffective is undoubtedly of common occurrence in these homogamous or slightly proterandrous flowers, and once on a windy day, soon after the opening of a flower I saw a swaying anther touch the stigma before any insects had made their appearance.

A small bee, *Halictus versatus Rob.,* while collecting pollen was observed crawling around on the anthers as well as on the stigma, and a repetition of this behavior in a second flower might lead to cross-fertilization. Lovell (8) saw a bumble-bee, Bombus vagans Sm., alight on the stigma and afterwards crawl up along the anthers. He expresses the opinion that this species is visited by bees only, but it is probably adapted to Lepidoptera the

7. Thomas Meehan. Observations on Lilies. Proc. Acad. Nat. Sc. Phil. 1875. pp. 412-413.

8. J. Lovell. The color of northern monocotyledonous flowers. Am. Nat., Vol. XXXIII., p. 498 (1899).

same as the average species of Lilium, and I have witnessed the visits of a butterfly, *Argynnis cybele* Fabr., to the flowers. I have often been on the lookout for visitors, but have seen the following only:

A. Hymenoptera

Andrenidæ: (1) *Halictus forbesii* Rob., female, c. p.; (2) *H. versatus* Rob. female, c. p.

B. Lepidoptera

Rhopalocera: (3) *Argynnis cybele* Fabr., s.

Lilium umbellatum Pursh. Western red Lily.

This lily occurs on the clay-bluffs along Lake Michigan together with *Tofieldia glutinosa,* the species considered previ- and its flowering period from June 20 to July 16 falls together with that of *Tofieldia.* In the specimens under observation each plant carried either one or two of the erect flowers measuring about 12 cm. across. The perianth-segments are directed laterally, and there is a slight recurving of the tips. Each of them becomes narrowed in the basal region, forming a so-called claw, the margins of which are turned inward so as to meet each other and form a tube 2 cm. in length leading to the nectary at the base of the claw. There is a scanty supply of nectar, and no odor. The perianth-segments are red, changing to orange mixed with dark-brown spots around the opening of the tube. The stamens reach a length of 7 cm., and in consequence of an outward movement the anthers form a circle of 2 cm. diameter around the stigma, the same as in *Lilium Canadense.* Anthers and stigma are on the same level, and in the older flower the latter is carried to one side and often brought in touch with an anther. This leads to spontaneous self-pollination. Whether this species is also self-sterile like the preceding one I am unable to state. In these homogamous flowers the filaments and style agree in color with the perianth-leaves, but the anthers and stigma are dark-brown and the pollen brownish-yellow.

In favorable weather pollination is mostly due to the visits of butterflies, but pollen-collecting bees may also touch the stigma if they appear very shortly after the opening of the flower before the anthers have moved away from the stigma. The butterfly *Argynnis cybele Fabr.* is the most frequent visitor. It settles down

on one side of the flower and crawls around between the stamens and the perianth-leaves, draining one nectary after the other, and thereby dusting the lower surface of its front wings with pollen. Incidentally it rubs these same parts against the stigma. One bee and three butterflies make up the list of visitors:

A. Hymenoptera

Andrenidæ: (1) *Augochlora confusa* Rob. female, c. p.

B. Lepidoptera

Rhopalocera: (2) *Papilio polyxenes* Fabr.; (3) *Argynnis cybele* Fabr.; (4) *Phyciodes tharos* Dru.—all s.

Erythronium albidum Nutt. White Adder's Tongue. White Dog's tooth Violet.

This plant has been found in bloom from April 20 to May 15. Robertson (9) has given an account of this species and from this we see that there is a considerable difference in size between the flowers of our region with a diameter of 3 to 4 cm., and those of southern Illinois with a diameter of 6½ cm. There is a solitary nodding white flower at the end of a scape of about 12 cm. length. Each of the three inner perianth-leaves has a pit-shaped nectary near the base and a small furrow running down to the latter. The adjoining filament covers the furrow from within, and the proboscis of an insect has to pass through the canal thus formed in order to obtain nectar. There is a median yellow spot, a "nectar-guide" near the base of each of the perianth-leaves, and it is of a deeper color and more distinctly heart-shaped on the inner ones. The stamens of the outer row are shorter than the others on account of the shorter anthers, and they shed their pollen entirely before those of the inner row start to dehisce. The flowers are homogamous since the stigma matures together with the outer anthers. As a rule the stigma in this species has three long and spreading branches, while that of *E. Americanum* the second species of our flora is usually short and simple. But Meads (10) has shown that there exists a great amount of vari-

9. Chas. Robertson. Flowers and insects VIII. Bot. Gaz., Vol. XVII., pp. 69-71 (1892).

10. M. E. Meads. The range of variation in species of Erythronium. Bot. Gaz., Vol. XVIII., p. 134 (1893).

ation in the two species, and that *E. albidum* may produce a stigma of the type credited to *E Americanum,* and vice versa. The inner anthers surpass the stigma to a slight extent only.

According to Robertson cross-pollination may take place at any time, but he considers spontaneous self-pollination of common occurrence in absence of insects. The closing of the flowers at night and in rainy weather would seem to me to favor spontaneous self-pollination as thereby the anthers of the inner row are pressed against the stigma. The same mode of pollination may also result from the falling of pollen in a flower in which the stigma is situated directly below an anther. As Robertson points out the nodding position of the flowers favors the visits of bees, and nearly excludes other insects, and sixteen of the twenty-two visitors observed by him were bees. In our region the flowers are not so extensively visited, and I have noted the following bees only:

Hymenoptera

Apidæ: (1) *Ceratina dupla* Say; male and female, s.; (2) *Osmia pumila* Cr. male, s.; Andrenidæ: (3) *Andrena vicina* Sm. female, s. and c. p.; (4) *Augochlora confusa* Rob., female, s.

Erythronium Americanum Ker. Yellow Adder's Tongue.

The first flowers appear several days behind those of the foregoing species, and the blooming time extends from about April 25 to May 19. When open the nodding flower is conspicuously yellow and is situated about 16 cm. above the ground. The bud has a reddish-brown color, due to such a coloration of the outer surface of the outer perianth-leaves. The inner surface of the latter and the leaves of the inner row in their entirety are yellow except towards the base where they become brownish with numerous minute reddish-brown spots. In this species too, as in the preceding one the nectaries are situated at the base of the inner perianth-leaves, and a furrow guides the insect's tongue down to each of them. Dehiscence begins in the anthers of the outer row, the stamens of which are shorter than those of the inner row. The latter are 25 mm. long or about 2 mm. longer than the pistil. While considering the preceding species it was stated that the stigma in *E. Americanum* usually does not spread out in branches as in *E. albidum.* It is therefore not as liable to catch falling pollen in the open flower or to meet the anthers in the

closing flower as that of the last named species, and consequently spontaneous self-pollination might not be favored to such an extent in *E. Americanum* as in *E. albidum.*

As regards pollination through the activity of insects the conditions are about the same in both species. Bees are here also the principal visitors.

Besides perfect (hermaphrodite) flowers Meads (11) has come across female flowers i. e., with rudimentary anthers, not producing any pollen. This species therefore furnishes an example of a gynodioecious plant.

The following species of bees are the only visitors I have noted on the flowers.

Hymenoptera

Apidæ: (1) *Bombus americanorum* Fabr. female, s.; (2) *Osmia pumila* Cr. male, s.; Andrenidæ: (3) *Andrena vicina* Sm. female, c. p.; (4) *Halictus 4-maculatus* Rob. female, c. p.

FAM. CONVALLARIACEÆ.

Asparagus officinalis L. Asparagus.

The asparagus has escaped from cultivation and is a comparatively common wild plant around Milwaukee, blooming from about May 29 throughout the summer. Belated flowers have been seen even on October 6. Mueller (12) described and figured the greenish, pendulous and bell-shaped flowers. Breitenbach (13) noted the occurrence of perfect (hermaphrodite) flowers, but as a rule each plant has either male or female flowers only. Among the numerous specimens examined in our surroundings I have never come across one with perfect flowers. The male flower has a length of 6 mm., and always contains a rudimentary pistil. The female flower is considerably shorter (3 to 4 mm.) and is supplied with abortive anthers.

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11. M. E. Meads. Loc. cit., p. 137.

12. H. Mueller. Befruchtung der Blumen durch Insekten, pp. 64-65. See also P. Knuth Handb. d. Bluetenbiologie, Vol. II., pp. 505-506.

13. W. Breitenbach. Ueber Asparagus officinalis, etc. Bot. Ztg., Vol. XXXVI., pp. 163-167.

The flowers with their faint odor are regularly visited by bees, but the larger and therefore more conspicuous male flowers are decidedly more attractive than the female flowers. On June 19 two large plants standing close together, one with male and the other with female flowers, were kept under observation for some length of time. The male flowers received a grater number of visitors, mostly female bees of the genus *Halictus* in search of pollen, and the few bees paying their attention to the female flowers were mostly supplied with pollen from their previous visits to the male flowers. In this manner cross-pollination is insured in accordance with the rule laid down by Sprengel that in diclinous plants the male flowers are more showy so as to attract the insects in the order most favorable to pollination. Both kinds of flowers secrete nectar at the bottom of the tube.

The following visitors were observed on three different days in June:

Hymenoptera

Apidæ: (1) *Bombus consimilis* Cr. female, s.; (2) *Ceratina dupla* Say female, s. and c. p.; (3) *Megachile infragilis* Cr. male, s.; Andrenidæ: (4) *Augochlora confusa* Rob. female, s. and c. p.; (5) *Halictus coriaceus* Sm. female, c. p.; (6) *H. 4-maculatus* Rob. female, c. p.; (7) *H. zephyrus* Sm. female, c. p.; (8) *Prosopis pygmæa* Cr. female, s.

Clintonia borealis (Ait) Raf. Yellow Clintonia.

On two different occasions, on June 3 and 5, I have had the opportunity of watching these flowers in a tamarack swamp at Elkhart Lake, Sheboygan Co., Wis. They were visited by two species of bumble-bees and two smaller bees as follows:

Hymenoptera

Apidæ: (1) *Bombus consimilis* Cr. female, s. and c. p.; (2) *B. virginicus* Oliv. female, s. and c. p.; Andrenidæ: (3) *Halictus versatus* Rob. female, c. p.; (4) *Agapostemon radiatus* Say female, s.

Miss Alice Carter (14) witnessed the visits of bumble-bees at Ithaca, N. Y., and Lovell (15) in Maine those of a beetle, the

14. Alice Carter. Notes on pollination. Bot. Gaz., Vol. XVII., p. 21 (1892).

15. J. Lovell. Loc. cit., p. 499.

honey-bee and a bumble-bee *Bombus consimilis,* one of the species represented in the list given above.

The bell-shaped greenish-yellow flowers are situated at the summit of a scape forming an umbel of three to six pendulous flowers directed to one side, and in addition to these we sometimes find two or three flowers lower down on the same side of the scape. The six perianth-leaves are recurved so as to give the fully developed flower a diameter of 2½ cm. Stamens, pistil and perianth-segments are all of the same length, from 18 to 20 mm. In the basal region the segment is folded together and forms a medial furrow of 2 mm. depth along the inner side, at the bottom of which nectar is secreted. The broadened base of the opposite filament covers the furrow and a canal of 6 mm. length is thereby constructed running down to the nectary.

The style protrudes from the middle of the flower, but it is directed slightly downward and carries a broad flattened stigma. The anthers are about 5 mm. in length. They are kept well out of the way of the stigma, being arranged in a circle of 2 cm. diameter around the latter. Such an anther splits open laterally and within a short time along its entire length. In warm and dry weather this whole process of dehiscence may be accomplished within an hour. The flowers are homogamous.

There is a slight possibility of spontaneous self-pollination taking place through the falling of pollen on the stigma, but the flowers are adapted to long-tongued bees and bumble-bees (flying at this time of the year in the female sex only) are certainly the most efficient pollinators. Such a bumble-bee usually alights on the lowest flower of a group and after sucking and collecting pollen crawls up to the neighboring one. Cross-pollination or at least self-pollination is the outcome. The visits of the short-tongued bees mentioned in the list, (*Halictus* and *Agapostemon*), are hardly of any use to the flowers, unless they alight on the stigma, but this is generally not the case.

An interesting feature of these flowers is the arrangement by which they are more or less protected from unwelcome visitors. The bases of the filaments are well supplied with protruding hairs, and the same is the case with the perianth-divisions in their basal region along the outer surface, where they are close together. This renders it difficult for ants and all kinds of short-tongued insects to push their mouth parts from the outside in between the peri-

anth-divisions at the base of the flower or in between the base of a filament and a perianth-division on the inside.

Vagnera racemosa (L.) Morong. Wild Spikenard.

Robertson (16) has described the structure of these flowers, and given an account of their pollination as observed by him in Macoupin Co. in southern Illinois, where the flowers bloom from May 7 to 30. In our latitude they appear nearly a month later, extending their flowering period from about June 2 to 29. The white flowers are very small, and are gathered in a panicle at the end of the stem, but being very numerous they render the inflorescence visible from a considerable distance. I estimated the number of flowers in an inflorescence of 5 cm. breadth and 14 cm. length at about 500. The main parts of the flower are the divergent stamens and the pistil, while the perianth-segments are exceptionally small and inconspicuous as pointed out by Robertson. The flowers are proterogynous and cross-pollination is the probable outcome. Grassmann (17) noted the presence of septal glands, but Robertson could not detect any nectar, and in our surroundings these flowers do not show the slightest trace of nectar. They are visited for pollen only, but their peculiar odor may be quite attractive to certain insects, bugs for example that I have repeatedly seen gathering in numbers on the flowers towards evening.

In southern Illinois this species seems to be poorly visited, only three small bees and one beetle having been noticed by Robertson. In a certain locality along the railroad north of West Allis, a suburb of Milwaukee, the plants are plentiful, and I observed quite a gathering of various insects, notably bees and flies, but also beetles and bugs. Following is the list of these visitors:

A. Hymenoptera

Andrenidæ: (1) *Andrena nivalis* Sm. female, c. p.; (2) *A. corni* Rob. female, c. p.; (3) *A. cressonii* Rob. female, c. p.; (4) *Augochlora confusa* Rob. female, c. p.; (5) *Halictus lerouxii*

16. Chas. Robertson. Flowers and insects XVI. Bot. Gaz., Vol. XXI., p. 270 (1896).

17. P. Grassmann. Die Septaldruesen, Flora. Vol. LXVII., p. 118 (1884).

Lep. female, c. p.; (6) *H. zephyrus* Sm. female, c. p.; (7) *H. albipennis* Rob. female, c. p.; (8) *Sphecodes clematidis* Rob. female, searching for nectar.

B. Diptera

Stratiomyidæ: (9) *Stratiomyia lativentris* Lw.; Bombyliidæ: (10) *Bombylius atriceps* Lw.; Syrphidæ: (11) *Mesogramma geminata* Say; Tachinidæ: (12) *Peleteria tessellata* Fabr.; (13) *Archytas analis* Fabr.; Sarcophagidæ: (14) *Sarcophaga* sp.; Dexiidæ: (15) *Myocera cremides* Walk.; Muscidæ: (16) *Lucilia sylvarum* Meig.; (17) *L. sericata* Meig.; Anthomyidæ: (18) *Phorbia* sp.; (19) *Drymeia* sp.—all except (10) f. p., (10) probing around the base of the ovary for nectar.

D. Coleoptera

Elateridæ: (20) *Agriotes oblongicollis* Mels.; Scarabæidæ: (21) *Trichius piger* Fabr.; Cerambycidæ: (22) *Cyrtophorus verrucosus* Oliv.; (23) *Acmæops bivittata* Say; Anthicidæ: (24) *Corphyra collaris* Say; Meloidæ: (25) *Macrobasis unicolor* Kirby —all f. p.

D. Hemiptera.

Capsidæ: (26) *Calocoris rapidus* Say; (27) *Poecilocapsus lineatus* Fabr. (28) *P. goniphorus* Say—all resting on the flowers.

Vagnera stellata (L.) Morong. Star-flowered Solomon's Seal.

This common species blooms around Milwaukee from about May 13 to June 8 and the flowers are abundantly visited by bees as well as flies. Robertson (18) speaks of an adaptation to the less specialized bees—*Andrenidæ*, but my observations show that they are equally well adapted to the specialized flies of the family *Syrphidæ*, over one-half of the visitors belonging to the *Andrenidæ* and *Syphidæ*, taken together. This is what might be expected when we consider the structure of the flowers. They are pure white with the exception of the light yellow anthers and are arranged in a terminal raceme. The diameter of a flower is about 12 mm. The leaves of the perianth are spread so as to form nearly a right angle with the axis of the flower, and the stamens take up an intermediate position between the perianth-segments and the pistil, whereby the anthers are kept at a distance from the

18. Chas. Robertson. Loc. cit., pp. 269-270.

stigma. The latter is receptive from the opening of the flower on, and later the introrse anthers open one by one. Proterogyny is well marked, and the flowers are destined to become cross-pollinated. Where the flowers grow in patches as they usually do, visitors are not lacking, and they are attracted by a liberal supply of pollen, an agreeable sweet odor, and easily accessible drops of nectar secreted at the base of the ovary.

I have taken the following insects on the flowers:

A. Hymenoptera

Apidæ: (1) *Apis mellifera* L. worker, s.; (2) *Bombus consimilis* Cr. female, s.; (3) *B. ternarius* Say female, s.; (4) *Nomada cuneata* Rob. female, s.; (5) *N. cressonii* Rob. male, s.; (6) *Osmia purpurea* Cr. female, s.; Andrenidæ: (7) *Andrena nivalis* Sm. female, s.; (8) *A. hartfordensis* Ckll. female. s.; (9) *A. cressonii* Rob., s.; (10) *A. sigmundi* Ckll., female, s.; (11) *Augochlora viridula* Sm., (12) *A. confusa* Rob., female, s. and c. p.; (13) *Agapostemon radiatus* Say, female, s. and c. p.; (14) *Halictus provancheri* D. T., female. s. and c. p.; (15) *H. lerouxii* Lep., female. s. and c. p.; (16) *H. zephyrus* Sm. female, s. and c. p.; (17) *H. cressonii* Rob. female, s.; (18) *H. sparsus* Rob., female. s.; Eumenidæ: (19) *Odynerus pennsylvanicus* Sauss., s.

B. Diptera

Stratiomyidæ: (20) *Odontomyia pubescens* Day; Syrphidæ: (21) *Mesogramma marginata* Say; (22) *M. geminata* Say; (23) *Sphærophoria cylindrica* Say; (24) *Neoascia globosa* Walk.; (25) *Eristalis dimidiatus* Wied.; (26) *Helophilus similis* Macq.; (27) *H. laetus* Lw.; (28) *H. chrysostomus* Wied.; (29) *Mallota cimbiciformis* Fall.; (30) *Tropidia quadrata* Say.; (31) *Xylota cjuncida* Say; (32) *Syritta pipiens* L.; Tachinidæ: (33) Cistogaster *immaculata* Macq.; (34) *Siphona geniculata* Deg.; (35) *Melanophrys insolita* Walk.; (36) *Gonia capitata* De G.; (37) *Peleteria robusta* Wied.; (38) *Archytas analis* Fabr.; Sarcophagidæ: (39) *Sarcophaga* sp.; Muscidæ: (40) *Lucilia sylvarum* Meig.; Anthomyidæ: (41) *Hydrotæa* sp.—all s. or f. p.

C. Lepidoptera

Rhopalocera: (42) *Pontia rapæ* L.; s.; (43) *Atrytone zabulon* Bd. and Lec.—all s.

D Coleoptera

Scarabæidæ: (44) *Trichius piger* Fabr. s. and f. p.

Vagnera trifolia (L.) Morong. Three-leaved Solomon's Seal.

It is a common inhabitant of the same tamarack swamp at Elkhart Lake, Sheboygan Co., Wis., referred to above in connection with *Clintonia borealis,* and it was observed on the same dates as the latter, viz: June 3 and 5. The average height of the plants is 15 cm., and the ten to fourteen flowers on slender pedicels are arranged in a loose raceme. As regards the structure of the flower and the relative position of perianth-segments, stamens and pistil to each other there is a striking similarity to the flower of *V. stellata* considered above, but that of *V. trifolia* is much smaller, measuring only 6 to 7 mm. across. All of the parts of the flower are white, except the anthers which are brown-violet. Nectar appears in droplets in the furrows along the ovary and this indicates the presence of septal glands. In view of the more or less upright position of the flowers spontaneous self-pollination can hardly occur. Such a flower is proterogynous, but only for a short while, and consequently cross-pollination results from the early visits of insects while later on after the anthers have begun to empty their pollen either cross or self-pollination may be effected by such visitors. Altogether these flowers do not seem to attract insects to any extent. They are sweet-scented, but the individual flower is inconspicuous and the same may be said of the few-flowered loose inflorescence as a whole. On the two dates mentioned above two beetles were the only insects seen on the flowers, but the time available for such observations was too short, and we might expect to find small bees and flies paying attention to them. The two beetles belonged to the following species:

Coleoptera

Elateridæ: (1) *Cardiophorus convexulus* Lec.; (2) *Elater rubricus* Say—both s.

Unifolium Canadense (Desf.) Greene. Two-leaved Solomon's Seal.

Flowering period from May 27 to June 21. There may be as many as 50 of the small white fragrant flowers forming a terminal raceme on a stem 10 to 18 cm. high. The flowers are borne by short (4 mm.) pedicels two of which originate from a common point of the stem. A short time after the opening of the flower

the four perianth-leaves of 3 mm. length become strongly reflexed, and the four stamens which are only 2 mm. long move outwards. The two divisions of the pistil are connected nearly for their entire length, but the stigma is two-parted. The latter is already receptive at the time the flowers open, and the introrse anthers begin to dehisce shortly afterward. Proterogyny is therefore short-lived. On account of the vertical position of the flowers pollen is more liable to fall on the stigma of the same flower and produce spontaneous self-pollination then in any of the species of *Vagnera* dealt with above. No nectar is present, but the flowers receive sufficient attention from short-tongued bees and flies to effect cross-pollination in many instances. In the following I present the list of visitors observed on the flowers:

A. Hymenoptera

Andrenidæ: (1) *Halictus provancheri* D. T., female, c. p.; (2) *H. leronxii* Lep., female, c. p.

B. Diptera

Culicidæ: (3) *Culex stimulans* Walk.; Syrphidæ: (4) *Mesogramma geminata* Say; (5) *Neoascia globosa* Walk.; (6) *Mallota posticata Fabr.;* Conopidæ: (7) *Zodion fulvifrons* Say—all except (3) and (7) f. p.

C. Coleoptera,

Cerambycidæ: (8) *Cyrtophorus verrucosus* Oliv.; Chrysomelidæ: (9) *Crepidodera cucumeris* Harr.—both f. p.

Streptopus roseus Mich. Sessile-leaved Twisted-stalk.

This species has a rather short blooming time, viz: from about May 23 to June 7. None of the specimens under observation were higher than 4 dm., and while the smaller plants have simple stems the larger ones carry one or two branches in addition to the main stem. The slender pedicel of 1½ cm. length is bent downward under the corresponding stem-leaf, and carries a rose-colored pendulous and bell-shaped flower. The position of the latter under the nearly horizontal stem-leaf hides it from view from above, and also affords it some protection from the rain and the rays of the sun. There is an overlapping of the three perianth-leaves of the outer row and those of the inner row, whereby a tube is formed 8 mm. in length with reflexed tips. Each leaf of

the inner row has a furrow directed downwards to the nectary at the base, and such a cup-shaped nectary is also present at the base of each of the outer leaves, but without a furrow. The broadened filaments are closely appressed to their corresponding perianth-leaves, and for this reason the nectar of the three inner leaves can be reached only through a narrow tube, 3 mm. in length. The six anthers in two rows are inclined towards the style, and dehiscence starts in those of the outer row. The three branches of the style surpass the anthers by at least 2 mm., and their stigmas are visible in the mouth of the flowers. This species seems to be slightly proterandrous since the papillæ of the stigma do not become plainly developed until the pollen is being shed. There is a sweet odor and an abundant supply of nectar. In the older flowers a change of color to a more intense and darker red takes place.

We have here an interesting example of an andromonoecious plant. In addition to the perfect (fertile) flowers just described there appear regularly somewhat smaller male flowers with normally developed stamens and undeveloped pistils, but furnishing a full amount of nectar. About one-half of the flowers are male (sterile), and these are always situated along the apical portion of the stem, while the perfect flowers are below. For example in a large plant with three branches the distribution of flowers was as follows:

Lower branch	3	perfect	2	male	
Middle	"	2	"	3	"
Upper	"	5	"	2	"

In this specimen with seventeen flowers ten were perfect and only seven male, but in some instances fully one-half are male.

The only visitors seen on several occasions belonged to the same species of bee: *Andrena milwaukeensis* Graen, female. This bee is in the habit of collecting pollen on various flowers and is therefore not an oligotropic visitor of *Streptopus roseus*.

Salomonia biflora (Walt.) Britton. Hairy Solomon's Seal.

The plants vary in height from about 5 to 8 dm., and are in blossom from May 17 to June 10. There are usually two, sometimes three of the greenish-white tubular flowers hanging from the same pedicel. The length of the perianth is 10 to 12 mm., and in width the tube varies from 4 mm. in the region of the ovary to 3 mm. in the middle, and still less at the mouth. The

six stamens are inserted above the middle of the tube. Their introrse anthers are directed inwardly and brought with their tips so close together as to form a cone in the mouth of the flower. An insect's probocis has free access to the flower through the six lateral spaces between the filaments and the tubes. On account of the length of the style (9 mm.) the capitate stigma with its numerous papillæ protrudes into the cavity of the hollow cone formed by the anthers. As soon as the line of dehiscence which begins at the apex of the anther reaches the stigma spontaneous self-pollination may take place. Before dehiscence has progressed so far an insect may effect self or cross-pollination by introducing its probocis through the middle of the flower and touching the stigma with pollen of the same or of another plant.

The species of *Salomonia* (*Polygonatum*) which have been examined so far are known to have homogamous flowers (19), but in *S. biflora* we are undoubtedly dealing with proterandry. While the stigma is receptive before the flower opens the anthers do not begin to dehisce until after the opening has taken place. This species differs in another respect from the species studied heretofore. In the latter nectar is secreted by the septal glands of the ovary, but in *S. biflora* it is produced in three spots on the inner surface of the perianth somewhat above the base. These three drops of nectar are visible from the outside through the transparent tube of the perianth, and they are situated on the distinct lines that indicate the middle of the three inner perianth-segments.

The opening of the flower takes place through the outward movement of the six tips (teeth) of the perianth-divisions, whereby those representing the inner row assume an erect position, while those of the outer row become reflexed. In the older (fertilized) flower these teeth move back to their original position and close the tube. The perianth gradually becomes yellow and withers.

The following visitors have been noticed on the flowers:

A. Hymenoptera

Apidæ: (1) *Apis mellifera* L. worker, s.; (2) *Bombus consimilis* Cr. female, s. and c. p.; (3) *B. virginicus* Oliv., female, s.; (4) *B. americanorum* Fabr., female, s.

19. P. Knuth. Handb. d. Bluetenbiologie, Vol. II, p. 507.

B. Aves.

(5) *Trochilus colubris* L., s.

Bumble-bees are the most important visitors. The visits of our humming-bird (*Trochilus colubris*) are of interest and have been discussed at the beginning of this paper.

Salomonia commutata (R. & S.) Britton. Smooth Solomon's Seal.

This plant, the *Polygonatum giganteum Dietr.,* is much larger than the one just referred to, reaching in our region a height of 10 to 15 dm. Its flowers appear later than those of the other species, from June 7 to July 3. Robertson (20) has considered this species in connection with a review of the genus. The specimens studied in our locality differ in several points from those of southern Illinois as described by Robertson. There are two to five flowers in a group. The tube is about 17 mm. long, and has a diameter of 4 mm. at the mouth and 6 mm. in the middle. The teeth of the outer perianth-divisions are hardly more reflexed than those of the inner, they are all nearly erect. The flowers are homogamous, stigma and anthers becoming mature as soon as the tube opens. In the Illinois plants (Robertson) the style is too short to touch the anthers, thereby excluding spontaneous self-pollination. In our specimens the style with its stigma either reaches up between the anthers as in *S. biflora,* or it even surpasses the anthers by at least 1 mm. In the latter case cross-pollination through insects may be more easily accomplished than in *S. biflora,* on the other hand spontaneous self-pollination may take place when the pollen falls. In the plants of our surroundings therefore two different ways are open to spontaneous self-pollination.

Nectar is produced by the septal glands of the ovaries, but in addition to this the tissues of the inner surface of the tube are very juicy and yield droplets of a sweet liquid when punctured by the mouth parts of the visiting insects. Even the inner surfaces of the teeth (tips of the perianth-division) which are dry immediately after the opening of the tube show such droplets after having received the attention of bees, and I have several times seen the short-tongued bees figuring in the list below (*Halictus*) obtaining sweets around the mouth of the flower.

In our region *Salomonia commutata* is andromonoecious. I

20. Chas. Robertson. Loc. cit., p. 268.

have come across specimens having the uppermost flower or the two uppermost flowers of the stem sterile i. e. with the style rudimentary or nearly wanting. This is the only example of an andro monoecious species of *Salomonia* (*Polygonatum*) hitherto reported.

The humming-bird has been observed at the flowers, and three bees besides:

A. Hymenoptera

Apidæ: (1) *Bombus consimilis* Cr., female, s.; Andrenidæ: (2) *Halictus forbesii* Rob., female, s.; (3) *H. 4-maculatus* Rob., female, s. and c. p.

B. Aves.

(4) *Trochilus colubris* L., s.

Trillium grandiflorum (Michx.) Salisb. Large-flowered Wake-robin.

It is the commonest of our species of Trillium and is usually found in blossom from about May 6 to June 3. The large erect white flowers are among the most conspicuous of the spring flowers of our woodlands. They are proterandrous as shown by Loew (21), who studied them from plants growing in the Botanical Garden at Berlin. The anthers are 12 mm. long, two-thirds of this length being above the stigmas and one-third reaching down below the latter. Dehiscence begins above, and as soon as the stigma is reached spontaneous self-pollination undoubtedly takes place unless it has it has been preceded by self or cross-pollination through insects. In flowers in which the anthers have shed their pollen completely the stigmatic surfaces may be seen surrounded by pollen. According to Miss Alice Carter (22) nectar is secreted by septal glands, and in the plants examined in our neighborhood this is very clearly the case. Large drops are sometimes visible between the septal furrows of the ovary and the petals, taking up the space around the bases of the filaments. We might expect these showy and sweet-scented flowers with an abundant supply of pollen and nectar to be decidedly attractive to insects, and still this is not the case. It is, on the contrary, quite astonishing how little attention is paid to them. The only insect ever seen by me

21. E. Loew. Bluetenbiologische Beitraege II. Pringsh. Jahrb. Vol. XXIII., pp. 78-79 (1892).

22. Alice Carter. Notes on pollination. Bot. Gaz., Vol. XVII., p 21 (1892).

visiting such a flower in search of food was a small bee, a male *Ceratina dupla* Say. Some bees, especially the males of solitary bees are in the habit of selecting flowers of convenient structure as lodging-places for the night or in inclement weather, and under these circumstances they may be instrumental in effecting pollination. On a very windy day I found a male of the same bee referred to above seeking protection in one of the flowers, and on another occasion I saw two males of *Andrena geranii* Rob., taking up their abode in such a flower, also on account of the very high wind. Miss Carter kept flowers of this species under observation at the Botanical Garden of South Hadley, Mass., and she mentions the visits of pollen-collecting honey-bees, (an introduced species), but not of any of our native insects. From all these facts I am forced to believe that spontaneous self-pollination is the rule in *Trillium grandiflorum* and that only a small percentage of the flowers becomes cross-pollinated.

Trillium nivale Riddell. Early Wake-robin.

On a former occasion (23) I mentioned this species as being the earliest among our entomophilous flowers. The first flowers may be expected within the first two weeks in April, and in the exceedingly early spring of 1898 they appeared already on March 26. Neither before nor since the publication of the paper just cited have I ever succeeded in witnessing the visit of any insect to this pollen-flower, and spontaneous self-pollination is to all appearances the usual mode of pollination in our region. This is brought about by the recurving of the style until the stigma meets the anthers, but it takes place rather late, and this circumstance, together with the fact that the sigmas are at first situated above the anthers, points to cross-pollination as a possible outcome during the early life of the flower.

Trillium erectum L. Ill-scented Wake-robin.

This species has been noticed in blossom from May 19 to June 1, but my observations do not cover its entire flowering period. It is of especial interest on account of the variation in color shown throughout its range. According to Britton's Manual the petals may be dark purple, pink, yellow, greenish or white.

23. S. Graenicher. Bull. Wis. Nat. Hist. Soc., Vol. I (new series), pp. 1-2.

Loew (24) considers the dark purple and ill-scented variety, a nauseous flower, and he informs us that the styles surpass the anthers, and that the former are bent backwards. Miss Carter (25) states of the dark variety with a disagreeable odor observed at South Hadley, Mass., that no nectar is secreted, that the stamens and pistils are of the same length, and that self-pollination is apparently the rule. She noticed four beetles on the older flowers and did not consider their presence of any importance. Weed (26) saw several species of flesh-flies feeding on the pollen of these flowers in New Hampshire, and he regards the latter as proterandrous and adapted to cross-pollination. Around Milwaukee *T. erectum* appears to my knowledge in the white variety only, and these flowers possess an agreeable sweetish odor, but they do not produce any nectar. Those examined measured 5 cm. across, and their stamens were 13 mm. long, 10 mm. of which were taken up by the anthers. The stigmas are situated somewhat above the latter, but they are gradually brought in contact with them when the branches of the style curve outward. I have seen a stigma in close touch with a dehiscent anther.

As set forth above these flowers offer only pollen to the visitors, and they probably attract very few of them. On May 24 I noticed a bumble-bee, a female *Bombus americanorum* Fabr., alighting on a flower hunting for nectar; not finding the desired object it immediately flew over to a neighboring flower of *Salomonia biflora* (see above) where it was more successful. Altogether the flowers of *T. erectum* seem to be poorly attractive to insects, and spontaneous self-pollination takes place probably in the majority of the cases.

Trillium cernuum L. Nodding Wake-robin.

The white flowers are concealed beneath the leaves, and for this reason they are not as readily noticed as those of the species of *Trillium* already considered. I have met with these flowers on several occasions between May 22 and 27, and have not witnessed a single visit. They are as Miss Carter (27) has noted,

24. E. Loew. Bluetenbiol. Beitraege II., pp. 78-79.

25. A. Carter. Loc. cit., p. 20.

26. C. M. Weed. Ten New England blossoms and their insect visitors, pp. 53-60 (1895).

27. A. Carter. Loc. cit., p. 21.

slightly proterandrous, and in the fully opened nodding flower spontaneous self-pollination may easily result from the position of the recurving stigmas directly below the anthers. Small drops of nectar from the septal glands may be seen near the base of the ovary. A bumble-bee was observed by Miss Carter sucking nectar.

Trillium recurvatum Beck. Prairie Wake-robin.

Robertson (28) has given an account of the pollination of this dark purple erect flower. Usually a number of plants grow together in patches in damp woods. The flowers of our region, blooming from May 15 to about June 1 agree in all details with those from southern Illinois as described by Robertson. The green sepals are reflexed, but the dark purple petals form an arch over the middle of the flower. The rigid anthers with their remarkably broad connective are very dark in color, and are inclined over the dark purple branches of the style. Pollen may fall directly on the stigmas, and this is one way in which spontaneous self-pollination is possible. It also takes place when the recurved stigma touches an anther lined with pollen, a procedure which I have witnessed in several older flowers. As Robertson remarks, the flowers possess neither nectar nor odor, in fact nothing to attract insects except possibly the purple color, and he expresses the opinion that they may be visited by small flies at night. On May 20 during the day I watched a fungus-gnat *Sciara exigua* Say (family *Mycetophilidæ*) crawling around in a flower and coming in contact with both anthers and stigmas. Although such a visit may be favorable to pollination, the flies of this family can hardly be depended upon to pay regular visits to these flowers, and it is more than probable that in *T. recurvatum* spontaneous self-pollination is the method usually resorted to.

28. Chas. Robertson. Loc. cit., p. 273.

NEW CHALCID-FLIES FROM CAPE COLONY.

By Charles T. Brues

The following seven new species of Hymenoptera of the superfamily Chalcidoidea were sent to me by Dr. Hans Brauns of Willomore, Cape Colony. The types are in the Milwaukee Public Museum.

They represent an interesting addition to the very small number of Chalcids so far described from South Africa. Two form the types of new genera, while the others add three genera not hitherto recorded from that region.

FAMILY TORYMIDÆ.

SUBFAMILY ORMYRINÆ.

Ormyrodes gen. nov.

Body coarsely punctate, nowhere striate, the punctures at the base of the middle abdominal segments scarcely coarser than elsewhere. Abdomen very long, subulate, nearly three times as long as the head and thorax, with a strong median dorsal carina extending from the base of the third abdominal segment to the tip of the abdomen. Ocelli large, the lateral ones equidistant from the median one and the eye-margin. Eyes thickly pilose. Prothorax one-half as long and considerably narrower than the mesonotum, the latter with a slight depression on each side to indicate obsolete parapsidal furrows. Legs slender, tibial spurs small and delicate. Tarsi all rather distinctly spinous beneath. Wings with a long marginal vein, two-fifths as long as the submarginal. Stigmal one-third the length of the marginal, clavate and unusually oblique; postmarginal as long or longer than the marginal, attenuated gradually at the tip and continued as a faint thickening as far as the wing tip.

Type *O. carinatus* sp. nov.

The extremely long, awl-shaped abdomen, uniformly punctuate body, hairy eyes, and long postmarginal vein in the wings will serve to identify the genus which falls close to *Ormyrus*. In sculpture of the body it resembles Förster's *Tribœus;* the latter is how-

ever not recognized by Mayr as generically distinct from *Ormyrus.*

Ormyrodes carinatus sp. nov.

Female. Length 10 mm., of body 7 mm. Head and thorax bronzed green, the thorax with a reddish cast; abdomen æneous, varied with bluish and greenish, sides of the third segment anteriorly whitish pubescent, anterior angles of the fourth and fifth segments much more strongly so, the spots appearing olive green in certain lights. Base of the sixth segment deep orange, seventh metallic blue. Legs light rufous; coxæ greenish black, thickened parts of the femora, especially the posterior pair, blue-black; base of tibiæ and tarsi except tips pale yellow. Wings hyaline, with a very indistinct cloud below the stigma. Head coarsely, almost confluently punctured, covered with a whitish pubescence. Antennæ black, the pedicel and second flagellar joint of equal length, first flagellar one-third shorter, no ring-joint, fourth and fifth equal, the following decreasing, tip of antennæ broken off in the type specimen. Occiput, especially on the sides, circularly striate. Thorax and scutellum punctured like the head, the scutellum broadly rounded at the tip. Metathorax very short, scarcely visible above. whitish hairy and punctured on the sides. First and second abdominal segments smooth, except for transverse bands of fine punctures at the middle. Third rather deeply pitted with punctures the size of those on the thorax. The abdomen is suddenly constricted at the tip of this segment, the tip of the fourth segment being only one-quarter as wide as the base of the third. Third segment longest, fourth to seventh about equal, each two-thirds the length of the third. Venter distinctly, but more finely punctate. Ovipositor projecting to a distance equal to one-half the length of the pygidium, blunt at tip.

Described from one female collected at Uitenhage, Cape Colony, November 15, 1896.

FAMILY ENCYRTIDÆ.

SUBFAMILY EUPELMINÆ.

Charitopus albopalpalis sp. nov.

Female. Length 3 mm. Head and thorax metallic green, abdomen beyond the first segment decidedly coppery. Legs brown or piceous; the anterior coxæ and trochanters, the spurs of the middle

and hind tibiæ, extreme base of first joint of middle tarsus, hind trochanters and a very decided stripe on the outer side of the posterior tibiæ, pale yellow or whitish. Antennæ piceous, the flagellar joints except the last, yellowish brown. Mandibles brown, with black tips. Palpi whitish, the last joint long, swollen and bent at the base. Body slender; head transverse, two and one-half times as wide as thick and about as broad as high; front microscopically rugose, face shagreened. Eyes hairy. Antennæ 11-jointed, the flagellum brown except the last joint, which is black. Scape piceous, thickened towards the middle, nearly one-half as long as the flagellum; pedicel a little shorter than the first and second flagellar joints together, ring joint wider than long. Third and following flagellar joints wider and shorter, the penultimate quadrate and one-half as long as the apical one. On the under side of the pedicel is a series of about ten very fine, long hooked hairs to be seen only under high magnification. Mesonotum shagreened, shining, the parapsidal elevations almost obsolete. Scutellum with a tolerably broad base on the mesonotum, its surface microscopically rugulose. Metanotum polished, the metapleuræ above with long white pubescence. Abdomen as long as the thorax, the posterior margins of the segments entire. Ovipositor projecting very slightly. Wings hyaline; submarginal vein two-fifths the length of the wing, twice as long as the marginal; postmarginal strongly developed, diminishing apically, but distinct to the apex of the wing; stigmal one-third the length of the marginal, knobbed at the tip.

One female, Algoa Bay Cape Colony, November 24, 1896.

The present species could be placed in no other described genus, but may possibly not be congeneric with the type of *Charitopus*. As it agrees in having no bristles on the middle metatarsi, scarcely any impression on the mesonotum, and long postmarginal vein, it seems to fall here. The spur of the middle tibia is well-developed but not especially long and I can not detect the "schildförmigen mittelbrustseiten" described by Förster (Hym. Stud. II, p. 31) in his generic diagnosis of *Charitopus*, as more evident than in other Eupelmines. The peculiar hooked hairs on the antennal pedicel are different from anything I have seen.

Parasolindenia gen. nov.

Female. Apterous, abdomen very strongly depressed, almost wafer-like; when seen from above oval, twice as wide as the thorax

and only one-half longer than wide. Ovipositor exerted. Head one and one-half times as high as wide and twice as wide as thick antero-posteriorly. Antennæ inserted low down on the face, very slender, with a white annulus on the flagellum. Face with a large, but very slight depression. Malar furrow present. Eyes bare, showing a faint pubescence only under a compound microscope; elongate-oval, convergent above. Ocelli in a rather small triangle, the lateral ones near to, but not contiguous with the eye-margin. Prothorax very much contracted in front. Mesonotum sloping very strongly in front, the parapsidal elevations very sharply defined, especially behind. Scutellum narrow, almost as long as the mesonotum, with a broad base against the mesonotum, the axillae triangular, three times as long as wide in front, the outer edges of the two axillae slightly converging behind. Scutellum narrowed behind the tips of the axillæ to a slightly rounded point. Posterior face of the metanotum with an irregular large anterior areola and a smaller posterior one. First to sixth abdominal segments of about equal length, the seventh short; posterior angles of the sixth and seventh roundly produced so as to make the tip of the abdomen quadridentate. Legs very short, the middle tibiæ with a large stout spur, their metatarsi spinose. Hind tibiæ with two very small, delicate spurs, one of them almost obsolete. Wings entirely absent. Type. *P. aptera.*

The type species is of very peculiar appearance due to its flattened abdomen and long, slender antennæ and legs. It falls near *Solindenia* Cameron, from which it differs by the complete absence of wings, very slender antennæ, and distinctly exerted ovipositor.

Parasolindenia aptera sp. nov.

Female. Length 3.4 mm, width of abdomen 1.75 mm. Pale brown, the head bronzed black; the abdomen and pleuræ more or less bronzed. Head shining, but microscopically punctured or shagreened. Base of mandibles brownish. Antennæ 13-jointed, scape very slender, not at all thickened apically, rufous; flagellum slender, black, two and one-half times as long as the scape, its sixth and seventh joints pure white. Scutellum, axillæ, and anterior enclosure of the metanotum paler brown than the mesonotum. Abdomen fuscous, with indistinctly bronzed surface. Its surface has a silken appearance due to a thick appressed brownish pubescence over which are scattered

sparse, white appressed hairs; sides of the abdomen paler in color. Venter with a bluish cast, its pubescense sparse. Ovipositor as long as the apical two abdominal segments, pale with a black tip. Legs brownish, hind tibiæ lined above with pale yellow; first two joints of hind tarsi, except the extreme base of metatarsus, whitish. Tips of all the tarsi blackish.

A single female from Willomore, Cape Colony.

Eupelminus robustus sp. nov.

Female. Length 4-5 mm. Sub-opaque, piceous black, antennal scape, except the apex, annulus on antennæ, middle coxæ and trochanters, and the base of four hind tarsi honey-yellow, the markings of the legs being somewhat paler, especially apically. Head three times as wide as thick when seen from above, and a trifle longer than wide when seen from in front, its surface microscopically rugulose. Front above the antennæ almost flat, scarcely impressed. Malar furrow distinct. Eyes oval, distinctly hairy, separated above by more than one-third the width of the head, the lateral ocelli near, but not contiguous with the eye-margin. Antennæ slender, inserted considerably below the level of the lower eye-margin; flagellum slightly thickened apically, not quite twice as long as the scape, the single ring-joint as long as thick. Thorax very short, the mesonotum sharply declivous, the parapsidal elevations sharp. Prothorax as wide as long, transversely aciculated; mesonotum scarcely as long as wide; the scutellum so sharply declivous behind that its surface forms a right angle with the surface of the mesonotum. Axillæ small, triangular, scutellum broad, finely rugulose, as is also the short, simple metathorax. Abdomen ovate, as wide as the thorax and two and one-half times as long as wide, subopaque and sparsely pale hairy; the upper surface and the venter both convex; six visible segments, the second to fifth of about equal length, their posterior margins not incised; sixth longer, rounded at the tip, and with a few scattered punctures, ovipositor slightly exerted. Venter more shining. Legs rather stout, the anterior femora slightly swollen; middle tibiæ with a strong black spine, the middle metatarsi spinose; posterior femora swollen near the base, their tibiæ of even width and distinctly arcuated. Wings very small and narrow, extending only to the tip of the metathorax; fuscous, with an oblique band near the apex. They are distinctly angled or broken near the middle.

One female from Algoa Bay, Cape Colony.

A species of rather remarkable aspect. The abdomen is convex above and shape and texture departs from the more typical Eupelminæ, recalling in superficial appearance certain Scelionidæ except that there is no lateral carina. It would seem similar in some ways to *Arachnophaga* Ashmead, which has no malar furrow; it is also fully winged.

Eupelmus nubifer sp. nov.

Female. Length 4 mm. Ovipositor 1 mm. Black, the head and the pleuræ strongly blue, the thoracic dorsum and abdomen less strongly bronzed. Scape of antennæ and legs varied with brownish yellow; ovipositor pale. Wings with a large fuscous cloud. Head two and one-half times as wide as thick, with a coarsely reticulate sculpture partially concealing a fine transverse aciculation. On the occiput and cavity of the face the reticulations disappear and the transverse aciculations show plainly; cheeks shagreened; clypeus with rugosities and punctures intermixed. Mandibles and palpi black. Flagellum of antennæ slender, a little more than twice as long as the scape, pedicel a trifle longer than the first flagellar joint; ring joint quadrate; flagellar joints gradually shortening, the penultimate quadrate, one-half as long as the apical joint. Prothorax evenly narrowed anteriorly, three-fifths as long as wide, obliquely aciculate on each side; mesonotum shagreened, with a trace of transverse aciculation anteriorly; parapsidal elevations parallel, very distinct but not sharp above, the posterior margin of the segment raised, then suddenly declivous and more or less distinctly trilobed. Anterior median elevation rounded in front and tapering to a point just behind the middle of the mesonotum. Scutellum rounded behind, with a moderately wide base against the mesonotum; scapulæ about two times as long as wide. Metathorax very short; pleuræ shagreened. Abdomen spatulate, the posterior margins of the basal segments strongly incised, not quite as long as the head and thorax together. Dorsal surface concave, except at the tip. Legs rather slender, blue-black; the middle and posterior trochanters, all knees, bases and tips of tibiæ, and tarsi except tips, honey-yellow or lighter. Marginal vein one-third longer than the submarginal; postmarginal and stigmal short, about equal, the stigmal curved and but slightly knobbed at the tip.

One female from Bothaville, Orange Free State, May 15, 1899.

The roughly sculptured head and clouded wings ought to make this species easily recognizable.

Eupelmus volator sp. nov.

Female. Length 3.5 mm. Shining purplish black; trochanters, bases of femora, knees, base and tip of tibiæ, and tarsi except tips, brownish testaceous. Wings hyaline, the venation pale. Head shining, the occiput finely transversely aciculate and the cheeks vertically aciculate; malar furrow very distinct. Antennæ short, distinctly thickened toward the tip. Pedicel as long as the first flagellar joint and the ring joint together, the joints thereafter shortening and thickening, the sixth flagellar being quadrate; penultimate joint only one-third as long as the apical one. Eyes without trace of any pubescence. The insertion of the antennæ is distinctly below the level of the lower eye-margin, and they are well separated at the base. Clypeus convexly elevated. Prothorax very short; mesonotum shagreened, with the parapsidal elevations broadly rounded above, slightly convergent behind, meeting the transverse posterior elevation in a curve; central elevation rounded, not acute behind. Metanotum with a large impression on each side, separated by a median carina. Pleuræ shagreened. Abdomen not quite as long as the head and thorax together, concave above, the posterior margins of the basal segments deeply incised. Venter subopaque toward the base. Ovipositor as long as the head height, pale except at the extreme base and tip. Marginal vein about as long as the submarginal; postmarginal and stigmal subequal, each one-fourth as long as the marginal, the stigmal distinctly curved and but little enlarged at the tip.

One female from Port Elizabeth, South Africa, October 1, 1895.

This is possibly not a true *Eupelmus* on account of the entirely bare eyes, low insertion of the antennæ, but it seems to belong nowhere else and I hesitate to erect a new genus for its reception.

Eupelmus cursor sp. nov.

Female. Length 4.5 mm. Elongate, slender; apterous, except for very small wing pads which reach only to the tip of the scutellum. Black, more or less bronzed; the prothorax bright greenish-blue; antennal scape pale brown. Mesonotum brown, with metallic blue reflections behind; the elongate scapulæ pale yellow; middle and pos-

terior legs with the trochanters, knees, tips of tibiæ, and tarsi except tips pale yellowish. Head shining, shagreened, the facial depression with indications of transverse aciculation. Lower part of face golden or coppery, the clypeal margin slightly emarginate medially and edged with white hairs. Eyes faintly, but distinctly hairy. Prothorax twice as wide as long, concave above and polished. Parapsidal elevations very sharp, converging behind, the central portion longitudinally concave, without any indications of an anterior central elevation. Axillæ rather approximated, the base of the scutellum therefore narrower than usual, as is also the entire scutellum. Metanotum shining, irregularly raised. Abdomen narrow, a little longer than the thorax, convex above and beneath; first dorsal segment incised behind, second only roundly emarginate, and third almost entire; surface shagreened. Ovipositor exerted only one-half the head height; stout, pale yellow. Legs slender, the spines of the middle metatarsi pale yellow, concolorous with the tarsal joint and not at all conspicuous, the metatarsus is enlarged in the usual way however. Middle tibial spur strong.

One female from Bothaville, Orange Free State, May 1, 1899.

This is a slender species much like the North American *E. dryorhizoxeni* Ashm. It differs from the *Eupelminus* described on a previous page by its very narrow body, aside from generic differences.

Public Museum,
Milwaukee, December 15, 1906.

NOTES AND DESCRIPTIONS OF NORTH AMERICAN PARASITIC HYMENOPTERA. III.

By Charles T. Brues.

ENCYRTIDÆ.

Eupelmus melanderi sp. nov.

Female. Length 3 mm. Ovipositor 1 mm. Black, varied with brown and greenish reflections; legs brownish; ovipositor pale. Head black with metallic greenish reflections especially strong on the vertex, those on the sides of the face purplish. Labrum and mandibles yellow, the latter with black teeth. Palpi black. Antennæ 11-jointed, rather stout, the flagellum a little more than twice as long as the scape. Scape pale yellow beneath, darker above and at tip, flagellum black; pedicel as long as the first flagellar joint, the ring-joint short, but nearly quadrate; the first, second and third flagellar joints gradually decreasing in length, the third about twice as long as wide at tip; fourth to seventh decreasing in length, the seventh about quadrate; last joint enlarged, spatulate and as long as the two preceding. Thorax brownish-yellow, the middle lobe and the scutellum more or less black with greenish reflections. Prothorax twice as wide as long, bilobed. Mesonontum three times as long as the prothorax, the parapsidal elevations very short and high. Abdomen as long as the thorax, shining black; ovipositor and its sheaths pale except at the extreme base. Wings aborted, very short, reaching only to a little beyond the base of the second abdominal segment, bent upwards at the base of the abdomen, their tips infuscated; subcostal vein distinct. Legs brownish-yellow, the tips of the middle and hind tibiæ and their tarsi whitish; hind femora darker at the middle.

Described from three female specimens sent me by my friend Professor A. L. Melander. He bred them from a gall of *Rhodites* sp. on *Rosa piscocarpa* at Pullman, Wash.

This is a close relative of *Eupelmus dryorhizoxeni* Ashm., a species abundant in certain parts of the eastern states. The

antennæ are shorter and stouter however, the wings not so sharply and peculiarly bent, the prothorax shorter, and the entire insect of much stouter habitus.

ICHNEUMONIDÆ.

Callidiotes kansensis sp. nov.

Female. Length 4.5 mm. Black, legs reddish-yellow, prothorax rufous, base of antennæ brownish, just beyond the middle with a pale annulus. Clypeus yellow, first three abdominal segments margined with ferruginous. Head twice as wide as thick; face slightly narrowed below; cheeks below almost smooth, white pilose. Clypeus oval, with a raised anterior margin, its upper edge distinctly separated from the face. Mandibles black at the tip, palpi pale. Antennæ 34-jointed, as long as the body, joints 11-14 whitish. Parapsidal furrows indistinct, uniting above the scutellum to form a depressed scabrous area; parapsides and anterior part of the mesonotum smooth. Scutellum punctulate, rufous. Pleuræ finely punctate, sericeous pubescent, hind margin of mesopleural piece with a row of submarginal punctures and with a deep impression above the middle. Metanotum rugulose, completely areolated, the basal and middle lateral areas separated. Abdomen distinctly petiolate, the first segment nearly three times as long as wide at the tip, longitudinally aciculate, with a lateral carina behind the spiracle reaching to the tip. Viewed from the side the upper margin is evenly arcuated. Second and third segments of about equal length, the second nearly quadrate and finely microscopically rugulose and aciculate. Third segment scabrous, remainder shining. Tip of abdomen yellow, the ovipositor projecting as far as the length of the hind metatarsus, its sheaths broadened except at the tip. Venter whitish. Legs, including coxæ, brownish-yellow; fourth and fifth tarsal joints of equal length. Wings hyaline, veins piceous, stigma piceous with a white base; radius originating beyond the middle of the stigma, areolet absent. Basal and transverse median nervure interstitial. Transverse median nervure of hind wings broken near the tip.

Described from one female collected at Lawrence, Kansas, during July by Mrs. E. S. Tucker.

This is the first North American species to be referred to this genus. It resembles *Mesoleptus albifrons* Cresson, on account of the annulate antennæ, but the metathorax is completely

areolated and the radial vein originates beyond the middle of the stigma. The abdomen is not entirely smooth as in the European species of *Callidiotes,* but the present form agrees in all other characters of genric value.

Scopiorus monticola sp. nov.

Female. Length 5.5 mm. Black, with face, mandibles, first three antennal joints beneath, cheeks, palpi, tegulæ, antetegulæ, and venter, except for a median series of black spots, white. Legs, including coxæ, sternum, mesopleuræ and metapleuræ, except above, ferruginous. Apical two-fifths of posterior tibiæ and posterior tarsi from tip of first joint black. The clypeal suture and tip of mandibles are black and the white of the face medially emarginate above. Head and mesonotum smooth, polished, the former two and one-half times as wide as thick. Antennæ 27-jointed, almost as long as the body, acuminate at the apex and indistinctly broadened medially; first flagellar joint the longest, about four times as long as wide, remainder decreasing in length, the middle joints not quite twice as broad as long. Scutellum foveate at the base, the fovea smooth. Metathorax shining, almost smooth, very strongly areolated. Abdomen coriaceous at the base, apex of first segment and beyond smooth. First segment with a deep preapical transverse impression, the one on the second segment less deep and broader. Carinæ of first segment not reaching beyond the transverse impression. Second and following segments narrowly margined with white posteriorly. Wings hyaline, the veins piceous; stigma black with a white base. Ovipositor very short, yellow.

One specimen collected at Colorado Springs, Colorado, 5915 ft. Aug. (E. S. Tucker).

This species is related to *S. quebecensis* Provancher, but differs by the shorter carinæ on the basal abdominal segment as well as in coloration.

Metopius birkmani sp. nov.

Female. Length 10 mm. Black, marked with yellow as follows: Anterior orbits, spot below tegulæ, line in front, scutellum except base, spot on post-scutellum, spot at side of metathorax near apex, spot above posterior coxæ, first abdominal segment, and wide posterior margins of segments two to six. Four anterior legs, including coxæ, reddish-yellow, the femora darker medially. Posterior legs black, with the upper side of coxæ, trochanters, tip of femora, and base of tibiæ

reddish-yellow, remainder of tibiæ fuscous, tarsi ferruginous. Clypeal shield with a central carina; honey-yellow with a central black dot. Antennæ rufous, 41-jointed, the scape and pedicel yellow below. Wings deeply infuscated but hyaline at the tip, i. e., beyond the second recurrent nervure. Stigma fulvous, veins piceous. The facial shield is somewhat less than twice as high as wide, rounded below, the sides nearly straight, converging; clypeus truncate. The antennæ are short and stout, scarcely more than half the length of the body, the flagellar joints, toward the apex, at least three times as wide as long.

Male. Length 8mm. This sex is much lighter in color, with the wings more strongly infuscated. The legs are entirely yellow except for reddish blotches at the base of the hind coxæ and at the middle of the hind femora. The pro-, meso-, and metapleuræ each have a large yellow spot that almost entirely covers them and there is a stripe just below the mesosternal suture. The mesonotum has a large yellow spot connected with a large triangular humeral yellow spot. The tegulæ are also yellow. The facial shield is lemon-yellow, and slightly narrower than in the female. The antennæ are 39-jointed, the flagellum ferruginous. The bands on the abdomen are wider, occupying nearly the entire second segment, two-thirds of the third, and more than one-half of the following ones.

Described from two specimens, male and female, from Fedor, Lee Co., Texas. They were sent to me by Rev. G. Birkman with a number of interesting Texan Hymenoptera.

The sexes are so dissimilar, that unless associated might be taken for distinct species. The present form resembles *M. rufipes* Cresson from Colorado, but the hind legs of the female are more or less black and the clypeal shield yellow while there is no rufous on the legs or abdomen

ALYSIIDÆ.

Asobara barthii sp. nov.

Length 1.75—2.25 mm. Black, the legs, first two joints of antennæ, mandibles and legs, pale brownish-yellow. Prothorax and abdomen more or less piceous brown. Head shining black, almost twice as wide as thick. Mandibles bidentate, the outer tooth longer and a little curved. Clypeus projecting anteriorly, with a raised margin. Palpi whitish. Antennæ 18-jointed in the female and 19-jointed in the male;

the scape, pedicel and base of first flagellar joint brownish-yellow. First and second flagellar joints about equal in length, the first stouter, third and fourth decreasing, remainder shorter, subequal, each about two and one-half times as long as thick; apical joint a trifle larger, oval and more slender. Thorax polished black, the propleuræ piceous. Mesonotum with more or less distinct furrows anteriorly, scapulæ each with a deep transverse groove. Mesonotum just in front of the scutellum with a fovea and occasionally with a trace of an impressed line connecting this with the depression at the base of the scutellum. This depression is broad and deep, rugose at the bottom, and undivided by any carinæ. Scutellum rounded at the tip and polished. Metathorax finely rugulose, not areolated, with indications of some irregular longitudinal carinæ anteriorly. Abdomen sub-petiolate, the petiole brown, gradually widened, twice as wide at tip as at base, sculptured above with irregular aciculations. Remainder of abdomen piceous, shining. Ovipositor of the female three-fourths as long as the body, its sheaths sparsely clothed with long hairs. Legs pale yellowish-brown, the posterior femora and tibiæ weakly clavate. Wings hyaline, the stigma narrow, but distinctly triangular in outline, about four times as long as wide. Radial cell extending to the tip of the wing, the first abscissa of the radius as long as the second transverse cubitus. First cubital and first discoidal cell separated, the first transverse cubitus also present. Second discoidal cell distinct and closed, although very narrow.

Described from many specimens of both sexes bred from the puparium of a Syrphid fly (*Temnostoma bombylans* Fabr.) issuing May 30, 1906, Milwaukee, Wis.

The puparium was collected under the bark of a fallen log by my friend Dr. Geo. P. Barth, after whom I take great pleasure in dedicating the species.

The present form differs considerably from the more typical species of *Asobara* and may perhaps find a more congenial place after the various genera of this group have been more exhaustively studied.

Coelinius longulus Ashm.

In our collections are two males of this large species originally described from Colorado. They are from Nebraska and Wisconsin. In his description Ashmead states that the antennæ of the

type are broken. The complete appendages are 50-jointed and one and one-half times as long as the body.

Dinotrema soror sp. nov.

Female. Length 1.75 mm. Black; legs, first abdominal segment and basal three joints of antennæ reddish yellow. Head twice as wide as thick, polished above, below the antennæ convex and punctured. Mandibles honey-yellow, with black tips; palpi whitish. Cheeks smooth and polished. Antennæ 19-jointed, first flagellar joint narrower, but considerably longer than the second which is twice as long as wide; following joints sub-equal, those near the apex a little shorter and slightly moniliform in shape. Mesonotum polished, without any traces of parapsidal furrows. The scutellum at base with a large transverse fovea divided by a delicate median carina. Metanotum rugose-reticulate, without carinæ. Spiracles round, very distinct. Abdomen sub-petiolate, three times as long as wide at tip, its surface roughened. Rest of abdomen polished; ovipositor projecting beyond the tip of the abdomen by somewhat less than the length of the first abdominal segment. Legs reddish-yellow. Wings hyaline, stigma linear, imperceptibly thickened basally and extending to the tip of the radius. First discoidal cell sessile; first and second abscissæ of the radius meeting at a distinct angle, the first abscissa and the second transverse cubitus about equal. First cubital cell almost quadrate, the second receiving the recurrent nervure and therefore five-sided. Subdiscoidal nervure originating well below the middle of the discoidal nervure.

Described from a female sent me a number of years ago by Mr. H. G. Klages, collected at Pittsburg, Pa.

The genus *Dinotrema* has never had any species referred to it so far as I know, and Förster designated no type. The present species runs into this genus in both the classification adopted by Ashmead and by Szépligeti, so I have followed the custom usually adopted with Förster's atypical genera and referred it here as *Dinotrema*.

Orthostigma americana sp. nov.

Female. Length 3 mm. Black; under side of scape and pedicel, mandibles, palpi, tegulæ, and legs, luteous; the hind tibiæ and tarsi blackish. Head shining, two and one-half times as wide as thick, the temples full and the occiput concave. Face microscopically punctured, protuberant, sparsely whitish hairy. Mandibles tridentate, with a

triangular median tooth and two less distinct lateral ones. Antennæ very long, the flagellar joints nearly equal after the first two which are slightly longer and subequal, each being about four times as long as thick. Cheeks smooth and polished. Mesonotum smooth, with indistinct arcuate parapsidal furrows anteriorly, posteriorly with a deep medially elongated fovea which is almost confluent by its posterior point with the deep transverse scutellar fovea; the latter fluted along its bottom. Metanotum about as wide as long, not areolated or carinated, but irregularly and finely rugose. Pleuræ smooth and polished, the mesopleura below with a polished depression. Abdomen as long as the head and thorax; first segment microscopically roughened, the spiracular angles protuberant; about twice as long as wide at the apex which is one-half wider than the base; second and third shining, equal in length, the third widest; fourth and following narrowed to a point. Ovipositor shorter than the hind metatarsus. The abdomen is distinctly petiolate, convex above and not compressed apically, the second segment more or less brownish. Wings hyaline, the veins dark and very distinct. Radial cell closed at the tip of the wing, the stigma linear, but thickened and reaching to the middle of the radial cell, its sides parallel except at each end. First and second cubital cells separate, the second transverse cubitus about one-third the length of the second abscissa of the radius and equal to the first abscissa of the latter. Recurrent nervure received very near the base of the second cubital cell; second discoidal cell distinct, small and closed at apex, the subdiscoidal nervure not interstitial; submedian cell considerably longer than the median. Hind wings with the submedian cell one-half as long as the median along the costa.

Described from one female collected June 18, 1906, at Milwaukee, Wisconsin.

BRACONIDÆ.

Hormiopterus Giraud.

TABLE OF NORTH AMERICAN SPECIES.

1. Wings distinctly infuscated or banded..... 2
   Wings pure hyaline, antennæ 30-jointed, ovipostor nearly as long as the body.....**claripennis** sp. nov.
2. Ovipositor shorter than the abdomen..... 3
   Ovipositor one and two-thirds times the length of the entire body, wings with only a faint indication of a white band, antennæ 30-jointed, head and legs ferruginous....**caudatus** sp. nov.

3. Ovipositor two-thirds the length of the abdomen, anterior wings with a distinct white band, body entirely black..**fasciatus** Ashm.
Ovipositor one-half the length of the abdomen, wings subfuliginous with some whitish streaks, but without a distinct white band, body dark fuscous varied with ferruginous.
aciculatus Cress.

Hormiopterus claripennis sp. nov.

Female. Length 4.5 mm. Ovipositor 4.25. Black, head, base of antennæ, prothorax, tegulæ and legs more or less ferruginous or fuscous. Head more transverse than usual, about one-half wider than thick. Occiput and vertex shining and very finely and distinctly transversely aciculated; cheeks polished; face with a delicate sculpture and covered with sparse glistening hairs. Eyes very large, their long diameter more than half the head-height. Antennæ very slender throughout, 30-jointed, the flagellar joints after the first decreasing in length, but the subapical ones are fully three times as long as thick. The joints are of even thickness and not easily counted. Palpi long, pale yellow. Mesonotum smooth, except for the crenulate sutures and furrows. Pleuræ very finely rugulose and whitish-hairy. Metanotum rugulose, with faint traces of areolation. Abdomen not quite as long as the head and thorax together, at the base two-thirds as wide as the tip of the metathorax. First segment two and one-half times as long as wide at apex, its surface coarsely longitudinally striated; basal two-thirds of second segment striated above, the striæ reaching the tip laterally; the oblique impressions are long and reach the basal margin of the segment. Apical margin of the segments shining. Ovipositor black. Wings clear hyaline, the veins and stigma piceous black. Submedian cell longer than the median, recurrent nervure almost interstitial, being received by the very tip of the first (not second) cubital cell; sub-discoidal nervure interstitial; second abscissa of the radius one-half longer than the first and two-thirds as long as the second abscissa of the cubitus. Legs, including coxæ, fuscous, the anterior legs, middle tibiæ, and all tarsi and trochanters ferruginous. Posterior tibiæ with a pale yellow annulus at the extreme base.

One female, Douglas Co., Kansas, Sept., collected by Mr. E. S. Tucker and sent by him for identification.

The hyaline wings and general appearance of this species remind one of *Hormius,* but the neuration is that of *Hormiopterus.*

Hormiopterus caudatus sp. nov.

Female. Length 6 mm. Ovipositor 10 mm. Black, head, base of antennæ, prothorax, and legs ferruginous. Head full behind the eyes, its surface sub-opaque, finely rugulose, the occiput with faint transverse aciculations; cheeks nearly smooth and shining. Antennæ setaceous, the joints very distinct, 30-jointed, the flagellar joints decreasing in size regularly from the first which is four times as long as thick, while the sub-apical joints are but little longer than thick. Eyes very small, their diameter less than one-third the head height. Thorax subshining, black, the anterior part more or less fuscous; mesonotum faintly sculptured scutellum slightly convex at tip, with a fluted depression at the base; entire pleuræ rugulose. Metanotum rugose-reticulated, not areolated, with a median carina evident anteriorly but fading out behind, on each side of this are two very short carinæ arteriorly, parallel with the median one. Mesopleuræ with no smooth space. Abdomen almost as wide at base as the tip of the metathorax. First segment one and one-half times as long as wide at tip, the anterior angles each with a short longitudinal carina, surface irregularly striate longitudinally. Second segment one-half longer than the first, its anterior half longitudinally striate, especially towards the center, the oblique lateral impressions short and more nearly transverse than usual; apical segments smooth and shining. Sheaths of the ovipositor fuscous with black tips. Legs, including coxæ, entirely ferruginous. Wings infuscated; the stigma, except base and veins, piceous. From the base of the stigma there extends a narrow, more or less indistinct hyaline cross-band which has a branch extending along the second abscissa of the cubitus. Submedian cell longer than the median, subdiscoidal nervure straight, interstitial; recurrent nervure interstitial with the first transverse cubits; first and second abscissæ of the radius nearly equal, each about as long as the second transverse cubitus and one-half the length of the second abscissa of the cubitus.

Described from one female specimen from Fedor, Lee Co., Texas, April 26, 1904, (Rev. G. Birkman).

The species comes near to *H. aciculatus* Cresson, but differs on account of its very long ovipositor and different thoracic sculpture.

Public Museum,
Milwaukee, January 18, 1906.

A WEASEL NEW TO WISCONSIN'S FAUNA.

By Henry L. Ward.

Last November the Milwaukee Public Museum received as a gift from E. J. Wehmhoff, Esq., of Burlington, Wis., a small weasel in the flesh which Mr. Wehmhoff wrote had been "caught in the country in the act of killing a mole." The specimen had excited some interest and discussion as to its identity, which would indicate that it is not commonly observed. In conversation with the mother of the donor I am informed that her husband, Mr. Wehmhoff, has for forty years trapped all about Burlington and is consequently well informed as to the mammals of the region, but that he had never before seen or heard of this kind of weasel. From these facts it is not unlikely that the species is peculiar in its habits or is very scarce. Its small size probably militates against its being frequently taken in the ordinary traps intended for larger mammals; so that, after all, our knowledge as to its rarity is dependent on more or less fortuitous observation.

As the Museum possessed no specimens of short-tailed weasels for comparison it was impossible to make a satisfactory determination of the species, though from a consultation of the literature it seemed to conform very exactly with *P. rixosus* as described by Bangs in Proc. Biol. Soc'y., Wash., Vol. X. Its position in the extreme southern part of the state so poorly agreed with what is known of the geographical distribution of this northern species that it seemed hardly probable that in these times of close splitting of species by faunal areas it would be allowed as cospecific with *rixosus.*

In order to obtain a satisfactory determination I forwarded the specimen to Dr. C. H. Merriam, who writes under date of Jan. 9th: "I have just now examined the specimen in connection with our specimens of *rixosus* and *allegheniensis.* I regard *allegheniensis* as a subspecies of *rixosus.* Your specimen being in winter pelage does not show the dark belly of *allegheniensis,* but probably would have this character in summer pelage. It is a female and therefore does not show the skull characters to advantage. I regard it however as *allegheniensis.*"

Considering this determination as authoritative the species should then be known as *Putorius rixosus allegheniensis* (Rhoads) which Rhoads, in Proc. Acad. Nat. Sci., Phila., Feb. 7, 1901, calls Allegheny Weasel and in his Mammals of Pennsylvania and New Jersey, 1903 p. 173 terms Alleghenian Least Weasel.

Our specimen is No. 1363, female, Nov. 26, 1906, Burlington, Racine Co., Wis. The measurements taken in the flesh are: length of head and body, normal, 150 mm.; under tension, 160; tail before skinning, 29; vertebral measurement as determined after skinning, 27; manus, 13; pes 21; ear, back, 4; ear, notch to tip, 11. Skull: condylar basilar length, 30; zygomatic width, 15; mastoid width, 14; interorbital constriction, 6.5.

The species is remarkable not only from its small size, but also because of the extreme shortness of its tail, the vertebral part of which does not reach to the end of the toes in the made up skin and the hairs extend only about 5 mm. beyond them. The end of the tail appears to be entirely devoid of any suggestion of the dark tip common to other species of weasels, but when held against a white background it can be seen that about one-third of the terminal hairs are dark in color.

The underparts to middle of sides are white. The upper parts extending on outsides of hind legs to the heels are mixed "walnut brown" and white; deepest brown on the occiput and nucha, becoming lighter posteriorily and also laterally from the vertebral region. Low on the sides anteriorily as well as all the posterior part of the back the brown is so mixed and interrupted by white as to produce a clouded effect.

This winter has been remarkably open, there being hardly a trace of snow up to the time that this weasel was captured, yet its change to winter pelage was well advanced.

A very large female *P. noveboracensis* taken Jan. 13th, 1907, a few miles north of Milwaukee, at Whitefish Bay, shows no indication of assuming its white coat, whereas a good sized male taken a few miles south of the city at Hales Corners on Nov. 11, 1906, had changed to about the same degree as shown in our *alleghenicnsis*. At no time up to the middle of January had the ground either at Burlington or about Milwaukee been entirely covered with snow and the little that had fallen had soon disappeared. The temperature had been exceptionally high for this period of year.

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Vol. 5 (New Series) APRIL, 1907 No. 2

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

EDITED BY THE SECRETARY

CONTENTS:

MILWAUKEE, WISCONSIN.
THE EDW. KEOGH PRESS.

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The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6, 1857.

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Henry L. Ward, Vice-President.....Public Museum, Milwaukee.
Charles T. Brues, General Secretary.....Public Museum, Milwaukee.
William Finger, Treasurer.....297 12th Street, Milwaukee.
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REGULAR MEETINGS.

These are all held on the last Thursday of each month, except July and August, in the trustees' room in the Public Museum Building, Milwaukee.

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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 5, New Series. **APRIL, 1907.** **No. 2.**

PROCEEDINGS.

Milwaukee, Jan. 10, 1907..

Meeting of the combined sections.

President Teller in the chair, and Messrs. Barth, Brues, Brundage, Case, Colles, Doerflinger, Graenicher and Ward present.

The secretary read the minutes of the last meeting, which were approved.

Dr. Case spoke of collecting fossil reptiles in Texas, and related some of his experiences there during the past summer.

Mr. Teller exhibited a beautiful specimen of millerite, a sulphide of nickel. It was an inclusion in a mass of calcite crystals.

Mr. Brues exhibited part of a lot of fossil insects belonging to the Harvard Museum. There was considerable discussion among those present regarding the rock in which the fossils are imbedded and concerning the extreme abundance of fossil insects at Florissant, Colorado.

The meeting then adjourned.

Milwaukee, Jan. 31, 1907.

Regular monthly meeting of the Society.

President Teller in the chair, and about fifty persons present.

Mr. Ward called attention to the suppression of part of the appropriation for the Biological Survey in the agricultural appropriation bill, then before Congress, and moved that the secretary be instructed to express the disapproval of the Society of such action to the Wisconsin Members of Congress. Motion seconded and passed.

Mr. Teller called attention to the fact that there would be a vacancy on the Board of Trustees of the Public Museum in May, 1907, when the term of office of one of the citizen members of the Board expires. As the state law requires that the Wisconsin Natural History Society

annually nominate a person for this office who shall be preferred by the Mayor for appointment, Mr. Teller asked that the Society take action on the matter.

Dr. Case said that this matter would require mature deliberation and moved that it be referred to the Board of Directors. Motion was seconded and passed without further discussion.

There being no further business, Mr. C. T. Brues addressed the meeting on the "Rôle Played by Insects in the Transmission of Certain Disease of Man and the Higher Animals." The speaker referred to the wonderful progress made during recent years toward an understanding of this matter and outlined the discovery, investigation and final proof of the connection between mosquitoes and malarial and yellow fever. He described the life history of the mosquito and of the malarial parasite which is the direct cause of malaria. The relation of the abundance of mosquitoes to proper drainage and sanitation was referred to briefly before turning to a consideration of certain insect-borne diseases of animals caused by small parasites known as trypanosomes. He closed his remarks with a discussion of the cause of the so-called Texas fever of cattle and the importance of this disease in the economic development of the southern part of the United States.

The meeting then adjourned.

DIRECTORS' MEETING.

After the regular meeting, a Directors' meeting was held and the name of Edw. W. Windfelder chosen for nomination as member of the Board of Trustees of the Public Museum. The secretary was ordered to transmit this decision to the Mayor.

Milwaukee, Feb. 10, 1907.

Meeting of the combined sections.

President Teller in the chair, and the following members present: Miss Torelle, Messrs. Barth, Brues, Case, Colles, Clowes, Doerflinger, Graenicher, Russell and Ward.

The secretary read the minutes of the last section meeting, which were approved.

Dr. Case opened the discussion with a description of certain Permian reptiles which he had been studying and collecting for a number of years. He referred particularly to a species of *Naosaurus* which had recently been mounted in the American Museum of Natural History. He told something of the history of the study of this peculiar

reptile and its relatives, and gave his most recent views concerning the probable cause for the remarkable developments shown by certain parts of the skeleton. The interesting geographical distribution of related Permian reptiles was also outlined.

Mr. Ward then exhibited a series of weasel skins from Wisconsin. He referred critically to the various records of species of weasels occurring in the state. He showed a skin of *Putorius rixosus allegheniensis* (Rhoades) from Burlington, Wis., a record which widely extends the known range of the species.

Mr. Brues then referred to a recent deviation in zoological nomenclature by a writer on a group of stony corals who considered it necessary to abandon binomial nomenclature and adopt a geographical series of names numbered according to the localities from which the species came.

The meeting then adjourned.

Milwaukee, Feb. 28, 1907.

Regular monthly meeting of the Society.

President Teller in the chair, and about 75 members present.

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

Mr. Teller reported that a committee consisting of Dr. Graenicher and himself had called upon the Mayor regarding the appointment of a trustee for the Public Museum.

The secretary read an invitation from the seventh international congress of Zoologists for the society to be represented by delegates at its Boston meeting in August in 1907.

There being no further business, Prof. S. W. Williston of the University of Chicago, delivered a lecture on the phylogeny of the Elephant.

The lecturer described with the aid of lantern slides the evolutional development of the Proboscidea to the modern elephants from the earliest known forms, recently discovered in Egypt, with the upper and lower incisors or tusks adapted for gnawing after the manner of rodents. The lower pair was gradually lost, while the upper ones became greatly increased in size. Their geographical migrations from Africa, through Europe to North America in recent times, and finally to South America, through the open land communication of the northwest and the Isthmus of Panama were traced. The numerous species inhabiting North America since late Miocene times were discussed, with a brief

history of the later elephants of the United States that have only recently disappeared. After the lecture President Teller thanked Professor Williston for his kindness in coming to Milwaukee to lecture, and expressed the great appreciation of the Natural History Society.

The meeting then adjourned.

Milwaukee, March 21, 1907.

Meeting of the combined sections.

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

Mr. George W. Colles spoke on the Classification and Origin of the Micas.

The term mica embraces a group of minerals which have certain marked chemical and physical characteristics, the principal of which is their cleavability into thin flexible plates. They are all compound hydrous silicates of aluminum and another base of a highly complex character. As is usual in complex minerals of this sort, the chemical composition is not fixed and invariable as in quartz, calcite and gypsum, and consequently to find a rational chemical formula which would embrace all the mica minerals was a very difficult matter. It was accomplished, however, by Mr. F. W. Clarke, who has given much study to the question of chemical formulas for minerals.

According to the old standard classification, which seems to have been followed by everyone who has written on the subject until the publication of Colles' work, all mica was divided into three sorts, termed muscovite, phlogopite and biotite. There is neither rhyme nor reason in such a classification as this. While the species known as muscovite and phlogopite belong in two separate groups, the term biotite either was applied to two different types or else it represented a type of which phlogopite was a mere variety. There are really two different main groups into which all the numerous species and varieties of mica that have been described naturally fall. Chemically, these are distinguished as monad and dyad types, that is, types in which the positive radicals are monads or dyads, respectively. Because of this difference in chemical composition the two classes have been called perissad and artiad micas, respectively, from the Greek words for "odd" and "even." In the perissad group the principal monad radicals are H, K, Li, $Al(OH)_2$, AlF_2, AlO, Fe‴, and in case of the semi-mica paragonite, Na. The principal dyad bases are Mg, Fe″, AlOH and AlF.

These chemical differences correspond to certain physical and mineralogical differences which are likewise strongly marked, whence the two classes may be termed alkaline and magnesian, or again granitic and pyroxenic; or again igneous and aqueo-igneous. The first class occurs in granitic rocks; the second in pyroxene, especially in connection with calcite and apatite. Micas of the first class are comparatively hard, brittle and anhydrous; those of the second class are soft, flexible and contain slightly more water, which is more easily driven off by heat. Moreover, the alkaline micas are more often clear and transparent, but the magnesian are invariably colored, whence it arises that the latter are worthless for glazing purposes, which has been until recently the principal commercial use of mica. It was not, therefore, until the development of the electrical industry that this magnesian mica came to have a commercial value.

It is remarkable, however, that while the granitic micas are of common occurrence in all parts of the world, the magnesian micas are comparatively rare, and there is only one district where they are at present mined, this being the Laurentian of Canada.

The circumstance of formation and the difference of the deposits point clearly to an absolutely different mode of origin of the alkaline from the magnesian micas. While different theories have been put forward to account for the former, the weight of evidence seems to show an origin by metamorphism and heat alone, probably accompanied by great pressure in the cases where large crystals are formed. The origin of the magnesian micas, on the other hand, is far from clear, but it is certain that it was absolutely different from that of the alkaline micas; and the most likely theory seems to be that they were formed near the surface from or in connection with a magnesian magma with the aid of hot water, steam and gases.

The speaker alluded to the existence of numerous facts in support of the theories and conclusions given, which, however, could not be stated in details in a short discussion.

After some discussion on the part of several members, Mr. Charles H. Doerflinger spoke on some recent archeological discoveries in Southern France.

The following papers were ordered printed by the Board of Directors:

NOTES ON A NEW GUEST-ANT, *LEPTOTHORAX GLACIALIS*, AND THE VARIETIES OF *MYRMICA BREVINODIS* EMERY.

By William Morton Wheeler.

In two former papers* I described the habits of *Leptothorax emersoni,* a small yellowish Myrmicine ant, which lives in interesting symbiotic relations with *Myrmica rubra brevinodis,* a larger brown species of the same subfamily. The *Leptothorax* occupies small cavities, communicating by means of tenuous galleries with the more spacious chambers and galleries of the *Myrmica,* and, while freely and intimately consorting with its host, is very careful to keep its own brood isolated. This small ant feeds, as I have shown, partly on the oleaginous secretion covering the bodies of the *Myrmica* workers, whom it licks and shampoos with comical assiduity, and partly on the liquid food which, after submitting to this treatment, these insects regurgitate.

L. emersoni was first discovered among the Litchfield Hills of Connecticut, at altitudes varying from 1,000 to 1,600 feet, but subsequently I found it also at similar elevations in the Berkshire Hills of Massachusetts. More recently, Mrs. Annie Trumbull Slosson took a single winged female on the summit of Mt. Washington. These facts indicate that the species belongs to the subboreal or alpine fauna, a conclusion which is confirmed by a study of the distribution of its host ant. As this host is extremely common in the Rocky Mountains and apparently also throughout British America, I fully expected to find the *Leptothorax* occuring over much of the same territory, but, although during the summer of 1903 I collected ants extensively in Colorado at alti-

*The Compound and Mixed Nests of American Ants. Amer. Natural. XXXV, 1901, pp. 431-415; and Ethological Observations on an American Ant (*Leptothorax Emersoni* Wheeler) Arch. f. Psych. u. Neurol. II, 1903, pp. 1-31, 1 Fig.

tudes varying from 5,000 to 10,000 feet, I never once saw a specimen. During the summer of 1906, however, while collecting in Florissant Cañon, at an elevation of 8,500 feet, I came upon a flourishing colony of *M. brevinodis* spread out under a group of five flat stones on the grassy bank of a stream and containing numerous workers, a few callow females and males, and many larvæ and pupæ of a *Leptothorax,* which, on account of its very dark color, I at first took to be an undescribed species. Closer examination, however, showed that it might be regarded more properly as a subspecies of the New England *emersoni.* The host, too, was found to differ in several minor characters from the eastern form of *M. brevinodis.* A portion of the Florissant colony was taken alive and kept for six weeks in an artificial nest for the purpose of observing the behavior of the ants. My notes on this colony will be recorded below, after a description of the new subspecies of *Leptothorax* and a revision of the varieties of *M. brevinodis.* It was necessary to make this revision in order to gain a clearer conception of the taxonomic affinities of the host ants to each other and to the other varieties of the subspecies.

Leptothorax emersoni glacialis subsp. nov.

The worker measures 3-3.5 mm. in length and differs from the worker of the typical *emersoni* in the following characters: the mesonotum is distinctly less convex so that the thorax in profile is more like that of *L. acervorum,* and the hairs are less abundant and somewhat more reclinate on the antennæ and legs. As in the typical form, many of the hairs on the body and tibiæ are obtuse, but not clavate. The head and gaster are black, the thorax, upper portion of the petiole and postpetiole, and the extreme base of the gaster, dark brown; the legs, antennæ, clypeus and mandibles are yellowish brown, the clubs of the antennæ infuscated. The worker is less variable in size, and individuals with ocelli are much rarer than in the typical *emersoni.*

The female is no larger than the worker and of a very similar color, except that in mature specimens the thoracic dorsum is as dark as the head and gaster.

The male measures 3 mm. and is black throughout, except the tarsi and articulation of the legs, which are sordid yellow. The mandibles

are more pointed, and the thorax is more robust than in the male of the typical form. The pronotum and scutellum are much more opaque and heavily sculptured, the former being densely punctate and rugose, with three shining streaks, one down the middle and the others over the parapsidal furrows. The scutellum and epinotum are densely reticulate-punctate. In the typical *emersoni* the pronotum is shining, distinctly foveolate in front and rugose-punctate behind. The wings of *glacialis* are larger, broader and more whitish.

L. emersoni and its subspecies belong to a small group of the genus characterized by 11-jointed antennæ in the worker and female and a distinct though feeble constriction of the thorax at the mesoëpinotal suture. For this group, which comprises also the circumpolar *L. acervorum, muscorum* and *hirticornis,* and the neoboreal *provancheri,* Ruszsky* has recently erected a distinct subgenus, *Mychothorax. L. emersoni,* is evidently very closely related to *L. provancheri Emery,* but the latter is said to have clavate hairs on the tibiæ, whereas in the former the hairs both on the body and tibiæ, though often obtuse, are never clavate. As Emery described *provancheri* from a single specimen, this species, when more specimens are available, may prove to be cospecific with the one I have called *emersoni.*

Examination of several hundred specimens from a large number of colonies of *Myrmica rubra* from different parts of North America convinces me that Emery† was right in concluding that the true palearctic *M. rubra sulcinodis* Nyl. does not occur in this country, but is replaced by a distinct subspecies, *brevinodis.*. Of this Emery distinguished two forms, the typical *brevinodis* and a variety which he called *sulcinodoides,* because it approaches the European subspecies somewhat more closely. More recently Forel

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*The Ants of the Russian Empire. Kasan, 1905, p. 609 *et seq.* (in Russian).

†Beiträge zur Kenntniss der nordamerikanischen Ameisenfauna. Zool. Jahrb. Abth. f. Syst. VIII, 1894, pp. 312, 313.

‡Descriptions of Some Ants from the Rocky Mountains of Canada. Trans. Ent. Soc. Lond. 1902, pp. 699, 700.

has described a second variety, *frigida,* from British Columbia. The North American *brevinodis,* like the European *sulcinodis,* is restricted to the mountains, though in the Northern States one of its varieties occasionally, and in British America probably more generally, descends to much lower elevations. The worker and female of *M. brevinodis* differ from *sulcinodis* in the shape of the antennal scape, which even in the variety *sulcinodoides* is more uniformly and gracefully bent at the base. The males of all the forms of *brevinodis* I have seen, have the scape unusually short, never more than a third and often only a fifth or sixth as long as the funiculus, whereas the scape of the male *sulcinodis* is nearly half as long as the remainder of the antenna. The body of the male *brevinodis* is, moreover, always deep black, whereas it is more or less red or brown in the European subspecies. Although even in single colonies the size, sculpture and color of the individuals may vary considerably, I am able to distinguish the following varieties among the specimens in my collection:

1. **Myrmica rubra brevinodis** Emery, (typical).

This form was based on some workers from Salt Lake, Utah. Emery's description agrees very closely with a form which is not uncommon in Colorado, at altitudes below 7,000 feet, nesting in the sandy and gravelly banks of streams. The male described by Emery cannot belong to this, or indeed to any other form of *brevinodis,* on account of the great length of the antennal scape, which is recorded as "not quite as long as half of the funiculus." The following description is drawn from specimens belonging to a single colony:

Worker. Length 4—4.5 mm. Antennal scape evenly bent at the base, not angular and not compressed, gradually enlarged distally. Epinotum with well-developed, rather slender and curved spines, which are nearly as long as the base of the segment. Petiole short, less than twice as long as broad, in profile with gradual, concave, anterior slope, rather acute summit and angularly convex posterior slope. Sculpture of body moderately strong; rugæ on upper surface of head sharply longitudinal and reticulate, on the occiput and sides of head reticulate

only; the interrugal surfaces over the whole region finely and rather feebly punctate. Thorax with coarse, regular, longitudinal rugæ except on the sides of the pronotum where the surface, at least behind, is uniformly and densely punctate. Petiole and sides of postpetiole longitudinally rugose, node of latter smoother and densely punctate, finely striated or sometimes slightly glabrous. Hairs moderately abundant, slender and pointed. Body and appendages red; gaster with a broad dark brown or blackish band across the middle.

Female. Length 5—6 mm. Antennæ and sculpture of head like those of worker; thorax more sharply longitudinally striated above. Head, thorax, pedicel and appendages red; gaster black or dark brown; an anteromedian and two parapsidal blotches on the mesonotum, the metanotum, and posterior border of the scutellum, black. Nodes of petiole and postpetiole and in some specimens also the upper surface of the head dark brown. Wings dilute yellowish at the base, with pale brown veins and stigma.

Male. Length 4.5—4.8 mm. Scapes straight, rather stout, about ⅓ as long as the funiculus, and as long as its five basal joints together; club 4-jointed. Hairs white, very slender, rather long and abundant, erect or suberect on both the body and appendages. Body black; tarsi, mandibles, genitalia and articulations of the legs yellowish; antennæ reddish brown. Wings white, very faintly yellowish at the base, with pale yellow veins and stigma.

Colorado: Colorado Springs, 5,990 feet (Wheeler); Boulder, 5,347 feet (T. D. A. Cockerell).

2. Var. **brevispinosa** var. nov.

Worker. Resembling the preceding in stature and color, but with very short spines which are not longer than half the basal surface of the epinotum and with more irregular, vermiculate thoracic rugæ.

Female. Somewhat paler than the typical form. The anteromedian blotch of the mesonotum is lacking and the gaster is red, with a broad brown band across its middle. The epinotal spines are hardly longer than broad at their bases. Wings colored like those of the typical form.

Male. Scapes somewhat curved and constricted at the base, about ¼ as long as the funiculus and as long as its four basal joints together.

Colorado: Cheyenne Cañon, 8,500 feet, and Colorado City, 6,064 feet (Wheeler); Cañon City, 5,329 feet (P. J. Schmitt).

New Mexico: Las Vegas, 6,398 feet, and Pecos, 6,366 feet (T. D. A. Cockerell).

The specimens from Pecos (two workers) have unusually short spines, which are hardly longer than broad at their bases.

3. Var. **decedens** var. nov.

Worker. Length 3.5—4 mm. Scapes evenly curved at the base as in the typical form. Spines short, straight and acute, somewhat more than half as long as the base of the epinotum. Sculpture of head as in the typical form, but the thorax above vermiculately and reticulately, instead of longitudinally rugose; sides of pronotum densely punctate, meso- and metapleuræ longitudinally rugose. Sculpture of petiole and postpetiole as in the typical form. Body and appendages yellowish brown; head dark brown or blackish above; gaster black.

Male. Length 4.5 mm. Scapes straight, nearly ⅓ as long as the funiculi. Wings uniformly whitish hyaline, not suffused with yellow at the base; veins and stigma very pale brown.

Colorado: Buena Vista, 7,900 feet, and Florissant, 8,500 feet (Wheeler).

Colonies rather small, nesting under stones in grassy places on the banks of streams.

4. Var. **sulcinodoides** Emery.

Emery included more than one variety under this name, as shown by the localities which he cites (South Dakota, Utah, Maine). I would restrict the name to a distinct, large and dark-colored form, which is very common in the Rocky Mountains, at an altitude of 8,000 to 10,000 feet under stones and logs along the margins of subalpine streams and meadows. The larvæ and immature pupæ of this form have a pecular greenish yellow color and oily luster, which I have not observed in any of the other varieties. Emery's statement that *sulcinodoides* approaches the European *sulcinodis*, is true of the worker but not of the male, which has extremely short antennal scapes.

Worker. Length 4.5—5.3 mm. Antennal scapes with a distinctly angular bend at the base, which is narrow and somewhat compressed. Spines as long as the base of the epinotum, slender, straight, acute and diverging. Sculpture strong; rugæ on the sides of the head

reticulate and not longitudinal, those on the thorax somewhat reticulate above, but longitudinal on the sides, even of the pronotum. Petiole and postpetiole sharply and longitudinally sulcate, the node of the latter sometimes more finely and irregularly rugose or more or less punctate. Hairs yellow, acute, rather short and moderately abundant. Head and gaster black; thorax, petiole and postpetiole deep red or, in some colonies, almost black; mandibles, antennæ and legs of a somewhat lighter red.

Female. Length 6—6.5 mm. Resembling the worker. Spines as long as the base of the epinotum, straight, rapidly tapering and blunt at their tips. In some specimens the thorax is entirely black, like the head and gaster, and there is a black spot on each node of the pedicel; in others the thorax is deep red, with the mesopleuræ, metanotum, posterior border of scutellum and the mesonotum, except for a pair of small red anterior and a larger posteromedian spot, black. Wings distinctly brown at the base, with light brown veins and stigma.

Male. Length 5.5—6 mm. Scapes very short and straight, only about ⅙ as long as the funiculus and as long as its two basal joints. Club distinctly 5-jointed. Hairs yellow, long and abundant, especially on the legs. Body and appendages black; antennal clubs dark red, tarsi dark brown, articulations of legs yellowish. Wings like those of the female.

Utah: (Emery).

Colorado: Florissant, 8,000-9,000 feet; Cheyenne Cañon, 5,990 feet (Wheeler); Westcliffe, 7,849 feet, and Boulder, 5,347 feet (P. J. Schmitt); Ward, 9,000 feet, and Half-way House, Pike's Peak (T. D. A. Cockerell).

New Mexico: Top of Las Vegas Range, 11,000 feet; Harvey's Ranch, Las Vegas Range, 9,600 feet; Beulah, 8,000 feet; (T. D. A. Cockerell), Beatty's Cabin, Upper Pecos Valley (Mrs. W. P. Cockerell).

5. Var. **canadensis** var. nov.

Worker. Length 4—5 mm. Differs from the variety *sulcinodoides* in its somewhat smaller size and in the coloration, which is yellowish brown, with the upper surface of the head and the gaster, except at the base and tip, dark brown or blackish. The sculpture on the head is somewhat weaker, the hairs on the body slender and pointed.

Female. Length 5—5.5 mm. Resembling the worker. Thorax yellowish brown with the metanotum, posterior border of scutellum, an anteromedian, often double, blotch and two large parapsidal blotches on the mesonotum, black. Wings distinctly brown at the base, with brown veins and stigma.

Male. Length 5—5.7 mm. Closely resembling the male of the var. *sulcinodoides*, and with equally short antennal scapes. The wings, however, are of a deeper brown at their bases, the mesonotum is more densely and more extensively striated, and the hairs on the legs are shorter and stiffer.

Connecticut: Colebrook, Litchfield County, 1,000-1,600 feet.

Massachusetts: New Boston, Berkshire County, 1,400 feet.

Maine: (Pergande); Ogunquit (H. S. Platt).

Pennsylvania: Lehigh Gap.

Michigan: Marquette (M. Downing); Isle Royale (O. Gleason).

Wisconsin: Milwaukee (C. E. Brown).

Nova Scotia: Digby (J. Russell).

British Columbia: Golden (W. Wenman).

This is the only form of *brevinodis* which descends to lower levels in the Northern States. Transitional forms between it and the true *sulcinodoides* undoubtedly occur. Females from several of the Nova Scotia colonies have the thorax nearly black, and the workers of many colonies from the same region are almost yellow, with only the posterior portion of the head and a broad band across the gaster dark brown. The var. *canadensis* rarely reaches as great a size as the variety to which I have restricted the name *sulcinodoides*, and nests in cool bogs or meadows, under stones or logs. Its larvæ and young pupæ are pearly white and not greenish yellow.

6. Var. **subalpina** var. nov.

Worker. Length 4—5 mm. Resembling *canadensis* in color but differing both from it and *sulcinodoides* in having the hairs on the body obtuse, instead of pointed, and somewhat stouter than in the other varieties.

Female. Length 4.8—5 mm. Colored like the female of *canadensis*, but with the wings whitish hyaline throughout, with very pale brown

veins and stigma, and the upper surfaces of the petiole and postpetiole black.

Male. Length 4.3—4.8 mm. Closely resembling the male of *canadensis*, but with the wings colorless at the base as in the covarietal female.

Colorado: Florissant Cañon, occuring at a higher level (8,500) than *sulcinodoides* and replacing this variety along the margins of some of the streams and meadows.

7. Var. **frigida** Forel.

According to Forel, the worker of this variety has "the head longitudinally rugose, also at the sides, and nearly without transversal reticulations (in the typical *brevinodis,* the sides of the head are more reticulated). The abdomen highly polished, with only a few scattered erect hairs (more hairy and with slight scattered punctures in the typical *brevinodis.*) The whole body less hairy than in the typical *brevinodis.* Red; the abdomen and the upper side of the head brown. In all other parts like the typical form of the subspecies.

"Ice River Valley, British Columbia, 5,000 feet." [Edw. Whymper].

A single worker from Homer, Alaska, (A. Mehner) and a number of workers and males from the Bay of Islands, Newfoundland (L. P. Gratacap) in my collection agree very well with Forel's description. The color of the workers and the shape of the antennal scapes are the same as in the var. *sulcinodoides.* The sculpture is also very similar, except that the sides of the head are longitudinally rugose, and the petiole is coarsely longitudinally rugose in front and transversely rugose behind. In the male, the scapes are very short, not longer than the two succeeding joints together, or ⅓ of the funiculus. The hairs on the body and legs are nearly white. Length of worker, 4.8—5.3 mm; of the male, 5.5—6 mm.

The host of the typical *Leptothorax emersoni* is the variety above described as *canadensis,* that of *L. glacialis* the var. *subalpina.* I have been unable to detect any differences in the habits or behavior of these two host ants. The nest of the Colo-

rado variety resembled in every way that of the Connecticut form, and the small nests of *L. glacialis* were arranged around the periphery under the edges of the stones in the same manner as those of the typical *emersoni* in the bogs of the Litchfield Hills. That the habits of the Western inquiline, however. are somewhat different from those of the Eastern type, is indicated by the following notes on the colony kept under observation in an artificial nest from July 17th to August 31st.

The artificial nest was of the design which I have described and figured in a former paper.* and consisted of two chambers of the same size, one of which was kept dry and illuminated, the other darkened and kept moist with a slice of sponge soaked in water. The installed colony consisted of the broods of both species, about a hundred *Leptothorax* workers, and a few males and females, and about seventy-five *Myrmica* workers. The queen of the latter species escaped while the ants were being collected. As soon as the ants and their broods. together with some of the earth in which they had been living, were placed in the lighted chamber, the Myrmicas hastened to transport their own larvæ and pupæ to the dark chamber. The *Leptothorax*, however, remained behind, and by the following day had hollowed out a small cavity in the earth and had brought into it all their young. This cavity was immediately beneath the glass roof-pane and fully exposed to the light. The Myrmicas kept visiting the *Leptothorax* continually, but the latter pulled the intruders by the forelegs or antennæ, and in every way showed the same desire to be left alone in their own habitaculum, as I have observed, under similar circumstances, in the Eastern *emersoni*. The Myrmicas endured no end of tweaking and pulling, but nevertheless kept pushing their way into the *Leptothorax* cavity as if unable to forego the society of their little inquilines.

Although so jealously guarding their own habitaculum against

*On the Founding of Colonies by Queen Ants, with Special Reference to the Parasitic and Slave-Making Species. Bull. Am. Mus. Nat. Hist. XXII, 1906, p. 48, fig. 1.

the intruders, the *Leptothorax* workers did not hesitate to enter the chamber in which the Myrmicas had taken up their abode. There they ran about, accosting the Myrmicas, which had gorged themselves with the sugar water in the manger in one of the corners of the chamber. The *Leptothorax* mounted their backs, shampooed their bodies and then, turning to the ventral side, promptly placed their tongues in contact with those of their host and imbibed the regurgitated sweets. The shampooing, however, was of much briefer duration and much more perfunctory than in the colonies of the typical *emersoni.* Often the *glacialis* worker omitted these manipulations altogether and went at once to the mouth of its host. Sometimes as many as five or six of the little ants would remain standing on the floor of the nest and drink simultaneously from the tongue of a single *Myrmica.* If the host failed to proffer the droplet of food, the *Leptothorax* would usually pinch her fore leg or antenna, and this more emphatic and probably more painful appeal rarely failed to elicit the desired response. The *Leptothorax* undoubtedly obtained all of their food from their hosts, for during the entire six weeks they were under observation, I never found one of them eating from the manger, or even showing the slightest interest in its contents. In the privacy of their own quarters, however, they freely fed one another by regurgitation with the food they had obtained from the Myrmicas.

As by July 20th the *Leptothorax* had shown no disposition to move their brood into the dark chamber with the Myrmicas, I undertook to coerce them by exposing their quarters to the bright sunlight. Even this had no effect, till the glass roof-pane became heated, when they slowly and reluctantly took up their larvæ and pupæ and migrated into the dark chamber. Then the entrance between the two chambers was closed. I expected the *Leptothorax* to establish themselves in one of the larger cavities of the sponge, as had been done by some of my colonies of the typical *emersoni,* but they merely stacked their brood in three piles at the end of the sponge. Here they were, of course, fully exposed to the *Myrmica* workers and the latter began to visit them assiduously. The

presence of the brood, however, caused the *Leptothorax* to react by pulling and tweaking the fore legs and antennæ of their visitors. By the following day they had brought all their laræ and pupæ together in a single pile on the side of the sponge opposite that occupied by the Myrmicas and their brood.

July 23rd I left Florissant, and for several days traveled about in Colorado, carrying the nest in my luggage. The jarring of the railway train must have had a tendency to mingle the broods of the two species, for during the night of July 23rd to 24th, the *Leptothorax* built a wall of agglutinated sugar crystals about 4 cm. long, parallel with and about a cm. from the edge of the sponge. This wall they were apparently unable to carry up to the roof-pane, so that the long, narrow chamher which they had endeavored to construct, and in which they had placed their brood, was open above and at both ends. The visiting Myrmicas were in no wise restrained by the crystalline rampart, but in their uncontrollable craving to be near the little inquilines kept climbing over it or pushing their way into the openings at the ends.

No change was observed in the relations of the two species till I reached Colorado Springs, July 26th, when I found that the *Leptothorax* had abandoned their useless abode at the edge of the sponge and had moved their brood in under a delicate film of sugar, which they had built inside the food-cup. This film was fastened to the floor and to the vertical wall of the cup, so as to enclose a triangular cavity, which communicated with the outside by means of a single small opening. Structurally this little cell was, of course, an admirable contrivance for preventing the visits of the Myrmicas, but, unfortunately, by August 1st, its sugar wall had been partly dissolved by the moisture in the chamber, and partly eaten by the host ants, so that the little guests and their brood were again exposed on all sides. They now gave up all attempts at keeping their brood sequestered, and by August 3rd, when I arrived in New York, to my surprise, both species had collected and mingled their broods together in a single large cavity in the sponge. Henceforth, till all of the pupæ of both species had hatched, the workers of one species did not hesitate

to seize and carry the offspring of the other indiscriminately, although up to this time neither had shown the slightest interest in the brood of the other. By reversing the illumination of the chambers and keeping damp sponges in both of them, it was possible to make the ants move back and forth from one to the other, but, although this was repeated on several successive days, the ants always ended by keeping their brood intermingled, either at the edge of the sponge, or in one of its cavities. The original compound nest had, therefore, been converted into a mixed colony. This was quite unexpected, as I had found it extremely difficult to bring about such a result in my colonies of the typical *L. emersoni* and *M. canadensis.* The rapidity of this conversion may have been connected with the condition of the inquiline and host broods, for at the time of its occurrence all the larvæ had become pupæ, and many of these were pigmented and ready to hatch. The presence of eggs or larvæ among the *Leptothorax* brood would probably have rendered such a fusion of the two colonies impossible.

Early in August a few males and females of the *Leptothorax* and seven males of the *Myrmica* made their appearance. The behavior of the inquilines towards the latter was the same as towards the workers. The little ants shampooed these black, winged creatures and licked their mouth-parts, but I was unable to ascertain whether any food was regurgitated. The *Leptothorax* were always on hand whenever a *Myrmica* male was being fed by a worker of its own species. Sometimes the guests would congregate in numbers and lap up portions of the food as it was passing from the tongue of the worker to that of the male.

August 10th I isolated twenty of the *Leptothorax* workers and a few of their pupæ in a nest provided with honey and a few dismembered house-flies. The ants lived for a few days in a cavity of the sponge till their pupæ had hatched and then wandered aimlessly about the nest. They were never seen to approach the food in the manger and gradually died one by one before the end of the month. This result was very different from that obtained with isolated colonies of the typical *L. emersoni,* for these soon

learned to eat from the manger and lived several months as a pure colony.

During August the gaster of one of the larger *Myrmica* workers in the original nest became unusually distended, and as small packets of eggs were continually appearing and being as rapidly devoured by the workers, I concluded that this unusual individual had become gynæcoid and was trying to function as the queen of the colony. At the end of the month, after all the brood of both species had hatched and the ants had become demoralized, as usually happens when there are no young on which to concentrate their attention, I discontinued my observations. The gynæcoid worker was dissected and found to contain a number of mature eggs.

The above observations indicate that the habits of *L. glacialis* are similar to those of the typical *emersoni,* although differing in two important respects: first, the Colorado form feeds less on the surface secretions of its host and more on regurgitated food; and, second, this ant seems to have lost the instinct to secure its food in any other way. If further observations should prove that these differences are common to all colonies of *L. glacialis,* and not an idiosyncracy of the colony which I happened to have under observation, or due to the depressing and demoralizing effects of confinement in an artificial nest, we should be justified in concluding that this subspecies has reached a more advanced stage of inquilinism or parasitism than the typical form of the Eastern States.

American Museum of Natural History,
New York City, March 9th, 1907.

WISCONSIN FLOWERS AND THEIR POLLINATION.

II.

By S. Graenicher.

SAXIFRAGACEÆ and GROSSULARIACEÆ.*

FAM. SAXIFRAGACEÆ.

Saxifraga Pennsylvanica L. Swamp Saxifrage.

The genus Saxifraga is represented by a very large number of species in Europe, and for many of these their relations to insect visitors have been recorded, while for our North American species this has not been done in a single instance. The only one occurring in our immediate neighborhood is the species named above. It is fairly common in swampy grounds, and is rather large for a saxifrage, some specimens attaining a height of about 1 m. In the Menomonee Valley, between Milwaukee and Wauwatosa, the plants were seen in blossom from May 15 to June 18. The numerous small flowers (about 5 mm. in diameter) are arranged in cymes, and the latter form a long panicle on a stout scape. In the erect flower the small greenish calyx-lobes are reflexed, but the lanceolate white petals assume an horizontal position, and the 10 stamens in 2 rows are also directed laterally from the time on that they begin to shed their pollen. The upper portion of the ovary forms a disc-shaped nectary around the two styles, and nectar is secreted in abundance. These flowers are decidedly proterandrous, and in this respect they agree with the majority of the European species, very few of which are proterogynous. Dehiscence starts in the stamens belonging to the outer row, and a few days later those of the inner row become

*Classification and nomenclature according to "Britton's Manual of the Flora of the Northern States and Canada."

involved in the same process. At the beginning of this, the male stage of the flower's existence, the styles are very short, and the stigmas hardly noticeable. But the styles gradually rise above their surroundings, and after all the anthers have emptied their reddish-yellow pollen the small capitate stigmas become receptive. The female stage is therefore very plainly separated from the male stage, and in such a flower self-pollination is entirely out of the question. Cross-pollination is insured by the visits of numerous insects, and these obtain a bountiful supply of nectar and pollen. The individual flower is unsightly, but the grouping of such a large number as are usually present in the inflorescence of each plant renders the whole more or less attractive. Corresponding with the entirely exposed situation of the nectar we find these small flowers visited nearly exclusively by insects with short tongues. Several European species of Saxifraga are especially attractive to flies, but in our *S. Pennsylvanica* other short-tongued insects are just as well represented, and the small bees of the genus Halictus are always regular attendants. According to the list given below the flies and short-tongued bees together represent 64% of the entire number of visitors, and this agrees quite well with the figures obtained for other flowers with entirely exposed nectar.

A. Hymenoptera.

Apidæ: (1) *Apis mellifera* L., worker, s.; Andrenidæ: (2) *Andrena mariæ* Rob., female, s.; (3) *Halictus pilosus* Sm., female, s. and c. p.; (4) *H. zephyrus* Sm., female, s. and c. p.; (5) *H. sparsus* Rob., female, s. and c. p.; (6) *H. hortensis* Lov., female, s. and c. p.; (7) *H. anomalus* Rob., female, s. and c. p.; (8) *Sphecodes cressonii* Rob., female, s.; (9) *S. arvensis* Patton, female, s.; (10) *Prosopis pygmæa* Cr., male, s.; Eumenidæ: (11) *Odynerus philadelphiæ* Sauss., s.; Crabronidæ: (12) *Crabro obscurus* Sm., s.; (13) *C. trifasciatus* Say, s.; (14) *Oxybelus 4-notatus* Say, s.; Ichneumonidæ: (15) *Ichneumon* sp., s.; (15) *Cryptus persimilis* Cr., s.; (17) *Cryptus* sp., s.; (18) *Chorinæus carinatus* Cr., s.; Tenthredinidæ: (19) *Dolerus similis* Norton, s.; (20) *D. aprilis* Norton, s.

B. Diptera,

Stratiomyidæ: (21) *Odontomyia pubescens* Day; Syrphidæ: (22) *Paragus bicolor* Fab.; (23) *Platychirus quadratus* Say; (24) *Allograpta obliqua* Say; (25) *Mesogramma marginata* Say; (26) *Sphærophoria cylindrica* Say; (27) *Syritta pipiens* L.; Conopidæ (28) *Zodion fulvifrons* Say; Tachinidæ: (29) *Exorista confinis* Fall.; Sarcophagidæ: (30) *Sarcophaga helicis* Town.; Muscidæ: (31) *Lucilia cæsar L.;* (32) *L. sylvarum* Meig.; Anthomyidæ (3) *Phorbia fusciceps* Zett.; (34) *Phorbia* sp.; (35) *Hydrotæa* sp.; Geomyzidæ: (36) *Agromyza æneiventris* Fall.—all s. or f. p.

C. Coleoptera.

Elateridæ: (37) *Glyphonyx recticollis* Say; Cerambycidæ: (38) *Acmæops bivittata* Say; Chrysomelidæ: (39) *Orsodachna atra Ahr.*—all s. or f. p.

Heuchera hispida Pursh. Rough Heuchera. Alum-root.

This plant is remarkable on account of the close relations existing between it and the bee *Colletes æstivalis* Patton. The latter is an oligotropic bee, collecting pollen from the flowers of some species of Heuchera only, and it has been observed by Patton (1) in Connecticut, on the flowers of *H. americana*, and by Robertson (2) in Southern Illinois, on *H. hispida*. Around Milwaukee it is a regular visitor of the latter species, and last year, on June 3, I also came across it at Eagle, Waukesha Co., Wis., where *H. hispida* occurs in great numbers along the railroad leading to Palmyra. In Illinois Roberson found the plant visited by this bee exclusively, but in our region bees of the

(1) W. H. Patton. Proc. Bost. Soc. Nat. Hist. XX, pp. 142-144 (1879).

(2) Chas. Robertson. Flowers and Insects. VIII. Bot. Gaz. XVII, pp. 178-179 (1892).

Chas. Robertson. Notes on Bees, etc. Trans. Am. Ent. Soc. XXII, p. 116 (1895).

genera Halictus and Augochlora also resort to these flowers in search of pollen, as shown by the heavy and very conspicuous load of brick-red pollen that they carry away. The earliest flowers of *Heuchera hispida* make their appearance several days ahead of their special pollinator *Colletes œstivalis.* In 1901, for example, the first flowers were noticed on June 7. On June 11 the females of Halictus and Augochlora were busy at these flowers, but of Colletes a single specimen was seen, a male flying around the flowers in search of the females, which had not arrived up to this time. Four days later, however, (at the time of my next visit) they were also present, sucking and collecting pollen. Judging from the description of the flowers as given by Robertson, those of our surroundings agree essentially with those from Southern Illinois. The inflorescence is a panicle containing numerous greenish tubular flowers, which have been observed in blossom from June 3 to July 2. Along its upper side the flower is longer than along the lower side; in other words, it is obliquely cut off, and the width of 4 mm. enables the visiting short-tongued bees to insert their heads into the tube in search of nectar at the bottom. The tube is 6 mm. long, and nectar is secreted in drops on the upper surface of the ovary and on the adjacent walls of the calyx. These flowers are proterogynous, but the upper anthers shed their pollen soon after the stigmas have become receptive. The two divergent styles, with their small stigmas, reach the mouth of the flower, but since the dehiscent anthers are situated 2 or 3 mm. beyond the mouth of the flower, spontaneous self-pollination can hardly be expected to take place in the nodding flower. As a rule, the flowers are visited early before their anthers begin to open, and this insures cross-pollination. The following bees were taken on the flowers:

Andrenidæ: (1) *Colletes œstivalis,* Patton, male and female, s. and c. p.; (2) *Halictus provancheri* D. T., female, s. and c. p.; (3) *H. zephyrus* Sm., female, s. and c. p.; (4) *H. hortensis* Lov., female, s. and c. p.; (5) *Augochlora confusa* Rob., female, s. and c. p.

Mitella diphylla L. Mitrewort.

The small, white, cup-shaped flowers, blooming from about May 5 to June 15, are adapted to small-sized insects. Syrphid-flies and short-tongued bees are the principal visitors, and the smallest among these belonging to the fly-genus Paragus, and the bee-genus Halictus are the most frequent ones, as far as the number of individuals is concerned. The flowers are arranged in a terminal raceme on a scape that attains a length of 30 to 40 cm. At its entrance the flower is 2 mm. wide, its depth is the same, and the nectar-drops on the lower portion of the calyx-tube are easily reached by insects with very short mouth-parts. The small, triangular calyx-lobes are erect, while the much longer white petals, with their fringed appearance, are spread out laterally or reflexed, as in the older flower. There are 10 stamens, all of them arising at the same level from the wall of the calyx and converging towards the middle, thereby forming with their anthers a small circle below the mouth of the flower. The very short styles, with their stigmas, are situated somewhat below the anthers. In the opening flower the anthers are all nearer to the calxy-tube but as those of the 5 stamens that alternate with the petals begin to open, they move towards the middle, and later on the 5 remaining stamens undertake the same movements. Proterandry is present, but of short duration, since the stigmas reach maturity very soon after the first anthers have burst open. In view of the vertical position of the flower, spontaneous self-pollination by the falling of pollen can hardly be expected, at least not in the young flowers. But the styles increase in length and place the stigmas beneath the anthers, and in the older flower this kind of pollination may take place if pollination through insects has not been accomplished previously. The latter are mostly present to such an extent as to insure either cross or self-pollination. Pollen is transported by the mouth-parts of the visitors. When in search of nectar an insect has to insert its proboscis between the stigmas and the introrse anthers, whereby some of the pollen adheres to the sides of the proboscis and in this way may be brought in con-

tact with the stigmas of the same or of another flower. Following is a list of the bees and flies observed on the flowers:

A. Hymenoptera.

Apidæ: (1) *Ceratina dupla* Say., female, s.; Andrenidæ: (2) *Augochlora confusa* Rob., female, s.; (3) *Halictus quadrimaculatus* Rob., female, s. and c. p.; (4) *H. pilosus* Sm., female, s. and c. p.; (5) *H. albipennis* Rob., female, s. and c. p.; (6) *H. hortensis* Lov., female, s. and c. p.

B. Diptera.

Syrphidæ: (7) *Paragus bicolor* Fab.; (8) *Allograpta obliqua* Say.; (9) *Mesogramma marginata* Say.; (10) *Sphœrophoria cylindrica* Say —— all s. or f. p.

FAM. GROSSULARIACEÆ.

Within the genus Ribes (currants and gooseberries) the species differ considerably in the structure of the flowers, and accordingly in their adaptation to insects, as has been shown by Hermann Mueller (3) for several species of Europe. The same is clearly illustrated by the 5 species of our region considered below. We have on one side the primitive and saucer-shaped flowers of *R. rubrum* receiving the attention of small and poorly adapted insects; on the other side, the campanulate flowers of *R. gracile* and *R. floridum* adapted to the largest among the specialized bees (the bumble bees), and between the two extremes we find *R. oxyacanthoides* and *R. Cynosbati*, adapted to bees in general.

They all bloom close together, as will be seen from the follow-

(3) H. Mueller. Weitere Beobachtungen, pp. 298-300. See also P. Knuth Handb. d. Bluetenbiologie, Vol. II, p. 437.

ing dates, indicating the blooming periods of these species as observed around Milwaukee:

R. rubrum, April 24—May 27.
R. Cynosbati, May 2—May 29.
R. floridum, May 6—June 7.
R. gracile. May 6—May 25.
R. oxyacanthoides, May 9—June 16.

According to these observations, all of the species have their flowers open together between May 9 and 27.

Ribes rubrum L. Red currant.

This plant is an inhabitant of damp woods, and is rapidly disappearing from the immediate surroundings of Milwaukee on account of the changed condition of most of the woods of our territory. It occurs also in Europe and Asia, and H. Mueller (4) has given an account of its pollination. The structure of the flower, as it occurs with us, does not quite agree with Mueller's description and the figure presented by Knuth (5). The flower of our region is purplish, has a diameter of about 6 mm., and is rather flat, with entirely exposed nectar like *R. alpinum* (6), while the European one is more campanulate, with slightly concealed nectar. From this we must conclude that the flower of the North American *R. rubrum* has remained nearer to the primitive type of the ancestral flower, while in Europe the flower has progressed in the direction of a campanulate flower. The same may be stated for the cultivated form, the red currant of our gardens.

There are 20 or more flowers in a drooping raceme. The stamens, with their introrse anthers, and the style with the greenish 2-parted stigma, are all of the same length, hardly reaching 1 mm. above the disc. The anthers and the stigma become mature at the same time (homogamy). Nectar appears as small drops on the

(4) H. Mueller. Die Befruchtung der Blumen durch Insekten, p. 95.

(5) P. Knuth. Handb. d. Bluetenbiologie, Vol. II, part 1, p. 439.

(6) H. Mueller. Loc. cit., p. 94.

uneven purplish disc, and the flowers are slightly sweet-scented. Insects crawling around on them may effect either self or cross-pollination. Some of the flowers are directed upwards, while others assume a vertical position, and in the latter pollen may fall down on the stigma and cause spontaneous self-pollination. The only visitors I have been able to observe on the few plants met were with a small fly, *Themira putris L.*, (family Sepsidæ), and a small parasitic wasp, *Orthocentrus nigricoxis* Prov., (Tryphoninæ).

Ribes oxyacanthoides L. Northern gooseberry.

In this species the greenish pendulous flower is campanulate. The different parts at the entrance, i. e., the calyx-lobes, petals, and long stamens are more or less divergent, and for this reason insects can easily gain access to the flower. The white petals are inserted near the upper margin of the calyx-tube, and in this region the latter measures 3 mm. across and is just as deep. The flowers are homogamous. From its middle on the style is divided into 2 long slender branches, and these gradually become divergent, and carry the stigmas a short dlistance past the anthers. There is hardly any possibility of the latter coming in contact with the stigmas, but spontaneous self-pollination due to the falling of pollen may take place in the drooping flower. Nectar is present at the bottom, and is to some extent hidden from view and protected by hairs on the lower part of the calyx-tube and the style. In some flowers round openings may be noticed in the wall of the calyx-tube near its base, and these are made by ants, and enable the latter to steal nectar from the outside instead of proceeding along the natural route which is protected by hairs. The structure of these flowers and their pendulous position point to an adaptation to bees, and 7 of the 9 visitors figuring in the following list are bees:

A. Hymenoptera.

Apidæ: (1) *Bombus consimilis* Cr., female, s.; (2) *B. affinis* Cr., female, s.; (3) *B. ternarius* Say., female, s.;

Andrenidæ: (4) *Andrena milwaukeensis* Graen., female, s.; (5) *A. vicina* Sm., female, s.; (6) *Halictus coriaceus* Sm., female, s. and c. p.; (7) *H. forbesii* Rob., female, s. and c. p.; Eumenidæ: (8) *Eumenes fraternus* Say, s.

B. Diptera.

Syrphidæ: (9) *Melanostoma obscurum* Say., f. p.

Ribes Cynosbati L. Wild gooseberry.

There are usually 3 of the greenish campanulate flowers forming a small raceme only 3 cm. in length. The calyx-lobes are entirely reflexed, but the much smaller white petals are erect. At its entrance the flower has a diameter of 3 mm., it widens out somewhat below, and has a depth of 4 mm. The stamens arise from the calyx-tube a short distance below the petals and converge towards the style. The anthers form a ring around the style about 1½ mm. beyond the mouth of the flower, and, as a rule, the dark-green two-parted stigma surpasses the white anthers by at least 1 mm. But the style shows a tendency to variation, and in some plants the stigma hardly surpasses the anthers at all, thereby favoring spontaneous self-pollination in these homogamous flowers. Nectar is present at the bottom of the tube, a sweet odor is noticeable, and the laterally directed flowers are well visited by insects, mostly bees. Numerous hairs arising from the inner wall of the calyx-tube, as also from the style, serve to protect the nectar from unwelcome visitors, but so far as ants are concerned, I have on several occasions seen specimens of *Cremastogaster lineolata* (Say) Emery and *Formica fusca* L. var. *subsericea* (Say) Emery force their way down to the nectar. Not rarely these ants also gain an entrance to the flower by biting a piece out of the calyx-wall, and Trelease (7) has seen the white-faced hornet (*Vespa maculata* L.) perforating these flowers in the same manner; although on other occasions he witnessed this insect

(7) Wm. Trelease. Note on the Perforation of Flowers. Bull. Torr. Bot. Club, VIII, pp. 68-69 (1881).

visiting the flowers in a legitimate way. The following insects were seen on the flowers:

A. Hymenoptera.

Apidæ: (1) *Apis mellifera* L., worker, s.; (2) *Bombus virginicus* Oliv., female, s.; (3) *B. americanorum* Fabr., female, s.; (4) *B. separatus* Cr., female, s.; (5) *B. ternarius*, Say., female, s.; Andrenidæ: (6) *Andrena milwaukeensis* Graen., female, s. and c. p.; (7) *A. vicina* Sm., female, s. and c. p.; (8) *A. nivalis* Sm., female, s. and c. p.; (9) *A. dubia* Rob., male, s.; (10) *Halictus lerouxii* Lep., female, s.; Vespidæ: (11) *Vespa germanica* Fabr., s.

B. Diptera.

Syrphidæ: (12) *Pipiza femoralis* Lw.; (13) *Syrphus americanus* Wied. —— all s. or f. p.

Ribes gracile Michx. Slender gooseberry.

Robertson (8) has made us acquainted with the mode of pollination of this species. In the slender, pendulous flower, the calyx-lobes are reflexed, and together with the petals, they serve as footholds for the visiting bees. The converging stamens are rather long, and extend in the flowers of our region about 11 mm. beyond the calyx-tube. The latter is 3 mm. deep. By pressing up against the filaments, the erect petals, which are only 2 mm. long, form a tube which practically constitutes an elongation of the calyx-tube. In order to reach the nectar at the bottom of the flower, the insect must have a proboscis of at least 4 mm. length. This is inserted through one of the openings between two filaments and the top of a petal. In this species, as in the two preceding ones, there are numerous hairs at the bottom of the tube.

In these flowers we are dealing with proterandry. When the first anthers dehisce the stigma is still 4 mm. below the anthers (above in the pendulous flower), but on account of a gradual

(8) Chas. Robertson. Flowers and Insects. IX. Bot. Gaz. XVII, pp. 270-271 (1892).

lengthening of the style, the stigma surpasses the anthers before it becomes receptive. Pollination is generally due to insects and the flowers are, as Robertson states, adapted to bumble bee females, the only sex of bumble bees represented so early in the year. On account of their size, they are the only bees which, while hanging on to the flowers, are capable of sucking, and at the same time touching the anthers and stigma. These parts of the flower come in contact with the ventral surface of the base of the abdomen. Robertson observed 4 species of bumble bees, and in addition to these, 18 smaller bees which he regards as intruders, for the reasons set forth above. But in several instances I have seen some of the smaller bees (species of Andrena) visiting the flowers for nectar, and besides crawling to the top of the flower for the purpose of collecting pollen. Such visits of the smaller bees are of course of as much importance to the flower as the visits of bumblebees, although these flowers are undoubtedly adapted to the latter. The exceptional visits of flies to such a flower are of little significance. At Milwaukee I have seen the following insects as visitors:

A. Hymenoptera.

Apidæ: (1) *Bombus americanorum* Fabr., female, s.; (2) *B. consimilis* Cr., female, s.; (3) *Nomada cressonii* Rob., female, s.; (4) *Ceratina dupla,* Say, male, s.; Andrenidæ: (5) *Andrena nivalis* Sm., female s. and c. p.; (6) *A. milwaukeensis* Graen., female, s. and c. p.; (7) *A. cressonii,* Rob., female, s. and c. p.; (8) *Augochlora confusa* Rob., female, s.; (9) *Halictus lerouxii* Lep., female, s.; (10) *H. provancheri,* D. T., female, s.; (11) *H. quadrimaculatus* Rob., female, s.; (12) *H. connexus* Cr., female, s.; (13) *H. albipennis* Rob., female, s.; (14) *Sphecodes clematidis* Rob., female, s.; Eumenidæ: (15) *Odynerus philadelphiæ* Saus, s.

B. Diptera.

Syrphidæ: (16) *Syrphus americanus* Wied., f. p.

C. Lepidoptera.

Sphingidæ: (17) *Hemaris diffinis* Bsdv., s.

Ribes floridum L'Her. Wild black currant.

When visiting the yellowish-green pendulous flowers of this species, the bees hold on to the reflexed calyx-lobes the same as in the case of *R. gracile*. The white, erect petals form together with the slightly shorter stamens, a tube of 3 mm. length on top of the calyx-tube, which is 4 mm. long. The whole tube is, therefore, 7 mm. long; it has a diameter of 3 mm. at its entrance, and widens out to 4 mm lower down. The anthers are situated just inside of the mouth of the flower, but the two-parted stigma protrudes slightly. Anthers and stigma reach maturity together, and spontaneous self-pollination is very apt to take place on account of the falling of the pollen. There is a free supply of nectar at the bottom of the flower, but no protecting hairs are present as in the three preceding species with campanulate flowers. These flowers are adapted to bumble bees, but smaller bees also pay their attention to them on account of the pollen near the mouth of the flower. Any of these bees may be instrumental in effecting either self or cross-pollination, but the latter is favored by the advanced position of the stigma. Bees, the names of which I herewith present, were the only visitors witnessed on the flowers:

Apidæ: (1) *Bombus pennsylvanicus* Deg., female, s.; (2) *B. separatus* Cr., female, s.; Andrenidæ: (3) *Andrena nivalis* Sm., female, c. p.; (4) *Halictus coriaceus* Sm., female, c. p.; (5) *H. forbesii* Rob., female, c. p.; (6) *H. versatus* Rob., female, c. p.

NOTES AND DESCRIPTIONS OF NORTH AMERICAN PARASITIC HYMENOPTERA. IV.

By Charles Thomas Brues.

A very interesting lot of small Hymenoptera collected by Mr. Charles Schaeffer, of the Museum of the Brooklyn Academy of Arts and Sciences, have furnished most of the material contained in the following pages.

They were collected principally in the Southwest, and were kindly sent to me by Mr. Schaeffer for examination. The types of these species are in the Brooklyn Museum, those of the others in the Milwaukee Public Museum.

FAMILY BETHYLIDÆ.

Epyris Westwood.

A considerable number of species of this large cosmopolitan genus have been described from the United States. Some of them are very closely allied, but the following table will aid in their identification.

Kieffer includes in *Epyris* all species previously put into *Mesitius* by Ashmead and others, restricting *Mesitius* to certain forms not occurring in our fauna. I have followed his arrangement, and our species heretofore placed in this latter genus will be found in the table:

1. Scutellum with two distinctly separated foveæ at the base.... 2
   Scutellum with a broad transverse impressed line at the base, or at least a narrow one connecting two foveæ..... 16
   Scutellum without either groove or foveæ; black, legs and antennæ brown, wings brownish.....**reticulatus** Kieffer.
2. Wings fully developed..... 3
   Wings short, reaching to only a little beyond the base of the abdomen; legs rufous, metanotum with a faint median carina .....**brachypterus** Ashmead.

3. Body entirely black..... 5
   Body pale, or the tip of the abdomen conspicuously red..... 4
4. Brownish-testaceous, head piceous, antennæ and legs honey yellow .....**flaviventris** Kieffer.
   Only the tip of the abdomen reddish.....**texanus** Ashmead.
5. Metanotum with a median raised longitudinal line or carina which extends to the tip, and often with shorter basal ones on each side..... 6
   Metanotum without a median carina except toward the base, four anterior tibiæ and all tarsi rufous.....**indivisus** Kieffer.
6. Wings hyaline or nearly so..... 7
   Wings distinctly subfuscous..... 15
7. Metanotum with only a single median carina, aside from the lateral raised margins..... 8
   Metanotum with additional longitudinal carinæ on each side of the median one toward the base..... 11
8. Pronotum twice as long as the mesonotum..... 9
   Pronotum at most one-third longer than the mesonotum..... 10
9. Eyes bare, femora black.....**clarimontis** Kieffer.
   Eyes hairy, legs entirely reddish.....**longicollis** Kieffer.
10. Head above finely punctate.....**nudicornis** Kieffer.
    Head above impunctate.....**erigoni** Kieffer.
11. Legs in part black, at least some of the coxæ..... 12
    Legs including coxæ pale rufous or pale honey-yellow, metathorax with about seven raised lines, the lateral ones abbreviated .....**bifoveolatus** Ashmead.
12. Legs entirely black, the tibiæ and tarsi brownish pubescent. **monticola** Ashmead.
    Legs not entirely black..... 13
13. Prothorax twice as long as the mesonotum; legs rufous, coxæ and anterior femora black, middle and posterior femora fuscous .....**minutus** Ashmead.
    Prothorax at least three times as long as the mesonotum.... 14
14. Head one-half longer than broad, joints 2-5 of the flagellum one half as long as thick.....**californicus** Ashmead.
    Head scarcely longer than wide, joints 2-5 of flagellum quadrate .....**myrmecophilus** Brues.

15. Mandibles with only a large outer tooth, the inner margin scarcely denticulate, femora distinctly reddish. **nevadensis** Ashmead.
Mandibles with inner denticulations besides the large outer tooth, all the femora black..... **vancouverensis** Ashmead.
16. Wings well-developed 17
Wings very small, reaching only to the tip of the metathorax; legs including coxæ rufo-ferruginous; head nearly twice as long as wide..... **subapterus** Melander and Brues.
17. Head and thorax metallic green, abdomen black, with ferruginous tip 18
Body black, sometimes æneous, especially the head..... 19
18. Head and thorax bright golden green, posterior face of metanotum polished, with a median raised line.. **fulgens** sp. nov.
Head and thorax dark metallic green, posterior face of metanotum transversely aciculated..... **analis** Cresson.
19. Four posterior coxæ and legs pale or rufous..... 20
All coxæ black..... 24
20. Head black or bluish, not at all metallic..... 21
Head æneous, abdomen bluish-black, wings fuscous. **æneiceps** Ashmead.
21. Head very large, broader than the thorax and strongly punctured ..... **megacephalus** Ashmead.
Head normal 22
22. Head and thorax bluish, transverse median nervure in wing giving out a spurious vein toward the disk of the wing. **grandis** Ashmead.
Head and thorax black..... 23
23. Mesopleura foveated, mandibles 5-dentate..... **rufipes** Say.
Mesopleura areolated, mandibles 6-dentate.. **columbianus** Ashmead.
24. Metathorax with five raised longitudinal lines..... 25
Metathorax with only one distinct delicate raised longitudinal line ..... **carbonarius** Ashmead.
25. Wings sub-hyaline, abdomen entirely black.. **occidentalis** Ashmead.
Wings sub-fuscous, abdomen red at the tip. **hæmorrhoidalis** Kieffer.*

*This is placed by Kieffer (Archiv f. Zool. I, 528 (1904), in his genus *Rhabdepyris*, characterized by simple tarsal claws, but this species as well as others later placed by him in *Rhabdepyris* have bifid claws. I have therefore included it provisionally in *Epyris*.

Epyris fulgens sp. nov.

Female. Length 7 mm. Head, thorax, and scutellum brilliant metallic green, metanotum purplish; abdomen black, with the tip of the fourth and all the following segments rufo-ferruginous. Legs except anterior coxæ and base of posterior pair ferruginous. Legs and antennæ, except second joint, rufous. Head as long as wide, polished, not shagreened, but covered with very sparse distinct punctures, without any median groove on the front. Eyes bare, separated by one-third their length from the posterior margin of the head. Malar space short. Antennal scape much swollen apically and bent, as long as the three following joints together; pedicel and second flagellar joints of equal length, the first flagellar joint only one-half as long; following gradually increasing, the fifth quadrate. Pronotum punctured like the head, rounded in front and on the sides, without any lateral or anterior carinæ. Mesonotum and scutellum smooth, with scarcely any punctures; the parapsidal furrows complete, but stronger behind; lateral furrows strongly convergent anteriorly, but not extending much more than halfway toward the anterior margin. Scutellum with a narrow straight basal groove connecting the two basal foveæ. Metanotum quadrate, with five longitudinal carinæ that extend to the posterior margin; between them the surface is transversely rugulose and on the sides microscopically transversely aciculated. Sides and posterior edges with a submarginal ridged groove like those between the discal carinæ. Posterior face polished, divided by a median line. Abdomen considerably shorter than the thorax, polished except for delicate scattered punctures on the anterior half of the apical segments. Venter with the posterior parts of the apical segments finely punctured. Legs stout, incrassated, middle and posterior tibiæ strongly spinulose. Tarsal claws with a single tooth within, the anterior metatarsus a little longer than the three following joints. Mesopleuræ polished, with a few punctures, below with a grooved line, and behind with an arcuate elongate fovea; above with a shallow oval fovea. Metapleuræ shagreened. Wings sub-hyaline, the anterior part distinctly infuscated. Stigma quadrate, postmarginal vein wanting, radial one-half as long as the basal, which is a little shorter than the strongly arcuate transverse median.

Described from one female collected by Mr. Schaeffer at Esperanza Ranch, Brownsville, Texas, August 4.

This resembles *E. aurichalceus* Westwood, from the West Indies, but this species as identified by Kieffer (Bull. Soc. Hist. Nat. Metz., XII (2 Ser.) 1905, p. 12), belongs to *Anisepyris,* in which the pronotum is margined anteriorly. It differs also by the entire lateral carinæ of the metanotum. From the South American *E. planiceps* Fabr., it differs by its lighter color, more evenly darkened wings and purplish metanotum, and from *E. analis* Cress. by the brighter color and different sculpture of the posterior face of the metanotum.

It is the most handsome species yet to be discovered in our fauna.

Parasierola bicarinata sp. nov.

Female. Length 3.5 mm. Shining black; mandibles, antennæ, coxæ and legs yellowish ferruginous. Head as high as broad, finely shagreened and covered with large thimble-like punctures that are separated by about twice their width. Front below with a median carina which reaches up as far as the middle of the eye and is continued onward about the ocelli as a widening polished strip. Eyes oval, bare, separated by one-half their length from the occiput. Head behind sculptured as in front. Projecting lobe of clypeus rounded, honey-yellow; mandibles with four teeth, of which the outer one is considerably the largest. Antennæ reaching to the tip of the pronotum, slender, 13-jointed, attenuated at the tips. Scape rather slender, as long as the first two flagellar joints together; pedicel and first two flagellar joints of about equal length, from thence the joints become shorter and narrower, the apical six joints being moniliform. The basal flagellar joints are scarcely longer than wide. Prothorax about as wide as long, shagreened and punctured like the head. Mesonotum about as long as the pronotum and similarly sculptured, without any trace of furrows except posteriorly very near the lateral margins, which evidently correspond to the outer pair of furrows seen in some genera. Scutellum rounded-triangular, two-thirds as long as the mesonotum, with a broad transverse groove at the base which is widened to form a rather distinct fovea on each side; its posterior edge with a series of about six large punctures. Metathorax quadrate, finely sculptured, with a smooth space medially in front that bears a pair of nearly confluent foveæ and with a carina on each side one-half way to the margin; its posterior face margined above and on the

sides. Abdomen oval, shining black. Legs stout, tarsal claws with a large triangular pointed tooth at the base which is very large and longer than the claw. Wings faintly tinged with fuscous; stigmata piceous; veins fuscous; radial vein reaching nearly half-way from the stigma to the wing tip; basal nervure broken at the middle, the closed discoidal cell as large as the stigma, its cubital side the shortest.

Brownsville, Texas. Mr. Schaeffer.

This form is related to *P. flavicoxis* Kieffer, from Nicaragua, but the mandibles are quadridentate and there is a longitudinal discal carina on each side of the median smooth space on the metanotum. It differs from *P. cellularis* Say, by the much shorter pronotum, as I have identified Say's species. It is evident, however, that what Kieffer rediscribed as *cellularis* (Berliner Entom. Zeitschr, L., p. 254 (1905) is still another species different from the one here described.

Chelogynus schaefferi sp. nov.

Female. Length 5 mm. Black; base of antennæ, mandibles and clypeus yellowish; prothorax, four anterior legs and the coxæ and basal parts of the femora of the posterior pair bright ferruginous. Head not quite twice as wide as thick, the vertex distinctly convex. Antennæ 10-jointed, the scape distinctly shorter than the first flagellar joint, which is twice as long as the pedicel, but distinctly shorter than the second and third together. Scape, pedicel and first two flagellar joints ferruginous, following black, the black joints being distinctly thickened. Front and vertex rugulose. Face and clypeus with a fine median keel between the antennæ. Mandibles pale yellowish, with black teeth. Head behind and cheeks rugulose, not at all striate below, palpi black. Prothorax bright ferruginous, smooth and polished, with scattered punctures; as long as the mesonotum and scutellum together. Remainder of thorax black, mesonotum and scutellum shining and with very sparse punctures. Mesonotum with four furrows; scutellum with a transverse crenulate impressed line at its base, and another simple one separating it from postscutellum. Metathorax rugulose, its posterior face nearly smooth above and faintly transversely aciculate below. Pleuræ rugulose. Abdomen entirely shining bluish black. Chela of anterior tarsus reaching nearly to the base of the second tarsal joint, whitish, dark at the tip, somewhat curved, especially at

the base. Posterior legs, except coxæ and base of femora, black, the tarsal joints each tipped with yellowish. Body everywhere except the flagellum of the antennæ conspicuously whitish pubescent. Wings with the usual two fuscous bands, which are very strong. Stigma lanceolate, pale at the base and piceous at the tip. Veins fuscous, except the submarginal, median and anal veins, which are pale yellow.

One female from the Huachuca Mountains, Arizona, collected by Mr. Schaeffer.

This species resembles *C. atriceps* Brues, a species occurring in the Northeastern United States, but the typical form differs conspicuously by the black metathorax, scutellum and mesothorax. The head behind is also much more coarsely sculptured, while the punctures of the prothorax are sparse. The first flagellar joint is shorter, being but little longer than the scape, while in *atriceps* it is nearly twice the length of the scape.

Var. *a.* Colored like *C. atriceps*, with the entire thorax reddish, but having the structural characters of the type. One female from Brownsville, Texas.

FAMILY SCELIONIDÆ.

Hoplogryon grandis sp. nov.

Female. Length 2 mm. Brownish-yellow; head, abdomen and antennal club black. Head two and one-half times as wide as thick, shining black; front smooth, with a median line extending from the anterior ocellus to the antennæ, the anterior orbits, cheeks and face below strongly vertically striated. Vertex irregularly rugose. Mandibles strongly curved, yellow, with two long, equal brown teeth. Mesonotum and scutellum very coarsely and almost confluently punctate; no parapsidal furrows; ferruginous, with a large orbicular spot which reaches nearly to the scutellum. Scutellum black, postscutellum ferruginous, with a long sharp spine. Metathorax ferruginous, with the lateral angles very acutely produced to form long spine-like teeth; its posterior face irregularly rugulose, truncate or slightly concave. Abdomen ovate, convex; shining black, the first segment brown, as long as broad at the tip and roughly striated; second segment sculp-

tured like the first, two and one-half times as wide at the base as it is long. Third segment occupying two-thirds of the remaining surface, smooth and shining, with a few scattered punctures. Legs, including coxæ, yellow, the pleura with a dark spot just above the posterior coxæ. Wings very short, ciliated, reaching only to the tip of the first abdominal segment. Antennæ 12-jointed, bright yellow, with the apical eight joints black. Scape slender, three-fifths the length of the flagellum; first and second flagellar joints subequal, each twice as long as thick and considerably longer and thicker than the pedicel; third and fourth short, moniliform or quadrate, forming the base of an unusually slender club; seventh flagellar joint the shortest, twice as broad as long and twice as thick as the second flagellar joint.

One specimen, Cold Spring Harbor, Long Island, New York.

This is a large and prettily marked species, distinguished at once by its large size, vestigial wings, and acutely toothed lateral metathoracic angles.

FAMILY EURYTOMIDÆ.

Chryseida inopinata sp. nov.

Female. Length 5.5 mm. Metallic green, the abdomen more or less blue. Femora reddish, tarsi whitish; antennæ ferruginous or rufous. Head two and one-half times as wide as thick, coarsely confluently punctate. Antennæ inserted at the middle of the face; their cavity transversely rugose, narrowed above and enclosing the anterior ocellus; lateral ocelli set in large foveæ near the eyes. The punctures of the row along the anterior margin of the eyes are elongated, giving the groove a transversely rugose sculpture; medially the groove is margined by a very sharp carina. Cheeks margined behind; mandibles rufous. Eyes oval, reddish, microscopically pubescent; a little longer than the malar space. Antennæ with only nine visible joints. Scape slender, but little longer than the first flagellar joint. Pedicel very small, rounded, only one visible ring-joint. Flagellum slightly clavate apically, the first joint one-half longer than the second which is two times as long as thick; third, fourth and fifth smaller; sixth oval, one-third longer than the fifth. Prothorax nearly three times as wide as long, sculptured like the head, as are also the mesonotum and scutellum,

the punctation becoming coarser posteriorly. Mesonotum scarcely longer than the pronotum; scutellum half longer than the mesonotum. Metathorax excavated behind, the cavity coppery, faintly aciculated medially and punctate around the sides. Metapleuræ purplish blue, coarsely punctate. Abdomen ovate, more or less compressed especially at the tip; sixth segment carinate above; fourth segment longest. All coxæ green; femora bluish, the hind pair reddish; base and tips of tibiæ and tarsi except last joint whitish, the tibiæ medially rufous. The legs are all rather stout, but the femora are not particularly thickened. The body is more or less sparsely whitish hairy, and the fourth, fifth and sixth segments each bear a well marked spot of white pubescence on each side. Wings with a brown cloud that extends entirely across the wing, although it is stronger in front where it extends apically a short distance along the costa beyond the postmarginal vein. Marginal vein four or five times as long as thick; postmarginal a trifle longer and the stigmal two-thirds as long, knobbed.

One female from Brownsville, Texas. Mr. Schaeffer.

This is the first representative of this handsome and attractive genus to be found in North America, other species being known only from Tropical South America and the Island of Grenada, in the Caribbean Sea.

The occurrence of this, together with the other Chalcidid genera *Kapala, Schizaspidia* and *Chalcedectes,* is extremely interesting and serves to emphasize the truly neotropical character of the fauna in this part of Texas. All these genera occur commonly in Brazil, where they reach their highest development. *Kapala* is also represented by a species from southern Florida, but none of the others have hitherto been found within our faunal limits.

FAMILY EUCHARIDÆ.

Schizaspidia septentrionalis sp. nov.

Female. Length 7 mm. Black, marked with luteous or testaceous; legs pale testaceous. Head black, twice as wide as high, coarsely striate, the striæ vertical on the sides of the face above, but curving in

transversely to the median line below the antennæ. Lower half of the sides of the face cross-striated. Clypeus smooth, occiput cheeks and malar space finely striated. Malar space distinctly longer than the eye-height. Mandibles falcate; testaceous, with long sharp tips and no teeth within. Antennæ 11-jointed, reaching as far as the tip of the scutellum; scape and ring-joint yellow; flagellum black, except the apical four joints, which are fuscous. First flagellar joint three times as long as the scape and more than twice as long as the second; following joints growing shorter, the seventh twice as long as thick. Prothorax entirely pale testaceous. Mesonotum pale testaceous, with a large median horseshoe-shaped spot, a large oval spot on each of the parapsides, basal half of axillæ, narrowed medially and connected with a median scutellar stripe that includes the scutellar teeth, also black, The entire surface of the thorax is coarsely reticulately punctate with the sutures crenulate. Scutellum triangular, with two blunt divergent teeth at the apex; it is as long as the mesonotum medially. Metathorax deeply constricted at the base and bilobate behind, but without teeth or sharp protuberances; more or less black on the sides and with a dark line above. Propleuræ entirely pale testaceous; mesopleuræ with three confluent testaceous spots above, the second of which extends farther down. Legs and abdominal petiole pale testaceous, slender, the latter as long as the posterior femora. Coxæ blackened at the extreme base, and last tarsal joint piceous. Abdomen as high as the thorax and one-half as long, squarely truncate at the base; polished black, the second segment concealing all the following ones. It is black, with a large honey-yellow crescentic mark on each side. Ovipositor very minute. Wings hyaline, tinged with yellow; marginal vein long, two-thirds the length of the submarginal; stigmal quadrate, sessile; postmarginal very short.

One specimen from the Huachuca Mountains, Arizona.

This is the first member of this genus to be discovered in North America although two species are known from Brazil.

Kapala furcata Fabr.

Mr. Schaeffer sent me a number of specimens of this beautiful Eucharid from Brownsville, Texas. The species occurs in Brazil, and has also been found in Grenada, but I believe that this is the first time that it has been recorded from so far north as the United

States. Quite recently Kieffer* has redescribed the species, but he does not mention any locality.

The Brownsville specimens have the scutellar processes more approximated at the tips, but otherwise they agree well with Kieffer's description, and also with Lepeletier's figure, published in his Histoire Naturelle des Insectes Hymenoptères (Pl. 38, fig. 5. The species is also figured in the Biologia by Cameron.†

FAMILY CLEONYMIDÆ.

Chalcedectes texanus sp. nov.

Male. Length 7 mm. Bluish-metallic, with reddish cupreous reflections. Abdomen æneous, hind femora more or less purplish; base of all tarsi pale. Head very strongly transverse, four times as wide as thick; seen from the front as wide as high; its color greenish, the antennal depression purple; surface whitish-hairy and closely, coarsely punctate, but not confluently so. Occiput but faintly punctulate; mandibles piceous, tridentate. Palpi piceus, the apical joint of the maxillary pair long and suddenly swollen at the base, apical joint of the labial pair triangular and flattened. Antennæ black, the flagellum one-half longer than the scape; first flagellar joint equal to the ring-joint and pedicel together; second, third and fourth decreasing; fifth and sixth quadrate; seventh transverse; eighth obliquely truncate. Malar space with a furrow, its height two-thirds the length of the eye. Thorax somewhat more coarsely punctured than the head; middle lobe and scutellum greenish-violet, the parapsides behind blue; prothorax blue in front and greenish on the sides. Metanotum reticulate medially and smooth on the sides, where there is a large distinct patch of white pubescence. Pleuræ variegated in color, coarsely punctate except for the smooth posterior side of the mesopleural and the finely arcuately aciculated propleural furrow. Abdomen narrowly ovate, shining greenish-black; margin of the first segment notched medially, the others entire; second, third and fourth segments short, the fifth long. Legs cupreous, the reddish tint very pronounced. Posterior femora twice as long as thick, with four long teeth below, and another

*Berliner Entom. Zeitschr. LXIX, p. 243 (1904).

†Biol. Centr-Amer. Hymenoptera, Pl. 5, fig. 17.

broad quadridentate one near the apex, the apical denticles of which are smaller. Hind tibiæ reddish at the base; first joint of all the tarsi whitish, the second brown and the rest piceus. Wings hyaline, the marginal vein two-thirds as long as the submarginal and four times as long as the stigmal. Postmarginal fully as long as the marginal.

Described from one specimen collected by Mr. Schaeffer at Brownsville, Texas.

This is the first species of *Chalcedectes* to be discovered outside of the South American fauna.

There is also a male of a second species from Brownsville, but is is too poorly preserved for description.

FAMILY ENCYRTIDÆ.

Anastatus laticeps sp. nov.

Female. Length 4.5 mm. Rufo-ferruginous varied with black. Entire body clothed with sparse glistening pubescence. Head flat, nearly four times as wide as thick; viewed from in front the eyes reach distinctly below the middle, being two-thirds as long as the head-height; above the eyes are close together so that the lateral ocelli are nearer to the eye-margin than to the median ocellus. Cheeks long, malar furrow distinct, eyes distinctly hairy. Antennæ long and slender, the scape pale rufous, black at tip and reaching to the anterior ocellus. Flagellum imperceptibly thickened apically, black, twice as long as the scape; pedicel and first flagellar joint nearly equal; second a little longer, following decreasing in length until the ones near the tip are nearly quadrate. Surface of head microscopically rugulose, with a metallic reflection in certain lights. Front very slightly and broadly excavated. Antennæ inserted just below the base of the eyes. Palpi blackish toward the tip, the apical joint slender, rounded at the tip. Prothorax very short. Mesonotum with the parapsidal depressions meeting behind the middle and continuing as a median depression to the hind margin; the elevations sharp on the posterior third, then becoming very weak and broadly rounded. Scutellum very strongly convex, almost pyramidal anteriorly, with a wide base on the mesonotum, clothed with a few scattered black hairs and bearing

a median row of more or less bristle-like ones anteriorly. Metathorax exceedingly short. The thorax is brownish-yellow, the mesonotum with a greenish reflection that conceals the brown; metathorax brown and mesopleura with a green stripe. Abdomen as long as the head and thorax, greenish-black, the venter brownish at the base. Posterior margins of all the segments entire, the basal segments smooth and shining, but the apical ones becoming very distinctly punctate. Venter smooth. Ovipositor pale yellow, distinctly longer than the abdomen. Legs brown, middle tibiæ, posterior femora and tibiæ and metatarsi greenish-piceous; posterior coxæ green black. The posterior tibiæ are distinctly compressed, with a whitish line externally; middle tarsi except the last joint and the hind tarsi, except the first and last joints, whitish. Wings hyaline, with a dark gray transverse band embracing the marginal and stigmal veins. Marginal vein as long as the submarginal and about four times as long as the short, very oblique and slightly knobbed stigmal. Postmarginal a little shorter than the stigmal.

Described from one female from Esperanza Ranch, Brownsville, Texas.

This is a close relative of the following species.

Anastatus longiceps sp. nov.

Female. Length 4.25 mm. Ovipositor 1 mm. Rufo-ferruginous, abdomen black toward the tip. Head transverse, seen from above three times as wide as thick and distinctly longer than high. The eyes do not reach below the middle of the head so that the malar space is as long as the eye. Eyes widely separated above; the lateral ocelli as far from the eye-margin as from the anterior ocellus. Eyes faintly hairy. Head microscopically rugulose, the front scarcely impressed. Antennæ inserted considerably below the level of the lower eye-margin. Antennal scape reaching to the anterior ocellus, slender, rufous; flagellum black, scarcely thickened apically. Pedicel and first flagellar joint of equal length, the following joints shorter, the subapical ones, however, longer than wide. Malar furrow distinct. Palpi black toward the tip, the apical joint swollen and obliquely truncate at the apex. Mesonotum short, the furrows very distinct anteriorly, forming a wide median depression behind the middle. Parapsidal elevations sharp posteriorly, rising to the posterior third, then suddenly declivous and rounding off anteriorly. Scutellum with a wide base against the

mesonotum; slightly convex, sparsely covered with black hairs, but without a median row. Metathorax one-half as long as the scutellum. The thorax is entirely rufo-ferruginous except for greenish reflections on the mesonotum behind. Abdomen almost as long as the head and thorax, shining basally and finely but closely punctate apically; first three segments pale brown, with greenish reflections, apical segments greenish black. Ovipositor pale, one-half as long as the abdomen. Legs pale rufous, the middle tarsi brown, and the entire hind legs piceous brown with greenish reflections. Hind tibiæ not at all compressed. Wings hyaline, with a broad brown cross-band which includes the marginal and stigmal veins. Marginal vein as long as the submarginal and five times as long as the stigmal, which is indistinctly knobbed.

One female from Brownsville, Texas. April.

This species is superficially extremely similar to the preceding, both in color and wing pattern. It is readily distinguished, however, by the shorter, more widely separated eyes, flat scutellum and non-compressed hind tibiæ.

FAMILY MYMARIDÆ.

Gonatocerus americanus sp. nov.

Female. Length .75 mm. Shining black, the anterior knees and all tarsi light yellowish; scape and pedicel of antennæ more or less pale. Head large and flattened, very wide, nearly one-half wider than the thorax. Antennæ 11-jointed, slender, especially toward the base of the flagellum. Scape extending to the vertex, about five times as long as thick; pedicel oval, as stout as the scape. First three flagellar joints very small, together only a little longer than the pedicel; fourth longer but slender; fifth and sixth stouter, about equal; seventh and eighth longer; last joint nearly as long as the four preceding taken together, but no thicker. Mouthparts piceous brown. Thorax smooth and shining, the scutellum distinctly longer but considerably narrower than the mesonotum. Metathorax very short, depressed. Abdomen small, as long as the thorax, but only about one-half as wide as long; somewhat concave and compressed above. Legs slender, the tarsi five-jointed. Wings hyaline, broad, being only three times as long as

broad. Marginal vein short, extending to one-third the length of the wing. Wings with short cilia, the longest ones less than one-third the greatest breadth of the wing.

Milwaukee, Wisconsin, June 8, 1906. This seems to be the first species of *Gonatocerus* to be described from this country, although it is probable that a number occur here.

FAMILY BRACONIDÆ.

(?) **Pambolus dispar** sp. nov.

Female. Length 3 mm. Subapterous. Rufo-ferruginous, abdomen varied with darker and pale spots. Legs testaceous. Head rufous, distinctly wider than long, the temples full, but strongly rounded and narrowed behind; its surface smooth and shining. Posterior margin of the head very distinct. Seen from the side the head is as high as thick. Antennæ 18-jointed, ferruginous, a little shorter than the body. First flagellar joint as long as the scape, second and third shorter, the second two-thirds as long as the first. Apical four or five joints submonilform. Thorax slender, narrower than the head and three and one-half times as long as wide; ferruginous, the small wing pads reaching barely beyond the tip of the metathorax. They are laceolate in shape and clothed with long whitish hairs. Pro- and mesothorax shining, the former with some coarse punctate sculpture laterally behind, and the latter with irregularly marked parapsidal furrows that coalesce before the scutellum. Scutellum triangular, with a deep broad fovea at its base, divided by several raised cross-lines. Metathorax cylindrical, truncate, its surface roughly reticulate. Abdomen broad, oval, as long as the head and thorax together. First segment longer than wide, and two times as wide at the tip as at the base, laterally with strong carinæ, its surface rugulose, with indications of two weaker central longitudinal carinæ that unite before the tip of the segment. Second segment large, as long as wide, shining and microscopically punctulate; third to sixth segments together as long as the second, indistinctly differentiated. Basal segment ferruginous, the rest piceous; third segment with an indistinct broad pale band near the middle, which is repeated less distinctly on the third, fourth and fifth. Ovipositor brownish-yellow, shorter than the first abdominal segment. Legs slender, testaceous, hairy.

Two females from Cold Spring Harbor, Long Island, New York.

This little subapterous species might perhaps be referred to Ashmead's genus *Pambolidea,* the type of which has not been described, so far as I can ascertain. However, the ovipositor is short and the second abdominal segment much smaller. The more or less distinctly differentiated abdominal segments separate it from the more typical species of *Pambolus.*

Ecphylus texanus sp. nov.

Female. Length 3.5 mm. Piceous black; head rufous; antennæ brownish-yellow at the base, piceous apically. Palpi and legs, except four posterior femora, pale testaceous; tip of abdomen, ovipositor and its sheaths except at apex rufous or brown. Head polished behind, in front microscopically rugulose, with a median raised polished stripe below the antennæ. Cheeks as wide as the eyes. Antennæ slender, 21-jointed, extending to beyond the middle of the abdomen; first flagellar joint longest, as long as the width of the eye, following subequal but growing shorter, the last few only a little more than half as long as the first. Middle lobe of mesonotum transversely rugulose, impressed in front and depressed behind; lateral lobes shining, elevated posteriorly; scutellum triangular, with a transverse fovea crossed by numerous carinæ at its base. Metanotum finely rugulose, with a median carina and two less clearly defined lateral carinæ on each side. Abdomen one-half longer than the head and thorax together, sessile, spatulate; first segment longitudinally striated, twice as wide at the tip as at the base; following smooth and highly polished. Ovipositor one-fourth shorter than the body, but its sheaths are fully as long as the body. Wings hyaline, stigma and veins fuscous. Second transverse cubitus entirely wanting and the cubitus beyond the first cubital cell is very indistinct. Transverse median nervure in front wings wanting.

One female from Esperanza Ranch, Brownsville, Texas.

This is quite closely related to *E. hypothenemi,* Ashmead, but differs by its much greater size, pale color and longer ovipositor.

Public Museum, Milwaukee, Wis.
April 4, 1907.

ON THE FERTILIZATION OF THE EGGS OF ASTERIAS AND ARBACIA BY SPERM IMMERSED IN SOLUTIONS OF ALCOHOL, ETHER, AMMONIUM HYDROXIDE, OR AMMONIUM CHLORIDE.

By Ellen Torelle.

Alcoholic solutions of sea-water, ranging from .5% to 8%, may induce activity in inactive spermatozoa of Asterias forbesii, but an 8% or a 10% solution is more frequently effective.

When inactive immature spermatozoa are immersed in ether, the greatest activity is induced by 1% or 2% solutions. A .5% solution of ether produces some activity, as does a 5% solution, but the activity so produced is of short duration. Weak solutions (.1% to 1%) of ammonium hydroxide, or of ammonium chloride, are also effective.

When active spermatozoa of Asterias forbesii, normally capable of fertilizing eggs, are placed in alcoholic solutions of sea-water, ranging from 1% to 8% in strength, their activity is increased. When they are placed in stronger solutions, their activity is decreased. In solutions above 10%, the spermatozoa usually become immediately quiescent. The activity of spermatozoa placed in weaker solutions, may continue for twelve hours or more;* those placed in 9% and 10% solutions usually become quiescent within two hours.

In solutions of ether, ranging from .5% to 2%, the activity is greatly increased, the spermatozoa in the .5% and 1% solutions may continue active for twenty-four hours.†

In ammonium hydroxide solutions of .001%, .005% and .01%, the spermatozoa become very active immediately upon immersion, but remain so only about five minutes in the first two, while in the last, they may continue active for two hours.

*This may be due to the fact that the solute is constantly evaporating, gradually producing a weaker solution.

†In solutions above 2% the activity is decreased.

In the ammonium chloride solutions of .1% and .5%, the activity of the spermatozoa is increased; but they continue active for some hours, only in the .01% solution.

Active and inactive sperm of Arbacia is affected by the solutions named above, in essentially the same way as is that of Asterias, with the difference that Arbacia sperm does not become active so readily.

During August and September, 1903, at the Marine Biological Laboratory, in Woods Hall, Mass., a series of experiments were carried out on the eggs of Asterias forbesii and Arbacia punctulata, with the object of discovering if spermatozoa normally ineffective in fertilization, could be rendered effective by immersion in the solutions named above, and also to see if changes brought about in active spermatozoa by an immersion in such solutions, would affect the development of the egg. In this paper no account will be given of the results as seen in sections of the eggs; these will be given in a later paper.

In the care of eggs and sperm, and in the manipulation of instruments and dishes, the usual precautions to prevent contamination, were taken. The eggs to be fertilized were placed in small glass crystals, or in finger-bowls, with an ample amount of sea-water. The spermatozoa, after immersion, were added to the eggs by means of a pipette, at intervals of one, five, ten and fifteen minutes, and, in some experiments, after an immersion of twenty and thirty minutes. The eggs so fertilized were compared with eggs normally fertilized and kept as a control. In each experiment, the condition of the spermatozoa before immersion was observed; the effect of immersion for shorter or longer periods of time in the various solutions used; the per cent of eggs which divided after fertilization by the spermatozoa which had been immersed; and, in most cases, the development of the eggs was watched for two days or more.

It was observed that spermatozoa, rendered inactive by being placed in certain of the stronger solutions, recovered their activity to some extent on being replaced in sea-water.* It is, therefore,

*See Table II. Exper. b.

probable that spermatozoa from all solutions recover to a greater or less degree on being added to the sea-water containing the eggs. That recovery is not complete, as Hertwig ** found it to be in the case for spermatozoa immersed in nicotin, is shown by the fact that eggs fertilized by spermatazoa, which had been immersed in weak solutions for a considerable time, or by spermatozoa immersed in strong solutions for a shorter time, the amount transferred invariably being the same, showed a large percentage of abnormalities in cleavage. The relation between the *time* of immersion of the spermatozoa and the *number of eggs which divide* after fertilization by such spermatozoa, is very striking, as shown by the following table, in which the results of the first series of experiments with Arbacia eggs and sperm are given. The eggs of one female, and the active sperm of one male, were used. The development of the eggs was observed for six days:

TABLE I.

Experiment a. Solutions of Alcohol.

Arbacia Eggs and Sperm.

Per cent. Alcohol.	Time immersed.	Effect on sperm.	Per cent. divided.	Development after 24 hours.	Development after 48 hours.
10	1 min.	inactive	2	Dead.	
7	1 min.	active	20	Gastrulae.	Plutei.
†5	1 min.	active	95	Gastrulae.	Plutei.
†3	1 min.	active	98	Gastrulae.	Plutei.
†1	1 min.	active	99	Gastrulae.	Plutei.
10	10 min.	inactive	.5	Dead.	
7	10 min.	active	1	Dead.	
5	10 min.	active	90	Blastulae & beg. Gast.	Gastrulae.
3	10 min.	active	90	" & 3% "	Gastrulae.
1	10 min.	active	99	" & 10% "	Gastrulae.

**Hertwig, O. and R. "Ueber den Befruchtungs und Teilungsvorgang des tierischer Eies unter dem Einfluss äusserer Agentien," Jena, 1887.

†The embryos developed from spermatozoa immersed in these solutions for 1 min. were alive the sixth day. All others were dead the fourth day.

From the above experiment, it is seen that an immersion in a 10% alcoholic solution produces inactivity in the spermatozoa, and a consequent ineffectiveness in their fertilizing ability. Although they recover to some extent on being placed in sea-water, the few eggs fertilized by such spermatozoa do not develop into gastrulæ. The experiment also shows that in solutions ranging from 1% to 5%, the activity is not lessened, nor is the fertilizing ability greatly impaired; and it is clearly seen that an immersion for ten minutes in 7%, 5% and 3% solutions not only causes a lesser number of eggs to divide, but retards the development of those which so divide.

Spermatozoa from the male used in Experiment a, were also immersed in solutions of ether, and the eggs fertilized by such spermatozoa were compared with those normally fertilized. The eggs normally fertilized practically all divided. Experiment b, Table II, shows the result of the immersion of the spermatozoa.

TABLE II.

Experiment b. Ether Solutions.

Arbacia Eggs and Sperm.

Per cent. Ether.	Time immersed.	Effect on sperm.	Per cent. divided.	Further development.
.5	1 min.	active	99	All blastulae in 16 hrs. Apparently more active than those normally fertilized.
1.	1 "	very active	99	All blastulae.
2.	1 "	active	98	All stages of division as well as blastulae.
5.	1 "	inactive	0	.....
.5	10 min.	active	99	Development further advanced than in .5% 1 min.
1.	10 "	very active	99	Beginning gastrulae when 1%, 1 min. were blastulae; very active; shoot across field.
2.	10 "	active	90	All stages of development seen, from 4 cell to gastrulae.
*5.	10 "	inactive	25	All stages from 4 cell to gastrulae.

From Experiment b, Table II, it is seen that a 1% ether solution produces the greatest activity in spermatozoa, while a 5% solution, produces quiescence. Eggs fertilized by spermatozoa immersed in .5% and 1% solutions for one or for ten minutes, develop apparently normally; but the embryos seem more active than those normally fertilized. Also, eggs fertilized by spermatozoa immersed for ten minutes develop more rapidly than do those fertilized by spermatozoa immersed for one minute, and are in the gastrula stage when the latter are in the blastula stage. I cannot account for the fact that the spermatozoa immersed for ten minutes in 5% ether and rendered inactive, recovered sufficiently to fertilize 25% of the eggs to which they were added, while the spermatozoa immersed for one minute, did not fertilize any eggs. Later in the season, spermatozoa immersed in 5% ether did in no case fertilize eggs.

In Experiment c, Table III, the effect of immersion in ammonium hydroxide is shown. Eggs and sperm from the male and female, used in Experiments (a) and (b), were also used in this experiment.

TABLE III.

Experiment c. Ammonium Hydroxide Solutions.

Arbacia Eggs and Sperm.

Per cent. NH_4OH	Effect on sperm.	Time immersed.	Per cent. divided.	Further Development.
.01	inactive	5 min.	3	Did not develop after first few cleavages.
.005	inactive	5 min.	5	Did not develop after first few cleavages.
.001	active	5 min.	95	Became abnormal morulae.
.01	inactive	10 min.	2	No development after *first* division.
.005	inactive	10 min.	2	No development after *first* division.
.001	active	10 min.	95	Became abnormal morulae.

Experiment c, Table III, shows that .01% and .005% solutions of ammonium hydroxide produced inactivity in the spermatozoa, and that only a few eggs (2%-5%) divided after fertilization by such spermatozoa. The eggs which were fertilized by such spermatozoa after immersion for ten minutes divided only once; those fertilized after an immersion of one minute divided several times, but did not reach the morula stage. Spermatozoa immersed in a .001% solution remained active and fertilized a large percentage of eggs which later developed into abnormal morulæ.

In general, the experiments show that the immersion of the spermatozoa of Arbacia in alcoholic solutions of certain strengths, seems to retard the development of eggs subsequently fertilized by them. Immersions in ether solutions, on the other hand, seems to accelerate the rate of development. After immersion in ammonium hydroxide (.01% and .005%), practically no development follows, although division and abnormal development takes place after immersion of the spermatozoa in very weak (.001%) solutions. When ammonium chloride was tried in .1% and .5% solutions, a few eggs segmented even when fertilized by spermatozoa immersed for twenty minutes. When eggs were fertilized by sperm immersed in .5% ether for thirty minutes, they developed into plutei like the normal ones, with the difference that the rays (arms?) were shorter, and the alimentary canal projected outward ventrally.

After immersion of the sperm in 5% alcohol for thirty minutes, division of practically all eggs followed, but the cells were atypical, and the morulæ assumed a crenate, shrunken appearance. In many cases, eggs fertilized by spermatozoa immersed for ten and fifteen minutes in 8%, 7%, and 5% alcohol, showed a tendency to divide in one plane only (the horizontal) after the four-cell stage.

Very active sperm, when immersed in alcohol for some time, was rendered incapable of fertilizing. In one experiment, designed to test the effect of prolonged immersion, the eggs, quite mature, and in excellent condition—practically all developing after normal

fertilization—were fertilized by spermatazoa immersed for twenty minutes in 5%, 8%, 9%, 10%, 11%, and 12% alcohol solutions, respectively; in .5%, 1%, 2%, and 5% ether solutions; and in .1% and .5% ammonium chloride solutions. Of these, 25% of the eggs fertilized by spermatozoa, immersed in 5% alcohol developed, 1% of the eggs fertilized by spermatozoa immersed in the 2% ether solutions; practically all from the spermatozoa immersed in .5% and 1% ether; and *none* from any of the other and stronger solutions. Early in the season, eggs sometimes, although rarely, divide (as indicated in Table II) after fertilization by spermatozoa immersed in 5% ether. Later, several experiments showed no division after immersion in 5% ether for ten minutes.

In Asterias, the relation between a prolonged immersion of spermatozoa in weak solutions, and an immersion in stronger solutions for a shorter period of time, becomes quite evident. Table IV, p. 119, shows the results of a series of experiments carried out to test this relation.

This table shows that immersion for twenty minutes in alcoholic solutions, ranging from 5% to 12%, is fatal to the spermatozoa of Asterias, at least as regards their ability to fertilize the eggs to which they are added. An immersion for ten minutes in solutions above 10% is also fatal. When immersed for one minute, eggs are fertilized from all solutions, except 12%. Immersion in 5% ether is fatal for all the periods of time indicated, and immersion in a .1% solution of ammonium chloride for a longer period than one minute, prevents fertilization of the eggs by the sperm, as does a .5% solution after all the intervals of time designated.

In all the experiments carried out, abnormal division of many eggs was observed after immersion of the sperm in strong solutions, or in weak solutions for a longer period of time, although a larger number of eggs might divide as a result of fertilization by such sperm. In one series of experiments, eggs were selected, which, normally fertilized, showed a division of practically all of the eggs. Very active spermatozoa were immersed in solutions

TABLE IV.

Asterias' Eggs and Sperm.

Per cent Alcohol.	Time immersed.	Per cent. divided.	Per cent. Ether,	Time immersed.	Per cent. divided.	Per cent. NH_4Cl.	Time immersed.	Per cent. dfvided.
5	1 min.	50	.5	1 min.	75	.1	1 min.	25
8	1 "	50	.7	1 "	50	.1	10 "	0
9	1 "	40	2	1 "	50	.1	20 "	0
10	1 "	25	5	1 "	0	.1	30 "	0
11	1 "	20						
12	1 "	0						
5	10 "	25	.5	10 "	75	.5	1 "	0
8	10 "	1	.7	10 "	50	.5	10 "	0
9	10 "	1	2	10 "	25	.5	20 "	0
10	10 "	0	5	10 "	0	.5	30 "	0
11	10 "	0						
12	10 "	0						
5	20 "	0	.5	20 "	70			
8	20 "	0	.7	20 "	33			
9	20 "	0	2	20 "	1			
10	20 "	0	5	20 "	0			
11	20 "	0						
12	20 "	0						
			.5	30 "	50			
			.7	30 "	20			
			2	30 "	0			
			5	30 "	0			

for ten and twenty minutes. Among the eggs fertilized after an immersion of ten minutes, abnormal division occurred from the 1%, 2%, and 5% ether solutions. Of those fertilized from the 8% and 9% alcoholic solutions, 75% were abnormal, although more than 75% divided. Very few divisions occurred from the 10% and 11% solutions, but abnormalities were conspicuous among those that did divide. From the 12% solutions, only about 5% of the eggs divided, and all abnormally. In most cases, the protoplasm became merely constricted. The eggs fertilized by spermatozoa immersed for twenty minutes were more abnormal than those fertilized after ten minutes, and a smaller per cent divided. Eggs developed to the morula stage from 1% and 2%

solutions and from 8% and 9% solutions of alcohol. There were none from the other solutions.

No division occurred after the immersion of spermatozoa in weak (.001%) solutions of ammonium hydroxide.

When inactive sperm of Asterias or of Arbacia is immersed in solutions of alcohol, ether or ammonium chloride in sea-water, it not only becomes active, but in some cases is rendered capable of fertilizing eggs not normally fertilized by the same sperm. Fertilization did not always take place, even when the spermatozoa became active and surrounded the eggs on being added to them.

In order to discover whether the eggs or the sperm were responsible for this lack of fertilization, a series of experiments was carried out, in which the eggs of two females and the sperm of two males, was used. The eggs were ripe and in good condition. The spermatozoa were altogether inactive and did not normally fertilize the eggs. Eggs and sperm were used interchangeably, as shown in Table V, p. 121.

After immersion in solutions of alcohol, ether, and ammonium chloride, as indicated in Table V, the inactive spermatozoa of both males became active. The spermatozoa of Male I fertilized the eggs of both Female I and Female II, except after immersion in 10% alcohol solutions, and, in one case, an immersion in 2% ether. [See (d).]

The spermatozoa of Male I did not in any case fertilize the eggs of Female I, but in all cases, except after immersion in 10% alcohol, they fertilized the eggs of Female II.

After fertilization by the spermatozoa of Male I, immersed in 1% solutions of alcohol and of ether for five minutes, 50% to 95% of the eggs of Female I and of Female II divided, and 1% divided after an immersion of the spermatozoa in 0.1% NH_4Cl.

A small number only divided after fertilization by spermatozoa immersed in the stronger solutions for the same length of time; and, with one exception [See 6], none divided after immersion in the strongest solution used.

After fertilization by the spermatozoa of Male II. immersed in 1% alcohol for five minutes, 80% of the eggs of Female II divided,

TABLE V.

Asterias' Eggs and Sperm.

(Used Interchangeably.)

(*a*)

Female I Male I	Per cent. Alcohol.	Time sperm immersed.	Per cent. eggs divided
"	1	5 min.	90
"	2	5 "	5
"	5	5 "	5
"	10	5 "	0

(*b*)

Female II Male I	Per cent. Ether.	Time sperm immersed.	Per cent. eggs divided
"	1	5 min.	95
"	2	5 "	5

(*c*)

Female II Male I	Per cent. Alcohol.	Time sperm immersed.	Per cent. eggs divided
"	1	5 min.	50
"	2	5 "	1
"	5	5 "	1
"	10	5 "	0

(*d*)

Female II Male I	Per cent. Ether.	Time sperm immersed.	Per cent. eggs divided
"	1	5 min.	90
"	2	5 "	0

(*e*)

Female I Male II	Per cent. Alcohol.	Time sperm immersed.	Per cent. eggs divided
"	1	5 min.	0
"	2	5 "	0
"	5	5 "	0
"	10	5 "	0

(*f*)

Female I Male II	Per cent. Ether.	Time sperm immersed	Per cent. eggs divided
"	1	5 min.	0
"	2	5 "	0

(*g*)

Female II Male II	Per cent. Alcohol.	Time sperm immersed.	Per cent. eggs divided
"	1	5 min.	80
"	2	5 "	2
"	5	5 "	2
"	10	5 "	0

(*h*)

Female II Male II	Per cent. Ether.	Time sperm immersed.	Per cent. eggs divided
"	1	5 min.	90
"	2	5 "	5

(*i*)

Female I Male I	Per cent. NH_4 Cl	Time sperm immersed.	Per cent. eggs divided
"	0.1	5 min.	1

(*j*)

Female II Male I	Per cent. NH_4 Cl	Time sperm immersed.	Per cent. eggs divided
"	0.1	5 min.	1

(*k*)

Female I Male II	Per cent. NH_4 Cl	Time sperm immersed.	Per cent. eggs divided
"	0.1	5 min.	0

(*l*)

Female II Male II	Per cent. NH_4 Cl	Time sperm immersed.	Per cent. eggs divided
"	0.1	5 min.	2

and 90% of the eggs of the same female divided after an immersion of the sperm in 1% ether. No eggs of Female II divided after immersion of the sperm in 10% alcohol, but 5% of the eggs divided after the immersion of the sperm in 2% ether; 2% of the eggs of Female II divided after the immersion of the sperm in 0.1% NH_4Cl—a larger number than any which divided after immersion of the sperm—NH_4Cl.

Table V also shows that a smaller percentage of the eggs of Female II divided after fertilization by spermatozoa from Male I. than was the case with the eggs of Female I, although the spermatozoa were immersed in solutions of the same strength and for the same periods of time.

From these results, it appears that inactive sperm can be made functionally active by immersion in the above named solutions, and that the absence of fertilization in the same cases cannot be said to be due to the sperm alone, or, on the other hand, to the eggs alone, but to a mutual incompatibility of the two elements, even after the spermatozoa have become active.

SUMMARY:

Inactive spermatozoa of Asterias or of Arbacia are rendered active by immersion in solutions of alcohol, ether, and ammonium chloride, in sea-water. In some instances, spermatozoa, thus made active, fertilize eggs not fertilized by them before immersion in the solutions.

In Arbacia, strong solutions of alcohol (10% and above), produce inactivity in active spermatozoa. A few of the eggs to which such inactive spermatozoa are added, divide, but they do not reach the later development stages.

Weak solutions of alcohol (from 1% to 5%) produce greater activity in the spermatozoa, and a large per cent of the eggs to which they are added, divide. But if the spermatozoa are immersed for ten miuntes or longer in these solutions, the development of the eggs fertilized by them is retarded.

A 5% ether solution produces inactivity in active spermatozoa; their activity is increased in .5% and 1% solutions.

Eggs fertilized by spermatozoa immersed in .5% and 1% ether solutions develop more rapidly, and the embryos are more active than those produced by normal fertilization. The rate of development is increased by an immersion before fertilization of the spermatozoa for several minutes, instead of one minute in the .5% and 1% ether solutions.

In most of the experiments, when the spermatozoa were immersed in 5% ether for one or for ten minutes, and then added to eggs in sea-water, division of the eggs did not take place.

An immersion of spermatozoa in the ammonium hydroxide solutions used, stronger than .001% produces inactivity in the spermatozoa; only a few eggs divide after such spermatozoa have been added to them, and the eggs which divide do not survive the first few cleavages. A large precentage of eggs divide after fertilization of spermatozoa, which have been immersed in .001% of ammonium hydroxide, but do not reach the gastrula stage.

In Asterias, no eggs divide when spermatozoa are added to them after an immersion of twenty minutes in solutions of alcohol, ranging from 5% to 12%.

Eggs of Asterias divide when spermatozoa are added to them after an immersion of ten minutes in 5% to 8% solutions of alcohol; when spermatozoa are immersed for one minute only in solutions ranging from 5% to 11%, division occurs in the eggs to which they are added.

Abnormal division and development follows the fertilization of eggs by sperm immersed in 10% to 12% alcohol solutions, and by sperm immersed in 2% to 4% ether solutions.

CONCLUSIONS.

The entire series of experiments show:

1. That inactive (immature?) spermatozoa can be made

functionally active by immersion in certain solutions of alcohol, ether or ammonium chloride.

2. That the number of eggs which divide after fertilization by active spermatozoa immersed in the various solutions, is dependent upon the *time* of immersion.

3. That abnormal development is produced by a prolonged immersion of the spermatozoa in the solutions used.

4. That prolonged immersion in weak solutions tends to have the same effect as a shorter immersion in strong solutions.

A NEW APIOCERA FROM SOUTH AFRICA.*

By A. L. Melander,

Professor of Entomology, The State College of Washington.

The family Apioceridæ is small. About a dozen species are known the world over, and of these about one-half are from North America. According to a recent catalogue of African diptera,** by Professor Mario Bezzi, no African species of this group has been described. Apioceridæ live in the arid plains of the Western States, but, with the exception of *Apiocera haruspex* Osten Sacken, they are quite rare.

In a most interesting collection of Diptera received from Dr. Hans Brauns of Willowmor, Cape Colony, I find a beautiful species of this archaic group. It gives me much pleasure to dedicate the species to this observant entomologist. The collections sent by Dr. Brauns seem remarkable to the American collector, although the forms, he states, are the commoner ones of his locality. A preponderance of the specimens belong to the Asilidæ. Several different Mydaidæ, numerous Tabanidæ, especially Pangonias, curious Bombyliidæ, Cyrtidæ, and Conopids, all bespeak the dry and arid character of the high steppes of the Cape. In one letter written in late April, Dr. Brauns stated that it had not rained since the September previous. Accordingly, there is a dearth of the moisture-loving diptera, such as Leptidæ, Dolichopodiæ, Empididæ, Tipulidæ, etc. To many of us it may seem strange to recall that the collecting season of the entomologist of the antipodes is confined to our winter months.

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*Contributions from the Zoological laboratory of the State College of Washington, Pullman, Washington.

**Ditteri Eritrei. Bull. del. Soc. entomol. ital., XXXVII, 1905.

Apiocera braunsi sp. nov. Plate 1.

Male. Length of body 18 mm., length of wing 9.5 mm. A black species ornate with white pollen and pubescence. Head very small. Front broad, white pollinose, but with a broad mesial vitta piceous. This vitta is suddenly narrowed just above the antennæ. The very sparse pile of the front corresponds in color to its basement, except that there is an irregular row of blackish hairs along the margin of the eye at the vertex. Anterior ocellus crescentic, light-colored, the posterior pair small, situated on the borders of the median vitta. Face short, fuscous, bare; genæ with a narrow white-pollinose stripe separating the eyes from an elongate velvet-black macula. Upper part of the flattened occiput blackened except at the margin of the eyes, where it is white pollinose like the lower portion; upper portion of the occiput with numerous black bristly hairs; the dense beard white.

The securiform palpi testaceous, white pollinose, and provided with sparse black hairs above. Proboscis short, piceous, loosely provided with dusky pubescence below, and with a bunch of white hairs behind. Antennæ short, black, the second joint smaller than the first, the upper and outer sides of the globose third joint dull fuscous; the first two joints provided with black bristles above, the first joint with long white hairs below.

Thorax short, mesonotum blackish, provided with brownish pollen, except on four equidistant broad white-pollinose vittæ, the middle pair of white vittæ are abbreviated on the last fourth of the dorsum, the outer pair begin on the humeri and extend back to include the white pollinose scutellum, pleuræ entirely white pollinose. Pronotum white pubescent and with a collar of short black bristles, mesonotum loosely provided with dusky hairs, pleuræ bare, prosternum with bushy white pubescence. All the bristles of the thorax comparatively short, black; humeri with four or five bristles; the outermost black vittæ with black hairs and about six bristles; about four supra-alar bristles present; post-alar callus with three longer bristles; a single pair of prescutellar bristles present; scutellum with six marginals.

Abdomen long, black, subshining, especially posteriorly, white fasciate on the hind border of the first six segments, the white border excised in the middle in front on the first and second segments, and on the third and fourth segments it becomes attenuated at the sides, the fifth, sixth, and seventh segments white pollinose at the base, on the sixth segment the black ground color is obliterated except on the

APIOCERA BRAUNSI MELANDER.

sides, venter loosely white pollinose. Hairs of the abdomen black, short, and sparse, the first four ventrals with longer white pubescence.

Hypopygium large, terminal, valvate, black, shining, and more densely black hairy than the rest of the body; the upper valves slightly shorter than the lower, the hairs becoming longer at their apex, the middle of the upper side bowed out so as to accommodate a pair of short black filaments; lower valves tipped with a dense fascicle of pure white, flattened hairs.

Ground color of legs black, becoming reddish apically. Coxæ closely white pollinose; front coxæ white pubescent and with a few white bristles beneath; middle and hind coxæ with straggling white hairs, and each with a lateral vertical row of three black bristles as well as with an apical fringe beneath. Femora more loosely pollinose, all the femora with a row of about six black bristles along the outer lower edge, front femora with a similar row of longer bristles along the upper edge. Tibiæ and tarsi subshining, more closely black bristly, the bristles of the hind tarsi long, pulvilli small.

Wings small, clear hyaline, veins narrow, blackish; neuration normal, second submarginal cell four times as long as broad, fourth posterior cell narrowly sessile with the second basal. Halteres destroyed.

Described from a single male taken by Dr. Hans Brauns, January 1, 1905, at Willowmore, Cape Colony, South Africa.

ADDITIONS TO THE LEPIDOPTEROUS FAUNA OF MILWAUKEE COUNTY.

By Richard A. Muttkowski.

The following list, comprising 187 species of Lepidoptera from Milwaukee County, Wisconsin, in intended as a supplement to a former list published in the Bulletin of this Society,* where 901 species are enumerated. This, therefore, brings the recorded number of species up to 1,088. Probably a very few of these will have to be eliminated in the future, but in its present form the list represents very well the local fauna. Most of the additional names here recorded are based on material contained in the collections of the Milwaukee Public Museum, but a few species not represented in the Museum collection are cited on the authority of Mr. Valentine Fernekes.

PAPILIONIDÆ.

IPHIDICLES Hbn.

5*a* *telamonides* Feld.
5*b* *marcellus* Bdv. & LeC.

PAPILIO Linn.

14 *thoas* Linn.

LAERTIAS Hbn.

23 *philenor* Linn.

PIERIDÆ.

CALLIDRYAS Bdv. & LeC.

52 *eubule* Linn

EURYMUS Swain.

66*a* *anthyale* Hbn.

NYMPHALIDÆ

AGRAULIS Bdv. & LeC.

91 *vanillæ* Linn.

LEMONIAS Hbn.

166 *hoffmanni* Behr.

CHARIDRYAS Scudd.

— *pascoensis* Wright.

PHYCIODES Hbn.

187 *vesta* Edw.
188 *phaon* Edw.

POLYGONIA Hbn.

209 *faunus* Edw.

*Vol. 4, Nos. 1-2, April 1906, pp. 39-58.

LYCÆNIDÆ.

URANOTES Scudd.

335 *melinus* Hbn.

THECLA Fabr.

345 *edwardsii* Saund.

STRYMON Hbn.

384 *titus* Fabr.

HESPERIIDÆ.

AMBLYSCIRTES Scudd.

459 *vialis* Edw.
464 *ænus* Edw.

HYLEPHILA Billb.

512 *campestris* Bdv.
515 *phylæus* Dru.

THYMELICUS Hbn.

516 *brettus* Bdv. & LeC.

LIMOCHROES Scudd.

556 *pontiac* Edw.
560 *arpa* Bdv. & LeC.

PHYCANASSA Scudd.

564 *viator* Edw.
566 *vitellius* Fabr.

EUDAMUS Swain.

577 *proteus* Linn.

PHOLISORA Scudd.

605 *catullus* Fabr.

THANAOS Bdv.

617 *brizo* Bdv. & LeC.

SPHINGIDÆ.

AMPELOPHAGA Brem. & Grey.

682*a* *cnotus* Hbn.

SATURNIIDÆ.

CALLOSAMIA Pack.

745 *angulifera* Walk.

HEMILEUCA Walk.

757*a* *lucina* Edw.

LITHOSIIDÆ.

CRAMBIDIA Pack.

802 *cephalica* Gr. & Rob.

HYPOPREPIA Hbn.

809 *cadaverosa* Streck.

ARCTIIDÆ.

EUBAPHE Hbn.

834*b* *ferruginosa* Walk.
834*c* *brevicornis* Walk.

HAPLOA Hbn.

842*a* *lumbonigera* Dyar.

HYPHANTRIA Harr.

856 *textor* Harr.

DIACRISIA Hbn.

862*a* *fumosa* Streck.

APANTESIS Walk.

878*a* *approximata* Stretch.
885 *proxima* G-M.
893 *placentia* S. & A.

NOCTUIDÆ.

APATELA Hbn.

982 *leporina* Linn.
994 *furcifera* Gn.
995 *hasta* Gn.
1001 *spinigera* Gn.
1007 *connecta* Grote.
1027 *hæsitata* Grote.
1039 *impleta* Walk.

MEROLONCHE Grote.

1050 *lupini* Grote.

CATABENA Walk.

1084 *lineolata* Walk.

PLATYSENTA Grote.

1088 *videns* Gn.

1089.1 *angustiorata* Grote.

CARADRINA Ochs.

1103 *exigua* Hbn.

OLIGIA Hbn.

1136 *festivoides* Gn.

HADENA Schrank.

1202 *misceloides* Gn.

1214 *burgessi* Morr.

1228 *plutonia* Grote.

SEMIOPHORA Steph.

1426 *climata* Gn.

1428 *tenebrifera* Walk.

PERIDROMA Hbn.

1468 *incivis* Gn.

NOCTUA Linn.

1491 *collaris* G. & R.

1514 *lubricans* Gn.

CHORIZAGROTIS Smith.

1518 *introferens* Grote.

1519 *agrestis* Grote.

FELTIA Walk.

1551 *malefida* Gn.

PARAGROTIS Pratt.

1574 *quadridentata* G. & R.

1578 *oblongostigma* Smith.

1598 *perpolita* Morr.

1603 *velleripennis* Grote.

1662 *comosa* Morr.

1699 *titubatis* Smith.

MAMESTRA Ochs.

1837*a* *illaudabilis* Grote.

1843 *erecta* Walk.

GRAPHIPHORA Hbn.

2035 *saturnus* Streck. (?)

XYLINA Ochs.

2079 *petulca* Grote.

2106 *unimoda* Lint.

2113 *capax* G. & R.

CALOCAMPA Steph.

2121 *curvimacula* Morr.

CUCULLIA Schrank.

2128 *florea* Gn.

2132 *intermedia* Spey.

NONAGRIA Ochs.

2151 *subflava* Grote.

GORTYNA Ochs.

2167 *obliqua* Harv.

PAPAIPEMA Smith.

2181 *nccopina* Grote.

2183 *cerussata* G. & R.

SCOPELOSOMA Curt.

2237 *moffatina* Grote.

TRILEUCA Grote.

—— *delicia* Dyar.

HELIOTHIS Ochs.

—— *ochracea* Ckll.

SCHINIA Hbn.

2366 *brevis* Grote.

MELANOPORPHYRIA Grote.

2397 *oregona* Edw.

AXENUS Grote.

2419 *arvalis* Edw.

EUTHISANOTIA Hbn.

2428 *unio* Hbn.

AUTOGRAPHA Hbn.

2515 *epigœa* Grote.
2519 *falcifera* Kby.

MARASMALUS Grote.

2551 *inficita* Walk.

PHIPROSOPUS Grote.

2573 *callitrichoides* Grote.

ISOGONA Gn.

2739 *natatrix* Gn.

DRASTERIA Hbn.

2755*a* *ochrea* Grote.
2755*b* *distincta* Neum.

SYNEDA Gn.

2795 *howlandii* Grote.

CATOCALA Schrank.

2806 *epione* Dru.
2811 *viduata* Gn.
2814 *dejecta* Streck.
2815 *retecta* Grote.
2827*a* *sylvia* Edw.
2828*a* *nurus* Walk.
2841 *junctura* Walk.
2857*b* *petulans* Hulst.
2865*b* *uxor* Gn.
2865*c* *osculata* Hulst.
2868 *piatrix* Grote.
2873*a* *annida* Fag.
2888 *clintonii* Grote.
2892*a* *cratægi* Saund.
2898 *fratercula* G. & R.
2898*b* *jaquenctta* Edw.
2898*f* *gisela* Meyer.

HYPOCALA Gn.

2912 *andremona* Cram.

PANOPODA Gn.

2920 *rufimargo* Hbn.
2920*a* *carneicosta* Gn.

CELIPTERA Gn.

2946 *frustulum* Gn.

ZANCLOGNATHA Led.

3023 *protumnusalis* Walk.

TETANOLITA Grote.

3052 *mynesalis* Walk.

CAPIS Grote.

3060 *curvata* Grote.

BOMOLOCHA Hbn.

3064 *manalis* Walk.

NOTODONTIDÆ.

MELALOPHA Hbn.

3092 *apicalis* Walk.
3093 *inornata* Neum.

PHEOSIA Hbn.

3119 *portlandia* Edw.

HETEROCAMPA Doub.

3142 *bilineata* Pack.

SCHIZURA Doub.

3152 *apicalis* B. & R.

GLUPHISIA Bdv.

3168 *scvera* Edw.
3169 *lintneri* Grote.

LASIOCAMPIDÆ.

HETEROPACHA Harv.

3222 *rileyana* Harv.

EPICNAPTERA Ramb.

3223*b* *roseata* Stretch.

PLATYPTERYGIDÆ.

DREPANA Schrank.

3229*a* *genicula* Grote.

GEOMETRIDÆ.

TEPHROCLYSTIS Hbn.

3277 *miserulata* Grote.
3284 *rotundopuncta* Pack.

EUCHŒCA Hbn.

—— *salienta* Pears.

EUSTROMA Hbn.

3351*a* *lugubrata* Moesch.

MESOLEUCA Hbn.

3372 *gratulata* Walk.

PETROPHORA Hbn.

3458 *spadicearia* D. & S.

SYNELYS Hulst.

3486 *alabastaria* Hbn.

CHLOROCLAMYS Hulst

2562 *phyllinaria* Zell.

SYNCHLORA Gn.

3580 *denticulata* Walk.

EUFIDONIA Pack.

3604 *notataria* Walk.
3604*a* *fidoniata* Walk.

DEILINEA Hbn.

3624 *erythremaria* Gn.

SCIAGRAPHIA Hulst.

3647 *granitata* Gn.
3650 *punctolineata* Pack.

MACARIA Curt.

3673 *eremiata* Gn.
3675 *aquiferaria* Walk.

CYMATOPHORA Hbn.

2709 *pustularia* Hbn.

ANAGOGA Hbn.

3898 *pulveraria* Linn.

THERINA Hbn.

3909 *athasiaria* Walk.
3910 *fiscellaria* Gn.
3911 *fervidaria* Hbn.

XANTHOTYPE Warr.

3925*a* *cælaria* Hulst.

PLAGODIS Hbn.

3927*a* *rosaria* Grote.
3928*a* *nigrescaria* Hulst.
3929 *fervidaria* H-S.
3932 *emargataria* Gn.

EUCHLÆNA Hbn.

3962 *vinulentaria* G. & R.

SABULODES Gn.

4026*a* *goniata* Gn.

ELIPLEMIDÆ.

CALLIZZIA Pack.

4043 *amorata* Pack.

THYRIDIDÆ.

THYRIS Lasp.

4132 *lugubris* Bdv.

DYSODIA Clem.

4134 *oculatana* Clem.

SESIIDÆ.

SESIA Fabr.

4224 *pyri* Harr.

PYRALIDÆ.

DIASTICTIS Hbn.

4287 *argyralis* Hbn.

PYRAUSTA Schrank.

—— *ochosalis* Fitch.

CRAMBUS Fabr.

4609 *luteolellus* Clem.

BENTA Walk.

4649*a* *diluculella* Clem.

ELASMOPALPUS Blanch.

4779 *floridellus* Hulst.

PTEROPHORIDÆ.

PLATYPTILIA Hbn.

4939 *acanthodactyla* Hbn.
4951 *petrodactyla* Walk.

TORTRICIDÆ.

OLETHREUTES Clem.

5042 *murina* Pack. l. sp.
5055 *chalybeana* Wals.

ANCYLIS Hbn.

5261 *goodelliana* Fern.

ALCERIS Hbn.

5312*a* *viburnana* Clem.

ARCHIPS Hbn.

5361 *rileyana* Grote.
5379 *persicana* Fitch.

PLATYNOTA Clem.

5382 *flavedana* Clem.

TORTRIX Linn.

5395 *citrana* Fern.

PHALONIA Hbn.

5433 *straminoides* Grote.

ŒCOPHORIDÆ.

ETHMIA Hbn.

5898 *arctostaphylella* Wals.

HEPIALIDÆ.

STHENOPIS Pack.

6604 *argenteomaculatus* Harr.
6605 *quadriguttatus* Grote.
6606 *thule* Streck.

HEPIALUS Fabr.

6609 *mustelina* Pack.
6610 *gracilis* Grote.

BRIEFER ARTICLES.

SOME RECENT RESEARCHES IN THE QUARTERNARY BEDS OF MARIGNAC IN THE COMMUNE OF TAURIDE, GIRONDE, FRANCE.

A paper read before the Linnean Society of Bordeaux, by François Daleau, presents some interesting recent discoveries made by that indefatigable explorer.

The quaternary alluvial deposits in many localities of the cantons of Bourg and Saint Savin have long been exploited at different altitudes for building sand and road gravel. His excavations in the sands of Sexcommunes had, until recently, not brought to light any finds except fossil wood, i. e., the silicified trunk of a tree that undoubtedly had been washed out of a lower formation by quaternary waters. In 1870, however, an incomplete maxillary and two teeth of an undetermined elephant taken from the sand of the left bank of the Dordogne River were given him, but without information as to the particular quarry whence they were taken. In 1889 he found *in situ* in a pit in Marignac, some flint implements shaped by man. The depth of the excavation reached 7 1-15 metres (30 feet) below the surface, penetrating the recent, middle and lower quaternary strata for 18 feet, and the upper and lower Tongrien beds of the Tertiary 12 feet or more.

The following relics were found in the *neolithic* strata, as defined by G. de Mortillett's schedule: A black flint nucleus; a quartzite hammer showing traces of battering; an oval, stationary mill, much used on both sides, all of the Solutréenne and Madalunéenne forms. In the *middle Quaternary,* ten bulbose and conchoidal flint flakes, due to a peculiar percussion characteristic of the Monstérienne period; a Monstérienne kind of pointed flint scraper chipped only on one side, covered by a white patine; and a very pretty small Acheuléen (perfected Chelléen form) flint implement, finely chipped on both sides, with a white patine on

one side and a yellow patine on the other; and an Acheuléen flaked flint, finely chipped on both surfaces.

In the *lower Quaternary* were found a superb Chelléen brown flint fist-ax, of almond shape, with large flakings on both sides, and over six inches long, taken from a wide cistern formed by currents in the Tertiary formation underlying the Quaternary; two other flint implements from the same bed; and four more that were not taken out of the undisturbed matrix. No prehistoric bones were found. A local peasants' adage explains it thus: "Le sable maigre mange les os; la terre gros les conserve." "The meagre (siliceous) sand eats the bones; the fat earth (argilocalcareous) preserves them."

The discovery of such tools *in situ* 12 feet under the lowest quaternary stratum would mean great glory for Daleau, but he candidly states that the quaternary waters probably drilled out the pothole and deposited in it the implements. Nevertheless, the discovery was the first in Southern France, where Monsteréen and Acheuléen (middle Quaternary) flint tools of human make were superimposed in their proper order over the Chelléen type of the inferior Quaternary, and where the latter were in contact with the Tertiary, thus corroborating the chronology of the Mortillets (father and son) who established the following schedule, now generally approved, although the localities Acheul and Chelles are nearly one hundred miles apart.

TABLE SHOWING THE SUCCESSION OF THE FRENCH QUATERNARY FORMATIONS.

Upper Quaternary	Neolithic	Lacustrine Madalunéenne Solutréenne
Middle Quaternary	Palæolithic	Monstérienne Acheulléenne
Lower Quaternary		Chelléenne

I wish to call attention to a circumstance which Daleau does not mention. The finely chipped "perfected Chelléen" implement, with white patine on one side and yellow patine on the other face, would indicate that its owner pursued his game on the surface of the yellow tertiary bed of sand and that the implement assumed the yellow tint on its under side from the yellow sand which had become fine enough to hold it in place during the time that the earliest quaternary deposit was forming. This seems to justify the idea that the implement in question was made and deposited *during* the Tertiary, *before* the Quarternary sands were deposited.

CHARLES H. DOERFLINGER.

KING EIDERS AT MILWAUKEE.—A CORRECTION.

My attention has recently twice been called to a misleading statement on p. 113, Vol. IV of this Bulletin in my Notes Of (should read On) the Herring Gull and Caspian Tern, where, writing of the ducks coming into the river between the factory lined docks in winter, I mention them as being "principally Old Squaws, Lesser Scaup and King Eiders." This is an error, and as the sentence stands American Golden Eyes should be substituted for King Eiders. I have an imperfect recollection of having left the third place open for reference to some misplaced notes on the comparative numbers of the ducks and intending to record the king eider as occasional.

I know of only three specimens of king eider actually and certainly taken at this point. Two of these are recorded by Hollister in The Birds of Wisconsin, Wis. Nat. Hist. Society, Bull. Nos. 1, 2 and 3 of Vol. III, i. e., a female taken Dec. 25, 1899, and a male Jan. 1, 1900, both in the Copeland-Russel collection in this city; and a female taken within the harbor Nov. 28, 1903, and now in the Public Museum. The museum also possesses two other specimens, an adult and an immature male received by gift from the Wis. Nat. Hist. Socy. about twenty-five years ago, at the time of the founding of the museum. The only

data accompanying these are those of sex and "Lake Michigan, Wis." One of these is evidently referred to by Mr. Hollister when he writes, *l. c.*, "and there is now a specimen in the Milwaukee Public Museum, taken at Milwaukee many years ago."

Various times I have heard of water men about the harbor describing ducks seen in or near the harbor that were probably this species. Mr. Hollister writes, *l. c.*, "During our sojourn on the Great Lakes we are positive of having seen king eiders in small flocks several times in late fall. Being very familiar with the bird in the Arctic regions, we think there was no mistake." We incline to the belief that this species is not as uncommon in this region as its scarcity in local collections would indicate; but it is far from being the third commonest winter species.

Henry L. Ward.

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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 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.

Vol. 5 (New Series) JULY, 1907 No. 3

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

EDITED BY THE SECRETARY

CONTENTS:

MILWAUKEE, WISCONSIN.
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The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6. 1857.

OFFICERS AND DIRECTORS.

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

PUBLISHING COMMITTEE.

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REGULAR MEETINGS.

These are all held on the last Thursday of each month, except July and August, in the trustees' room in the Public Museum Building, Milwaukee.

PUBLICATION.

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BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 5, New Series. **JULY, 1907.** **No. 3.**

PROCEEDINGS.

Milwaukee, April 11, 1907.

Meeting of the combined sections.

President Teller in the chair, and Messrs. Brues, Carpenter, Case, Copeland, Doerflinger, Ogden, Russell and Ward present.

Mr. Howland Russell gave some "Notes on Wisconsin Oaks." He read a recent paper by Prof. E. J. Hill from the Botanical Gazette, referring to the common occurrence of *Quercus ellipsoidalis* Hill in the vicinity of Milwaukee, and the probable absence of *Quercus palustris* Moench. in this region. Mr. Russell exhibited specimens of leaves and acorns of these and several other species, pointing out the various differential characters that separate them. Later the discussion was taken up by several members, after which the meeting adjourned.

Milwaukee, April 25, 1907.

Regular monthly and annual meeting of the Society.

President Teller in the chair and about ninety persons present.

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

Mr. Teller asked for nominations for the election of officers.

Mr. Doerflinger moved that the secretary be instructed to cast a unanimous vote for the re-election of the present incumbents.

The motion was seconded and passed and the officers elected as follows:

President—E. E. Teller.

Vice-President—H. L. Ward.

General Secretary—C. T. Brues.

Member of Board of Directors—S. Graenicher.

Publishing Committee—H. L. Ward, Geo. W. Peckham, C. E. Monroe.

The names of Mr. A. J. Wright and Rev. Frederick Edwards were proposed for membership and subsequently approved by the Board of Directors.

There being no further business, Mr. H. L. Ward addressed the meeting on "Museum Collecting." He described his experiences in collecting animals for museums in various parts of this country, Mexico, and the West Indies. The rediscovery of the West-Indian Seal was mentioned, and the manner in which he had obtained them. The collecting of sea lions on the Pacific Coast was described at length and the topography of the islands on which they live. The speaker also described several more recent trips which he had made into the northern parts of Wisconsin, made principally to obtain birds and accessories for bird groups in the Public Museum.

The lecture was illustrated by stereopticon slides prepared from negatives made by Mr. Ward on the various collecting trips to which he referred.

Milwaukee, May 9, 1907.

Meeting of the combined sections.

President Teller in the chair and Messrs. Barth, Brues, Clowes, Colles, Carpenter, Doerflinger, Graenicher, Russell and Sherman present.

Dr. Graenicher described a recent classification of entomophilous flowers and insects first proposed by Loew for the European Flora. He mentioned the several categories illustrating each by specimens of fresh flowers. He then showed the degree of mutual adaptation among the several classes which he compared with the results obtained by Loew in Europe.

Mr. Brues then exhibited two species of insects. One, *Ignotus enigmaticus*, was a peculiar beetle of very anomalous structure which has puzzled systematists since its discovery several years ago. The specimens exhibited had been found feeding on some dried Echinoderms in the Public Museum. This was the second time that the species has been collected, its original habitat being unknown, but probably the West Indies. The second was a new species of wingless fly belonging to the genus *Puliciphora*, recently bred from cattle tick eggs by the United States Department of Agriculture, and sent him for identification. Mr. Teller then exhibited some specimens of a rare fossil Echinoderm, *Ichthyechinus corbis*, from the Chicago formation of the Niagara limestone. After considerable discussion about these, the meeting adjourned.

OBSERVATIONS ON THE NESTING HABITS OF GORYTES CANALICULATUS, PACKARD

By George P. Barth.

While sojourning at Cedar Lake, Washington Co., Wisconsin, during the latter part of July of this year, my attention was attracted by a beautiful yellow-banded wasp busily engaged in performing its nesting labors among a large colony of *Aphilanthops frigidus,* an occasional *Bembex, Cerceris, Anacrabro ocellatus, Oxybelis,* leaf cutter bees and even an *Osmia.* All lived in perfect harmony on a little hill of sand not over twenty feet long and six feet wide located at the edge of a gravel pit bordering a wide, deep, though small ravine still in pristine state. An immense oatfield on the other three sides made this a secluded corner which received the full glare and heat of the sun during the greater part of the day.

It was a treat as well as a study to see the methods by which these busy workers accomplished their aim of procuring an abiding place wherein their young could develop undisturbed. Aphilanthops vigorously scratched, sending showers of sand to a distance of more than a foot with a rasping sound which could easily be heard at a distance of from ten to fifteen feet; restless Anacrabro diving into her burrow only to emerge again flying backwards to scatter broadcast a mass of sand grasped between her legs and body; Bembex with her angry hum when she attempted to pull out a pebble too large for even her strong mandibles; Cerceris digging away at a rate which caused her forefeet to resemble a blur of moving matter, while now and then Gorytes smoothed away her load of sand to make room for more.

Although the primary object of my visit to this hill was to become acquainted with Anacrabro, I found that it was still too early in the season for that interesting insect, as she had not begun to store her cells, and so turned my attention to the

worker whose habits, as far as I saw them, it will be my pleasant task to describe below. Unfortunately part of almost every day was marred by a shower of rain, or the conditions of the sky was such as is designated part cloudy in our weather reports.

The notes will be given just as they were entered in my field book at the time:

Gorytes begins her nest by scratching at the chosen spot with her forefeet, occasionally helping with the mandibles when a pebble or particularly hard spot is met, until she has loosened a small pile of sand when she backs out and smooths this away to some distance. Pebbles are grasped by the mandibles and carried a short distance and there dropped. After the burrow has reached a depth greater than the length of the wasp, the sand accumulates behind her and is then pushed out with the abdomen at the same time assisting with the legs as she backs out.

NEST NO. 1.

This nest was about one inch in depth when first seen at 5:25 P. M. July 14th. Activities were continued until nearly six o'clock, when the opening was closed from within. At 6:40 the nest was still closed and remained closed until I left as darkness fell, so the presumption was that labor had ceased for the night. It rained steadily during the morning of July 15th, and the nest was not visited until 4:00 P. M. It was still closed. The sand was blown away until the opening was free and the depth of the gallery tested with a grass stem. At 4:3:30 the wasp returned, carrying a leaf hopper. Although wide open, she instinctively began scratching at the entrance of the nest as if to clear it and then entered head foremost, carrying her prey. She came out at 4:4:20, closing the hole as she came, using mandibles and feet in the operation. She then turned around to examine the work but a *Formica subæneseens* running by disturbed her inspection, when she flew away a short distance and, upon the ant leaving, returned and proceeded to close more effectively with further material gathered by forelegs and mandibles from a radius of about one inch. After a short locality study in gradually widen-

ing circles departure took place at 4 : 11 : 00, leaving a smooth hill of sand over the entrance. Her further activities were as follows:

Returned at 4 : 55 with hopper. Opened the nest without dropping her prey.

Came out at 4 : 56. Closed the opening.

Flew away at 4 : 57 : 35. No locality study.

Returned at 5 : 17 : 15 with hopper, flying directly to the nest.

Entered at 5 : 17 : 38.

Came out at 5 : 17 : 55. Closed nest by scratching sand from a distance of about one inch.

Away at 5 : 17 : 59. No locality study.

Returned at 5 : 52 : 45 with hopper.

Entered at 5 : 52 : 57.

Came out at 5 : 53 : 30. Closed the nest.

July 16th. Part cloudy. Observations begun at 8 : 45 A. M.

Wasp came at 9 : 14.

Away at 9 : 14 : 40. A few scratches to close. No locality study.

Returned at 9 : 40 with hopper.

Entered at 9 : 40 : 15.

Came out at 9 : 40 : 20. A few scratches to close.

Away at 9 : 40 : 30. No locality study.

Returned at 9 : 50 : 45 with hopper.

Entered at 9 : 50 : 55.

Came out at 9 : 51 : 10. A few scratches to close.

Away at 9 : 51 : 14. No locality study.

Returned at 10 : 00 : 25 with hopper.

Entered at 10 : 00 : 30.

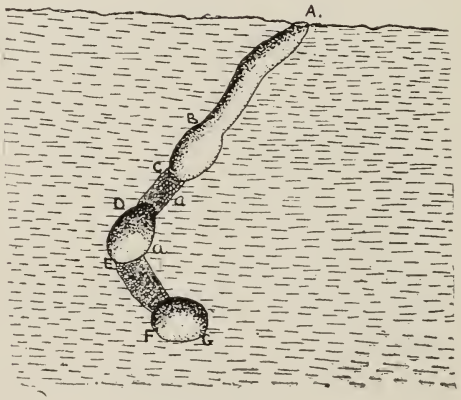
Came out 10 : 00 : 40. Began filling the entrance by scratching towards herself while still in the hole.

Away at 10 : 00 : 50.

The wasp had not returned by 11 o'clock, so thinking the nest complete I excavated. At 11 : 15 she returned with a hopper and sat about eighteen inches away watching the destruction going on. I then caught her.

The entrance of the nest was 0.4 cm. in diameter and widened

to 0.8 cm. one inch down. Whole nest following the curve A to G., 11 cm.; A to B., 4 cm.; C to D., 1.5 cm.; E to F., 2 cm.; a. a.—firmly packed sand. The cells and gallery were practically in the same plane, cell 2 being about 1 cm. lateral to cells 1 and 3.



NEST No. 1.

Cell 1. Contained eight leaf hoppers, seemingly placed haphazardly in the cell. The egg was on the left side of the thorax of a hopper in the middle of the cell, beginning at the neck and running parallel to the hopper's body at the edge of the wing. Cell practically spherical in shape, 0.7 cm. in diameter.

Cell 2. Egg shaped; 1.3 cm. long and 0.8 cm. in its greatest diameter; 14 leaf hoppers. No egg found.

Cell 3. 1.2 cm. long and 0.9 cm. in diameter; 3 leaf hoppers. No egg found.

NEST NO. 2.

July 16th. Wasp came at 2:54 with a hopper. A locality study of considerable care was made both before entering and on leaving, probably due to the fact that I had disturbed the surface to some extent in excavating an Anacrabro nest three inches away. The entrance was under a small, round stone and

the gallery descended at a very slight angle. The wasp left at 2:54:10 without closing the entrance. The nest was probably abandoned, as I did not see her again during my stay.

NEST NO. 3.

July 16th, 4:35 P. M. This nest was already quite deep when discovered, but the wasp was still digging. The entrance was in the side of the hill which had a slant of about 45°.

July 17th. Warm and dry. At 9 A. M. the nest was closed by a small hill of sand. This was blown away, completely exposing the entrance. At 9:18:30 the wasp came carrying a hopper and went directly into the nest seemingly undisturbed by the fact of the nest being open.

Came out again at 9:18:50 and closed by scratching sand from a radius of about one inch. Flew away at 9:20. Nest smoothly covered.

Returned at 9:50:7 with hopper.

Entered at 9:50:10.

Came out at 9:50:25. Closing by a few scratches.

Away at 9:50:30. No locality study.

Returned at 10:45:30 with hopper. Rested on sand near the nest.

Entered at 10:45:55.

Came out at 10:46:5. Head first.

Away at 10:46:10. No locality study.

Returned at 11:12:10 with hopper.

Entered at 11:12:12.

Came out at 11:12:25.

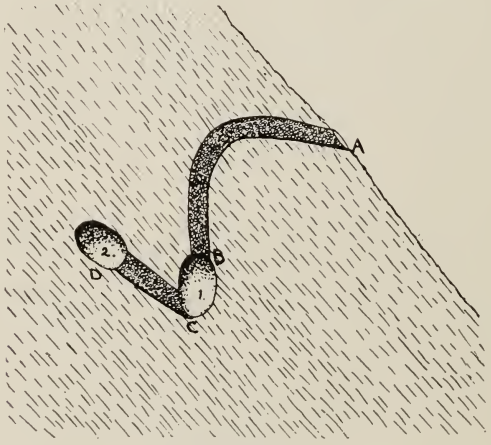
Away at 11:12:32. No locality study.

At 11:21:20, a Nysson fidelis (Cres.) entered the nest by quickly scratching it open. Came out at 11:21:48, closing the opening much less perfectly than the Hoplysis and flew away.

At 11:45:20 the Gorytes returned with a hopper and entered at 11:45:22, seemingly not disturbed by the fact of the Nysson having been there. 12:2:10 looking out of the nest. At

12:13:10 began to close the nest while still part way in the gallery scratching considerable quantities of material into the nest. She finally closed by taking material from around the nest, occasionally stamping it down with her abdomen. This she continued until a perfectly smooth surface was presented. Believing this careful closing to indicate the completion of the nest, the wasp was caught as she was flying away at 12:18.

As far as could be determined the entrance was but slightly narrower than the gallery. Cell 1 was 2 cm. lateral to cell 2, which again occupied the same plane as the entrance. A to B, 8 cm. Rather loosely packed with sand. C to D, 2 cm. also packed.



NEST No. 2.

Cell 1. 1.3 cm. long and 0.8 cm. in diameter. Regularly oval; 12 leaf hoppers. The egg was placed on the right side of the thorax parallel with the edge of the wing, but starting slightly posterior to the neck of the hopper.

Cell 2. Seven hoppers and an egg which showed beginning larval segmentation. Placed on the right side of the thorax of the hopper as in cell 1.

The Nysson egg was not found.

NEST NO. 4.

July 17th, 1907. Nest found at the base of a tussock of grass. Wasp came at 9:47:10 with a hopper; came again at 9:54:10 with hopper.

Entered at 9:54:45.

Came, 10:21:00, with hopper; entered, 10:21:20; out, 10:21:32; away, 10:21:45; closing rather careful. Locality study none.

Came, 10:28:28, with hopper; entered, 10:28:35; out, 10:28:55; away, 10:29:6. A few scratches. Locality study none.

Came, 10:32:28, with hopper; entered, 10:32:37; out, 10:32:40; away, 10:33:00. A few scratches. Locality study none.

Came, 10:48:10, with hopper; entered, 10:48:15; out, ————; away, 10:48:20. A few scratches. Locality study none.

Came, 11:13:10, with hopper; entered, 11:13:16; out, 11:14:00; away, 11:14:2. A few scratches. Locality study none.

Came 11:40:00, with hopper, and entered an Aphilanthops frigidus nest which was in the building close besides its nest. Seemed much puzzled by the change in the surface which the ejected sand of the Aphilanthops made. Hunted around, scratching here and there, and finally found the entrance.

Returned to post of observation at 1 P. M. Nest was very well closed.

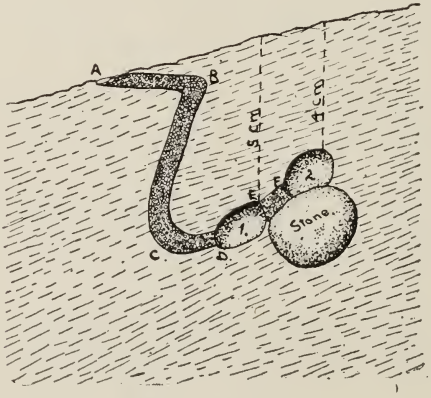
Came, 1:59:30, with hopper; entered, 2:00:00; out, 2:2:00; away, 2:2:20. Rather careful closing. Locality study none.

While the wasp was in the nest a Nysson fidelis (Cres.), identified for me by Mr. Viereck) started to enter the open nest but, becoming aware of the presence of the owner, backed out and flew to a distance of a foot, there resting quietly on the sand and

watching. At 2:3:00 it rapidly opened the nest and entered, remaining till 2:10:00, when she came out again and closed the entrance. She was then caught.

July 18th. The nest was excavated this morning. It ran northeast one and one-half inches, down and southeast by south two inches, east one inch to cell.

The gallery was regularly round, with smooth inner surface, the entrance being about the same size as the passage.



NEST No. 4.

Cell 1. Was regularly oval, as shown in the drawing, its length being about 1 cm., and greatest diameter 0.7 cm. Contained 9 leaf hoppers. The egg was on the thorax slightly below and parallel to the edge of the left wing, beginning at the neck. On the floor of the cell, about one-third from the entrance, another egg was found unattached. In shape it was similar to the wasp egg, but smaller and the surface less shining; slightly curved.

Cell 2. Eight hoppers, irregularly round and partially back of the stone. The egg was placed in a position on the hopper like that in the other cell.

NEST NO. 5.

July 20th, 1907. Wasp came at 10:27:00 A. M., with a hopper. Left at 10:27:40, after carefully closing the entrance. Returned at 11:16:20 with a hopper. Entered at 11:16:35, after resting about a foot from the nest. Came out at 11:17:15 and flew away at 11:17:30, with no locality study.

Rain set in at noon and continued all the next day, and as I was compelled to return to the city on an early train, July 22nd, this closed my observations.

GENERAL REMARKS.

The prey of the wasp seems to be exclusively leaf hoppers of the species *Cyrtolobus fenestratus* Fitch and *Atyma inornata* Say in all stages from the nympth to the adult as found in the cells. They were not closely packed and lay at all angles to each other as though carelessly thrown into place. None of the hoppers responded to stimulation with fingers or forceps, so presumably they were stung to death.

In all cases the entrance was opened just sufficiently to allow the wasp to slip in and careful watching failed to give any evidence of a shifting of hold on the prey as the wasp carried it in. This was carried tightly grasped about the neck or anterior thorax by the middle legs and, whether the wasp walked or flew, was never dropped. The wasp always entered the cell head foremost, carrying the hopper with her. The entrance was completely closed when the wasp left, the little work required to produce this being due to the small opening which the wasp made to enter, this being often but one-half of the actual size of the door.

The quickness with which the insects were able to return with prey was due no doubt to a plentiful supply in the densely over grown ravine close by, as the wasps seemed invariably to go and come from that direction. The presence of an observer seemed to have no disturbing influence on her actions, as very frequently I sat within a few feet of the nest with an umbrella over my head for protection against the heat of the sun.

NOTES AND DESCRIPTIONS OF NORTH AMERICAN PARASITIC HYMENOPTERA. V.

By Charles T. Brues.

FAMILY BETHYLIDAE.

Goniozus hortorum sp. nov.

Female. Length 2.25 mm. Black; antennæ, except apex, pale yellow, legs piceous, the anterior pair and all the tarsi brownish-yellow. Head sub-shining, shagreened and with scattered large punctures; one and one-half times as long as wide. Face with a median carina between the antennæ that extends just above the level of the lower eye-margin, and a lateral one of the same extent on each side above the antennæ. Seen from above the head is three times as long as the eyes. Eyes bare, ocelli in a small triangle near the posterior margin of the head. Antennæ 13-jointed, extending only a short distance beyond the vertex; slender, with the joints submoniliform. Scape stout, two times as long as thick. First flagellar joint only one-half as long as the pedicel, which is a little longer than the second; following subequal, becoming distinctly moniliform before the tip. Mandibles varying from piceous to black. Palpi piceous, malar space very short. Pronotum and mesonotum sculptured like the head, the former evenly narrowed in front, and about two and one-half times as long as the mesonotum, the latter almost two times as wide as long. Scutellum shagreened, distinctly longer than the mesonotum and as broad as long, separated from the mesonotum by a very delicate suture and with a short oblique linear fovea on each side basally. Metanotum strongly shagreened laterally, but smooth and polished medially; the entire lateral margins and the lower edge of the posterior slope margined, but otherwise without carinæ, except for a trace of one laterally at the top of the posterior edge. It is slightly longer than the mesonotum and scutellum together, with the posterior face coarsely shagreened. Abdomen oval, polished, as long or slightly longer than the head and thorax together; second and following segments broadly emarginate on their posterior margins. Legs stout but not at all spinose. Claws bifid, with a long slender inner tooth. Wings hyaline, both stigmata piceous, the stigma somewhat but only slightly larger than the parastigma. Basal nervure angularly broken, but without

any stump of a vein, its upper section one-half the length of the lower. Two basal cells defined by pale yellow nervures. Marginal cell open, the radial vein three times as long as the stigma, separated by its own length from the wing tip.

Three females bred by Prof. H. A. Surface from the larva of a microlepidopteron folding the leaf of the Apple; Floradale, Pa.: August 16, issued September 7.

As can be seen from the following table, it is most closely related to *Goniozus foveolatus* Ashmead.

NORTH AMERICAN SPECIES OF GONIOZUS.*

1. Metanotum smooth medially, without trace of a median carina. 2
   Metanotum with a delicate median carina; stump of cubital vein well developed.....**platynotæ** Ashm.
2. Head unusually large; legs piceous; tips of tibiæ and tarsi pale; stump of cubital vein very small.....**megacephalus** Ashm.
   Head of normal size..... 3
3. Stump of cubital vein as long as the upper section of the basal vervure; legs, except tarsi, black; wings hyaline; head without larger punctures interspersed.....**clarimontis** Kieff.
   Stump of cubital vein much shorter, often scarcely developed.. 4
4. Abdomen as long the the head and thorax together..... 6
   Abdomen shorter than the head and thorax together..... 5
5. Legs including coxæ yellow.....**hubbardi** Howard.
   Legs piceous, with trochanters, tibiæ and tarsi more or less yellowish .....**columbianus** Ashm.
6. Wing veins piceous or brown..... 7
   Wing veins testaceous or honey-yellow..... 9
7. Head of female one and one-half times as long as wide, with more or less distinct scattered punctures..... 8
   Head of female two times as long as wide, smooth and impunctured .....**politus** Ashm.
8. Metanotum not margined laterally, parastigma as large as the stigma .....**longiceps** Kieff.
   Metanotum margined laterally, stigma larger than the parastigma .....**occipitalis** Kieff.

* Exclusive of West Indian and Mexican species, and also of those with a closed discoidal cell. These latter are more properly to be regarded as forming the Genus *Parasierola* Cameron.

9. Stump of cubital vein distinct; wings subhyaline, with black stigma and honey yellow veins.....**foveolatus** Ashm.
Stump of cubital vein obsolete, wings hyaline, with piceous stigma and pale yellow veins.....**hortorum** sp. nov.

Phorbas longicornis sp. nov.

Male. Length 2.25 mm. Black; the anterior trochanters and all knees pale yellow; tibiæ and tarsi fuscous. Wings nearly hyaline, iridescent, stigma and marginal vein fusco-piceous. Head twice as wide as thick, the occiput evenly arcuated and excavated behind. Ocelli distinctly in a triangle, the anterior one being its own diameter in front of the lateral ones. Eyes oval, pubescent. Clypeus strongly protuberant below. Mandibles pale, with black tips, palpi pale. Head everywhere finely shagreened and thinly whitish pubescent. Antennæ long and slender, almost as long as the body. Scape and pedicel short, the former a little the longer, the pedicel two times as long as thick; first six flagellar joints subequal, growing gradually shorter, the first fully five or six times as long as thick. Prothorax scarcely visible from above, but attaining the tegulæ on the sides. Mesonotum broad, shining, faintly shagreened, with two very fine parapsidal furrows. Scutellum large, subconvex, shining, with a cross-furrow at its base. Metathorax about one and one-half times as long as wide, obliquely truncate behind, its surface regularly and finely rugulose. Abdomen small, flattened, smooth and shining, as long and about as broad as the thorax. Wings large, stigma very narrow, obliquely truncate basally, and prolonged into a thickened postmarginal vein apically. Radial cell nearly closed. Two basal cells indicated by yellow veins. No trace of any discoidal cells, although the subdiscoidal nervure is distinct nearly to the margin of the wing. Both pairs of wings distinctly ciliated. Legs slender, pubescent, the tibiæ each with a small very slender spur.

Described from one male sent me for identification by Prof. H. A. Surface of Harrisburg, Pa. It was bred by him from a cocoon thought to be that of a species of microlepidopteron collected at Saegerstown, Pa., January 30. As all members of the group are parasites of leaf-hoppers, feeding externally and later spinning their own cocoons, it is probable that the parasite's own cocoon was mistaken for that of a moth.

The present species differs from the only other described species by its long antennæ, and by the presence of a subdiscoidal vein in the wing.

I think it undoubtedly belongs to Ashmead's genus *Phorbas*, although it will not run to it in Kieffer's recent table (Genera Insectorum Fascicle 54, p. 12, 1907). He has placed *Phorbas* in his sub-family Dryininæ, characterized by the short pronotum which does not attain the tegulæ on the sides. Ashmead, in his diagnosis of *Pharbas*, says, "Thorax as in Aphelopus, but without distinct parapsidal furrows, the prothorax only slightly visible from above." In *Aphelopus* the prothorax attains the tegulæ. I think, therefore, that Kieffer has incorrectly placed the genus, and that it undoubtedly falls near *Labeo*. It seems probable to me also that Perkins' *Eukolbeleia* is a synonym of *Phorbas*.

FAMILY SCELIONIDÆ.

Macroteleia surfacei sp. nov.

Female. Length 4-5 mm. Black; the legs more or less pale rufous. Wings hyaline. Head quadrate, slightly broader than thick. Its surface shagreened and covered with moderately thick regular large punctures. Eyes oval, bare, ocelli in a triangle, the lateral ones as far from the eye-margin as from the median ocellus. Mandibles rufous, with black teeth. Antennæ 12-jointed; the scape about one-half the length of the flagellum. Scape, pedicel and first four flagellar joints more or less rufous or brownish. Pedicel long, a trifle shorter than the first flagellar joint which is about four times as long as thick. Second, third and fourth growing shorter, the fourth slightly longer than wide. Club six-jointed, black; slender, fusiform, the joints quadrate or slightly transverse, and all of nearly equal thickness, except the apical joint, which is more slender and a little longer. Occiput and cheeks margined behind. Mesonotum with well separated round punctures like those of the head, with distinctly impressed parapsidal furrows. Scutellum sculptured like the mesonotum, with a coarsely punctate frenum at its base and a more delicate one at the apex. Metathorax very short, the metanotum scarcely visible from above, elevated into a transverse ridge anteriorly and rugulose behind, without raised lines. Abdomen long, acuminate, seen from the side is is two and three-fourth times as long as the head and thorax

together, slightly depressed on the basal half and compressed apically. Its surface with moderately large regular punctures; the first segment also strongly striated and the second, fifth and sixth slightly so. Second segment one and one-half times as long as the first and equal to the third and sixth. Fourth and fifth equal, each three-fifths the length of the second. Venter finely punctate, weakly aciculated basally. Legs honey-yellow, or pale rufous, the tips of the middle femora, most of the posterior pair, and the apical tarsal joints infuscated. Coxæ black. Wings hyaline, stigmal vein slender, knobbed, one-half as long as the marginal. Postmarginal one-third longer than the marginal. Basal vein obsolete. The wings when folded reach to the base of the fifth segment.

Described from 10 female specimens reared during May by Prof. H. A. Surface from the eggs of a locustid: Chester, N. J.

This is the fifth species of the genus to be discovered within the United States, and may be distinguished from the others by the aid of the following table:

1. Eyes bare 2
   Eyes pubescent; legs, including coxæ, brownish-yellow; first and second abdominal segments about equal in length.
   virginiensis Ashm.
2. Flagellum of antennæ wholly or partly reddish-yellow..... 3
   Antennæ, except scape, dark brown, marginal vein about two times as long as the stigmal.....**floridana** Ashm.
3. Wings fusco-hyaline, marginal vein one and one-half times as long as the stigmal.....**macrogaster** Ashm.
   Wings hyaline 4
4. Head not margined behind, marginal vein one-third longer than the stigmal.....**punctata** Kieff.
   Occiput and cheeks margined behind, marginal vein almost two times as long as the stigmal.....**surfacei** sp. nov.

Sparaisoa gregarium sp. nov.

Female. Length 4 mm. Black; legs, except coxæ; mandibles and scape and pedicel of antennæ, honey-yellow. Head coarsely rugoso-reticulate, frontal ridge projecting one-half the diameter of the eye in front of the eye-margin. Seen from above, the head is as wide as thick, the frontal ledge one-half as wide as the front, rounded anteriorly, with a reflexed smooth margin. Face below the ridge arcuately transversely striated. Mandibles ferruginous. Antennæ 12-jointed.

black. the scape, except extreme tip and the pedicel ferruginous. Scape broadly dilated at the tip; pedicel two-thirds the length of the first flagellar joint; second to seventh slightly wider than long, the following growing more slender, but of equal length. Prothorax very closely and rather finely punctate in front. Pronotum and mesonotum deeply and coarsely punctate, the pronotum closely, but the mesonotum more sparsely apically toward the center. Parapsidal furrows vaguely defined by punctures, scapulæ punctate, with no trace of any groove. Scutellum with a punctate frenum, two times as wide as long, its surface coarsely punctate, the punctures much sparser toward the center. Postscutellum with a very short spine. Metanotum finely rugose, more or less distinctly areolated anteriorly, and with a V-shaped carina on each side, but no median one anteriorly. Mesopleura with a large smooth space, metapleura with a smaller one. Metanotum with its upper lateral angles produced. Abdomen elongate ovate, as long as the head and thorax, coarsely longitudinally striated above, except along the posterior margins of the segments which are smooth and polished. Apical segments more or less punctate; sutures crenulate. Venter sparsely and rather coarsely punctate. Legs weakly spinous, clothed with glistening hairs. Wings infuscated, the costal cell hyaline. Stigma separated from the submarginal vein; stigmal vein recurved, a trifle longer than the indistinct postmarginal one, with an imperceptible knob at the tip. Marginal vein indistinctly indicated, except at base and tip, where it is not visible.

Two females sent me by Mr. Nathan Banks. They were collected at Falls Church, Va., August 2.

This species can be readily distinguished by the pale legs from any other in our fauna, except *S. famelicum* Say, which, however, has hyaline wings.

The species of *Sparaison* so far discovered within the United States may be separated by means of the following table:

1. Wings hyaline, scapulæ with a distinct grooved longitudinal line, legs, except coxæ, honey-yellow..... **famelicum** Say.
   Wings infuscated, scapulæ without a distinct grooved line.... 2
2. Legs, except coxæ, honey-yellow, antennal scape, honey-yellow. **gregarium** sp. nov.
   Legs principally black, sometimes with the tibiæ and tarsi lighter, antennæ wholly black..... 3

3. Abdomen smooth and polished except at the sutures. **pacificum** Ashm.
   Abdomen longitudinally rugose or striate..... 4
4. Metanotum rugulose medially, without a central carina..... 5
   Metanotum with a distinct carina medially at the base; scapulæ punctate .....**graenicheri Brues.**
5. Frontal ledge broad, on the same plane as the vertex, scapulæ impunctate .....**pilosum** Ashm.
   Frontal ledge not so broad and not on the same plane as the vertex, more oblique.....**nigrum** Ashm.

Hadronotus robustus sp. nov.

Female. Length 1.7 mm. Entirely black; the tibiæ and tarsi dull rufous. Head large, considerably wider than the thorax, and three times as wide as thick, the occiput arcuately excavated; its surface coarsely rugose. Occiput above with a finely raised line, vertex without any smooth areas; lateral ocelli about their own diameter from the eye margin. Eyes bare. Facial excavation above the antennæ deep, transversely striated and margined by a raised line laterally. Antennæ 12-jointed, clavate, black, with the tip of the pedicel rufous. Pedicel and first flagellar joint of equal length, second distinctly shorter, third small, quadrate, club fusiform, not very stout, the joints slightly transverse. Mesothorax and scutellum coarsely rugose; no parapsidal furrows. Metathorax very short. Abdomen short, subglobose, about as wide and as long as the thorax; first segment deeply grooved and ribbed longitudinally near its base, apically rugulose. Second segment twice as long as the first, and one-third as long as wide, rugulose basally and microscopically so near the apex; third segment less than one-half as long as the second; fourth still shorter, both sculptured like the apical half of the second. Venter finely punctulate. Pleuræ rugose but still more or less shining. Legs black, knees, tibiæ and tarsi, except terminal joint, rufous. Wings hyaline, the venation yellowish brown. Marginal vein short, about one-half the length of the stigmal; postmarginal nearly twice the length of the stigmal.

Described from one female specimen collected by the writer at Austin, Texas.

The species is related to *H. insularis* Ashm. from Grenada, West Indies, and to *H. rugiceps* Ashm. from the United States. It differs from both in the relative lengths of the antennal joints and the segments of the abdomen.

FAMILY ICHNEUMONIDÆ.

Orthopelma thompsoni sp. nov.

Male and female. Length 3.75-4.25 mm. Head and thorax black; legs in part and abdomen beyond the petiole reddish. Head broad, almost three times as wide as thick. Face distinctly narrowed below, more strongly so in the male. Clypeus with an impressed line near the anterior margin which is raised and weakly emarginate. Mandibles black, clypeus reddish in the male. Palpi pale. Antennæ short and rather stout, 18-19-jointed in the female and 22-jointed in the male. Flagellar joints decreasing in length apically except the last, which is twice as long as the preceding; first flagellar joint four times as long as thick, penultimate only slightly longer than thick. Surface of head shining, faintly punctate, more distinctly so on the occiput and cheeks. Eyes bare, elongate, twice as long as wide. Occiput and cheeks margined behind. Mesonotum finely punctate, no trace of parapsidal furrows. Scutellum with a depression anteriorly and strongly convex posteriorly. Metanotum areolated, all the areas separated and distinct. Abdomen with a long petiole, which is at least four times as long as broad; spiracles prominent, placed near the basal third; its surface finely rugose, with a carina on each side from the spiracle nearly to the tip of the segment. Following segments polished. Ovipositor as long or a little longer than the abdominal petiole, reddish, its sheaths narrow, black and nearly bare. Mesopleura polished, with a fovea near the center, margined behind and with a wide finely crenate furrow below. Legs moderately stout; pale ferruginous, hind femora except tip piceous, and hind tibiæ darker apically. Coxæ and first joint of hind trochanters black. Tegulæ pale yellow, abdomen, except petiole, bright ferruginous, the segments often with darker spots laterally behind, especially in the male. Wings hyaline, stigma and veins piceous, the former broad and paler at the base. Areolet open behind and small in position.

Described from numerous specimens bred by Prof. M. T. Thompson from the galls of *Rhodites rosæ* at Worcester, Mass. Most of the known species of the genus are parasites of various members of the genus *Rhodites*.

FAMILY BRACONIDÆ.

Helcon ferrugineus sp. nov.

Female. Length 9-10 mm. Ovipositor 7-9 mm. Entirely pale, ferruginous, tips of hind tibiæ and antennal flagellum except for pale annulus, piceous. Head large, transversely quadrate, about one-half wider than thick. Face irregularly rugose, antennal excavation with a median carina, sharp lateral margins and a few irregular striæ below; above immargined, polished and including the anterior ocellus. Antennæ setaceous, 35-jointed, piceous, the first two joints rufous. Flagellum with a whitish annulus that occupies about seven joints. The basal joints are long, four or five times as long as thick, while those after the annulus become much shorter, those nearer the apex being only one-half longer than thick. Head above and behind highly polished, occiput and cheeks faintly punctate. Vertex with a finely impressed longitudinal line. Eyes rather small, oval, about as broad as the cheeks. Mandibles slender, edentate, black at tips. Palpi pale rufous. Prothorax rugose, with a small strip above on the sides closely punctate; nowhere striate. Mesonotum shining, sparsely punctured; trilobed, the parapsidal furrows crenulate anteriorly; behind, the space between them is roughly rugose. Scutellum small, narrow, with a broad rugose depression at its base. Metathorax coarsely rugose reticulate, the reticulations defining rather irregularly six longitudinal carinæ on the posterior three-fourths. Metapleuræ more finely rugose. Abdomen as long as the head and thorax, claviform. First segment twice as long as wide at the tip, coarsely rugose punctate, with two prominent longitudinal carinæ on the basal half and a much less distinct median one on the posterior half. Second segment with sparse coarse punctures except along the median line and the posterior margin. Following segments smooth and polished. Legs slender, except the posterior femora which are thickened and furnished with a single stout tooth beneath near the apex. Hind tarsi, except terminal joint, whitish. Ovipositor ferruginous, its sheaths black and hairy. Wings hyaline, stigma and nervures ferruginous. Recurrent nervure received near the posterior third of the first cubital cell; second cubital cell narrowed above, only half as long on the radius as on the cubitus. Submedian cell scarcely longer than the median; subdiscoidal nervure inserted at the lower fourth of the discoidal nervure. Transverse median vein in hind wing not broken.

Two females from Fedor, Lee County, Texas, sent me by Rev. G. Birkmann.

This species is rather closely related to *H. dentipes* Brullé, but is evidently distinct. Although variable in color, the latter is always in considerable part black, and also differs in the sculpture of the prothorax and metanotum. The mesonotum of the present species is also more roughly sculptured, and the recurrent nervure in the wing inserted farther from the transverse cubitus.

Calyptus collaris sp. nov.

Female. Length 2-5 mm. Ovipositor 2.8 mm. Black, the pronotum, mesonotum, coxæ and legs bright honey yellow. Wings hyaline. Head transverse, slightly more than twice as wide as thick. Face evenly convex, microscopically rugulose and whitish pubescent. Front, vertex, and occiput smooth, polished, and impunctured. Cheeks faintly shagreened. Mandibles and clypeus wholly ferruginous. Eyes rather small, elongate oval, one-half as long as the head height. Antennæ 26-jointed, black, the scape and pedicel more or less rufous. Second flagellar joint one-third longer than the first, five times as long as thick, following rapidly growing shorter, becoming quadrate near the apex. Ocelli large and prominent, in a small triangle. Pronotum rugose striate, smooth and polished near the lateral angles. Mesonotum impunctate or nearly so. Parapsidal furrows deep and crenulate, meeting before the scutellum. Scutellum piceous, with a broad fovea anteriorly, which is divided by a delicate median carina. Metanotum rugose, with two small triangular smooth basal areolas side by side anteriorly; a less distinct pentagonal areola behind these which gives off two delicate longitudinal carinæ. Abdomen as long as the thorax, with three visible dorsal segments; first segment as long as wide and longitudinally aciculated, with a pair of carinæ basally which converge behind. Second segment as long as the first and a little wider, finely aciculated; third smooth and polished. Legs and coxæ honey-yellow, the posterior tibiæ at tips and hind tarsi fuscous. Ovipositor rufous, its sheaths black, pubescent. Wings hyaline, stigma piceous, pale at the base, venation brownish testaceous. Recurrent nervure received beyond the apical third of the first cubital cell. Submedian cell distinctly longer than the median; second discoidal cell closed at apex, the subdiscoidal nervure interstitial; anal cell with no trace of dividing nervure. Transverse median vein in hind wing not broken.

Described from one female collected by Mr. Charles Schaeffer at Esperanza Ranch, Brownsville, Texas.

This resembles in color the West Indian *Calyptus thoracicus* Ashmead, but differs by its much smaller size, and in having only 26 joints instead of 35 joints to the antennæ.

FAMILY ALYSIIDÆ.

Acrisis americanus sp. nov.

Male. Length 1.75 mm. Thorax piceous, head, pleuræ, coxæ, legs, and second abdominal segment brownish-yellow. Wings hyaline. Head smooth and shining, faintly shagreened above; transversely quadrate, the temples rather narrow. Eyes moderately small, bare. Cheeks one-half as long as the greatest length of the eye. Antennæ slender, filiform, not quite as long as the body, about 18-jointed, the joints poorly differentiated and difficult to count; second to sixth joints about equal, each about four or five times as long as thick, following growing shorter. Palpi pale testaceous. Mesonotum shining, shagreened, trilobed, the parapsidal furrows deep anteriorly, approximated and less distinct posteriorly, where they become confused with some other longitudinal striate sculpture. Scutellum shagreened like the mesonotum, with a broad crenulated transverse furrow across the base and a semi-circular fovea just before the center. Metathorax finely rugulose, not at all areolated. Pleuræ rugulose above and shagreened below; dark above, but pale yellowish below on the mesopleuræ. Abdomen ovate, sessile, the first segment piceous, a little longer than wide, its base two-thirds as wide as the apex, surface finely aciculate; second segment aciculate, pale yellow, longer than the first and twice as wide. Following segments indistinctly separated, shining piceous. Legs moderately stout, the posterior femora strongly incrassated, their tibiæ slightly so. Apical joint of all tarsi piceous. Wings hyaline, stigma and venation very pale fuscous. Two cubital cells; first cubital, first discoidal and submedian cells all distinctly separated from one another. Radius and cubitus obsolete beyond the first transverse cubitus; subdiscoidal nervure distinct at its base.

Described from a single male sent me by Dr. M. T. Thompson. It was bred by him from an unidentified gall collected at Worcester, Mass.

This is the first American species to be discovered, and the second member of the genus. To judge from the diagnoses of Förster, Ashmead and Szépligeti, it is a typical representative of the genus.

Public Museum, Milwaukee, Wis.
June 10, 1907.

BRIEFER ARTICLES.

THE OCCURRENCE OF THE SYRPHID FLY, CONDIDEA LATA COQ., IN WISCONSIN.

It may be of interest to record the fact that a female specimen of *Condidea lata* Coq. was collected from the flowers of the Sumach, *Rhus glabra,* at Cedar Lake, Washington Co., Wisconsin, July 15, 1907. A male was taken at the same place July 19. These were the only two specimens obtained by two collectors in ten days, although flies were very abundant on the plants during that time. A few days later, Mr. Henry L. Ward obtained a single specimen from Little Cedar Lake, in the same county. The species was first described by Coquillett from North Saugus, Mass., (Can. Ent., Vol. 39, p. 75, March, 1907) and later mentioned by Jones (Journ. N. Y. Entom. Soc., Vol. 15, p. 95, June, 1907) as occurring in several parts of Nebraska. The sudden appearance of this conspicuous fly in a place which has for years been collected over by entomologists is, therefore, of considerable interest.

GEORGE P. BARTH.

CORRECTION.

Mr. Editor:

Though I requested the sending of proof for my article in the last (April) Bulletin, the printer sent me neither proof sheets, nor my MS., nor the plates. I regret to find the following corrections necessary:

Page 134. Quarternary should be Quaternary.
Page 134. Linnean should be Linnéan.
Page 134. Sexcommunes should be six communes.
Page 134. Madaleunéenne should be Madelainéenne.
Page 134. Monstérienne should be Moustérienne.
Page 135. The same as the last two.
Page 135. Acheulléenne should be Acheuléenne.
Page 136. fine should be firm.

The French adjectives frequently cause confusion on the part of English writers and printers who have not studied French grammar and do not know that and why the feminine form differs from the masculine.

I propose to English writing archeologists that they apply the English "ian" to the French name; it will always fit both genders and numbers in English.

Chelléen and Chelléenne are the masculine and feminine forms derived from Chelles, the name of a prehistoric station in the valley of the Marne river, about 11 miles nearly due east of Paris. Let us write the derived adjective *Chelléan*, which is plain English for both of the above adjectives and always correct for the masculine, feminine, singular and plural forms;

Likewise *Acheulian*, from St. Acheul (gravel beds in the valley of the Somme river);

Mousterian, from Le Moustier, the cavern near the bank of the very interesting Vezère river, a tributary to the Dordogne;

Solutrian, from Solutré, a rock shelter near Macon in the valley of the Saône river, some 50 miles almost due west from Geneva.

Madelainian, from La Madelaine, a rock shelter also on the Vezère, only a short distance below Le Moustier.

If my suggestion is adopted, it will save many who read or write on French archeology doubts and vexation.

You will oblige me by causing proof sheets of the above to be sent me for revision with my MS.

Yours truly,

C. H. DOERFLINGER.

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Orders and remittances should be addressed to the General Secretary, Public Museum, Milwaukee, Wis.

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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 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.

Vol. 5 (New Series) DECEMBER, 1907 No. 4

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

EDITED BY THE SECRETARY

CONTENTS:

MILWAUKEE, WISCONSIN.
THE EDW. KEOGH PRESS.

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

The Wisconsin Natural History Society,

MILWAUKEE, WISCONSIN.

ORGANIZED MAY 6. 1857.

OFFICERS AND DIRECTORS.

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

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

REGULAR MEETINGS.

These are all held on the last Thursday of each month, except July and August, in the trustees' room in the Public Museum Building Milwaukee.

PUBLICATION.

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BULLETIN

OF THE

Wisconsin Natural History Society

VOLUME V

(NEW SERIES)

EDITED BY THE SECRETARY.

MILWAUKEE

1907

CONTENTS OF VOLUME V.

INDEX TO VOLUME V.

New species and new names are marked with an asterisk.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY.

Vol. 5, New Series. **DECEMBER, 1907** **No. 4**

PROCEEDINGS.

Milwaukee, Sept. 26, 1907.

Regular monthly meeting of the Society.

President Teller in the chair and about fifty persons present.

The name of Mrs. E. Ruemmelin was proposed for membership and she was elected by the board of directors.

There being no further business Prof. I. N. Mitchell of the State Normal School spoke on "Burbank's Work With Plants." He described the early life of Mr. Burbank, his first experiments in plant breeding and the difficulties which he encountered at the beginning of his work. After referring to the peculiarly acute observation of Mr. Burbank and his fine and discriminating methods of plant selection, the speaker turned to a consideration of a number of the more important new varieties of plants which Mr. Burbank has produced, illustrating his remarks by means of stereopticon pictures.

After the lecture the meeting adjourned.

Milwaukee, Oct. 10, 1907.

Meeting of the combined sections:

President Teller in the chair and Mrs. Ruemmelin, Messrs. Brues, Colles, Edwards, Finger, Graenicher, Landau, Monroe, Russell and Ward present. Mr. Colles exhibited some rocks and minerals from Northern Ontario. Among them was a fine specimen of dendritic silver, probably deposited from solution; some cobalt bloom and some glaciated slate.

Mr. Monroe exhibited specimens of asters collected in September in the east. These included the following forms: *Aster divaricatus*, L., and varieties; *A. Claytoni* Burg; *A undulatus* L., and variety; *A. patens*, L., and *A. acuminatus Michx.;* all from western Massachusetts or Connecticut; *A. ericoides* L. from western Connecticut and *A. eri*

coides pilosus (Willd.) from northern Ohio. He also exhibited in connection with the two last, specimens of *A. faxoni* Porter and *A. pringlei* Gray, the former from northeastern Illinois, the latter from central Wisconsin. Mr. Monroe knew of no reason why the species above named should not all occur in Wisconsin, but he had never found the New England species in this state.

The members were very much interested in Mr. Monroe's exhibition and there was a considerable amount of discussion concerning certain species.

The meeting then adjourned.

Milwaukee, Oct. 24, 1907.

Regular monthly meeting of the Society.

Vice President Ward in the chair and 47 persons present.

The names of Mr. Charles B. Weil, 286 Knapp St.; Dr. Geo. W. C. Meyer, Oconomowoc, Wis.; Robert W. Martin, Jr., 3107 Cedar St., and Miss Alice Childs, East Side High School, were proposed for active membership in the Society, and they were elected at the directors' meeting following.

There being no further business, Mr. Howland Russel addressed the meeting on "A Visit to Linnæus," a retrospection on the life, home and character of the great pioneer naturalist gleaned from the writings of his contemporaries.

Mr. Russell gave a brief description of the personality of Linnæus, followed by a biography considering the more important epochs in his life with his achievements during each. At the close he pointed out the immense amount of work accomplished by Linnæus and its place as the basis of all present systematic botany and zoology. After some discussion on the part of various members the meeting adjourned.

Milwaukee, Nov. 14, 1907.

Meeting of the combined sections.

President Teller in the chair and about 50 persons present.

Mr. Colles spoke on the origin and deposition of the Principal Ores of Copper and its extraction.

The speaker described the most important ores of copper and classified them according to their chemical constitution. He described the manner in which ores are deposited, more particularly their relation to watery solutions, their geographical distribution and abundance. He also described the methods of extracting the metal from several of the more important types of ores. After he had finished some of the members joined in a short discussion on certain

points. Mr. Brues then exhibited a series of plants collected by the Museum expedition into northern Wisconsin during the past summer. He also showed a number of lantern slides illustrating the general aspect of the localities examined by the expedition.

The meeting then adjourned.

Milwaukee, Nov. 21, 1907.

Regular monthly meeting of the Society.

President Teller in the chair and about 60 persons present.

Dr. Geo. W. Peckham spoke on Recent Additions to Our Knowledge of the Habits of Wasps. The speaker described the wonderful stinging instincts of certain wasps and then showed the advancing steps in the evolution of such instincts as illustrated by living species in different families. He was followed by Dr. S. Graenicher, who discussed the habits of bees from the standpoint of recent discoveries. He dealt particularly with the locality and direction senses so frequently attributed to certain Hymenoptera. The recent concensus of opinion seems to be that these instincts are largely built up on individual experience and visual memory of objects whose position has to be learned by the bees.

The meeting then adjourned.

CHECK LIST OF THE FLORA OF MILWAUKEE COUNTY.

By Howland Russel.

The following list is, of course, mainly a compilation of the two lists of W. M. Wheeler, published in April, 1888, and April '89, with those of W. T. Bennetts, published July, 1900, and Jan. 1902, all of which were issued as bulletins of this society. To them have been added the names of such species as have been reported since the last of those lists was published. The generic and specific names used in those lists have been altered, wherever necessary, to bring them in accord with the latest authorities. There are several species given in the old lists which probably were never found in this county, but were so recorded as a result of imperfect identification. But, as this cannot be conclusively proven, these names have been included in the present list, although those plants are not now found in the localities mentioned. There are others reported from localities the character of which has so changed that the species recorded are no longer found there, although they may perhaps grow elsewhere in the county. This is notably the case with those plants given as found in "Larkins Tamarack Swamp" (Sec. 1 Town of Greenfield.) This swamp has entirely disappeared, the trees have been cut away, the soil drained and the entire tract divided into vegetable gardens, so that there is now practically no trace of the original flora. The same is true of one or two localities from which species were reported by Rev. T. A. Bruhin. Some of these species, it may be confidently stated, no longer grow in the county. The present list is doubtless more or less incomplete in several ways, for new species are constantly being added to our records as certain groups of plants and certain localities are more carefully studied. Except in the neighborhood of the lake, the extreme Northern and Southern parts of the county have received very little attention or study, and there are but few records from

these districts. The increase in facilities for reaching them, by means of electric cars, will probably add to our acquaintance with their flora. So, too, there are doubtless many in the city who are interested in botany and who could greatly aid in making a more complete plant census, if they would but report the results of their studies where they could be properly recorded. New plants also are added to our flora by the introduction of seeds, brought here in rubbish and waste materials. The list is, however, as complete as our present knowledge of the flora of the county makes possible.

In this list the arrangement of families is that given by Engler and Prantl; the nomenclature is that adopted, so far as completed, by the editors of the new Gray's Manual, which is soon to be published. Where the names so given differ from those used in the second edition of Britton's Manual, the latter are inserted as synonyms, printed in italics. There are a number of generic and specific names which are liable to still further change to bring them in full accord with the rules of nomenclature adopted by the Vienna Botanical Congress, but these changes have not as yet been fully decided upon, nor are American botanists agreed as to the acceptance of this code.

In the genus Cratægus the names of the original species, from which Prof. Sargent has made numerous new species, are here given as synonyms, although not strictly such.

The editors of the new Gray's Manual have very kindly given a great deal of time and labor in so correcting the names in the list as to bring them up to date. Thanks are also due to Dr. S. Graenicher, Mr. Wm. Finger, Dr. H. V. Ogden and Prof. E. J. Hill of Chicago for the great assistance they have given in the preparation of this list.

OPHIOGLOSSACEÆ.

Botrychium viginianum (L.) Sw. Botrychium.
Throughout county. Common.

OSMUNDACEÆ.

Osmunda regalis L. Royal Fern.
Throughout county. Locally abundant.

O. cinnamomea L. Cinnamon Fern.
Common near St. Francis and locally throughout county.

O. Claytoniana L. Clayton's Fern.
Throughout county. Locally abundant.

POLYPODIACEÆ.

Adiantum pedatum L. Maiden-hair Fern.
Throughout county. Common.

Pteris aquilina L. *Pteridium aquilinum* (L.) Kuhn.
Throughout county. Occasional.

Cryptogramma Stelleri (Gmel.) Prantl. Rock-brake.
In Town of Franklin.

Asplenium Filix-femina (L.) Bernh. Lady Fern.
Throughout county. Common.

Camptosorus rhizophyllus (L.) Link. Walking-fern.
Menomonee Valley. Very rare. Reported from Town of Franklin.

Aspidium Thelypteris (L.) Sw. *Dryopteris Thelypteris* (L.) Gray.
Shield Fern. Sec. 27, Oak Creek. Abundant.

A. cristatum (L.) Sw. *Dryopteris cristata* (L.) Gray.
Throughout county.

A. spinulosum (O. F. Müller) Sw. *Dryopteris spinulosa* (Retz.) Kuntze.
Sec. 5 Greenfield. Abundant.

A. spinulosum var. **intermedium.** D. C. Eaton. *Dryopteris spinulosa intermedia* (Muhl.) Underw. Sec. 27, Town of Lake.

Cystopteris bulbifera (L.) Bernh. *Filix bulbifera* (L.) Underw.
Bladder Fern. Menomonee Valley, and in Sec. 29, Town of Milwaukee.

C. fragilis (L.) Bernh. *Filix fragilis* (L.) Underw.
Throughout county. Common.

Onoclea Struthiopteris (L.) Hoffm. *Mateuccia Struthiopteris* (L.) Todaro. Ostrich Fern. Wauwatosa.

O. sensibilis L. Sensitive Fern.
Throughout county. Locally abundant.

EQUISETACEÆ.

Equisetum arvense L. Field Horse Tail.
Everywhere. Common.

E. sylvaticum L. Throughout county. Occasional.

E. fluviatile L. Menomonee Valley. Occasional.

E. hyemale L. Scouring-rush.
Throughout county. Locally abundant.

E. variegatum Schleich.
Lake shore and Milwaukee River. Common.

LYCOPODIACEÆ.

Lycopodium lucidulum Michx. Club-moss.
Near New Coeln.

L. clavatum L. Running Pine.
Near New Coeln.

PINACEÆ.

Pinus strobus L. White Pine.
Found sparingly along lake shore from Whitefish Bay to northern limit of county.

Larix laricina (Du Roi.) Koch. Larch. Tamarack.
Confined to a few small unreclaimed swamps throughout county. Formerly abundant.

Thuja occidentalis L. Arbor Vitæ.
Not uncommon along lake shore, also in a few scattered localities.

Juniperus communis L. Common Juniper.
Found sparingly along lake shore bluffs.

J. communis var. **depressa** Pursh. *J. nana* Willd. Low Jupiter.
More or less common throughout county, especially so near lake.

J. vinginiana L. Red Cedar.
Occasional.

J. horizontalis Moench. *J. Sabina* L. Shrubby Red Cedar.
Reported by T. Bruhin. Not found now in county.

TYPHACEÆ.

Typha latifolia L. Broad-leaved Cat tail.
Locally common.

SPARGANIACEÆ.

Sparganium eurycarpum Engelm. Broad Fruited Bur-reed.
Occasional throughout county.

S. simplex Huds. Simple-stemmed Bur-reed.
Along the Kinnickinnic River.

NAIADACEÆ.

Potamogeton natans L. Common Pondweed.
Common.

P. amplifolius Tuckerm. Large-leaved Pondweed.
Collected in county by Dr. H. E. Hasse.

P. Nuttallii Cham. and Sch. Nutall's Pondweed.
Collected in county by Dr. H. E. Hasse.

P. foliosus Raf. Leafy Pondweed.
Not uncommon.

P. diversifolius Raf. Rafinesque's Pondweed.
Collected in county by Dr. H. E. Hasse.

P. pectinatus L. Fennel-leaved Pondweed.
Reported by T. A. Bruhin from lake shore.

JUNCAGINACEÆ.

SCHEUCHZERIACEAE.

Triglochin palustris L. Marsh Arrow-grass.
Locally along lake shore north of city. Not common.

ALISMACEÆ.

Alisma Plantago-aquatica L. Water Plantain.
Abundant.

Sagittaria latifolia Willd. Broad-leaved Arrow-head.
Throughout county. Common.

S. rigida Pursh. Sessile-fruited Arrow-head.
Collected in county by Dr. H. E. Hasse.

HYDROCHARITACEÆ.

VALLISNERIACEAE.

Elodea canadensis Michx. *Philotria Canadensis* (Michx.) Britton.
Water-weed. Common.

Vallisneria spiralis L. Tape grass.
In Milwaukee River in northern part of county.

GRAMINEÆ.

Andropogon scoparius Michx. Broom Beard-grass.
Near rolling mills in Bay View.

A. furcatus Muhl. Forked Beard-grass.
In southwestern part of county.

Digitaria humifusa Pers. *Syntherisma linearis* (Krock.) Nash.
Small Crab-grass. Town of Franklin.

D. sanguinale (L.) Scop. *Syntherisma sanguinalis* (L.) Dulac.
Large Crab grass. Near New Coeln.

Echinochloa crus-galli (L.) Beauv. Barnyard-grass.
Not uncommon.

Panicum capillare L. Witch-grass.
Common everywhere.

P. dichotomum L. Forked Panicum.
Near New Coeln.

P. Porterianum Nash. Porter's Panicum.
In Wauwatosa and along banks of Milwaukee River, near city limits.

Setaria glauca (L.) Beauv. *Chaetochloa glauca* (L.) Scribn.
Yellow Fox-tail. Locally common.

S. viridis (L.) Beauv. *Chaetochloa viridis* (L.) Scribn.
Green Fox-tail grass. Menomonee Valley and other localities.

Cenchrus tribuloides L. Bur-grass.
Southern part of Bay View.

Zizania aquatica L. Wild Rice.
Common in the Menomonee Valley.

Leersia virginica Willd. *Homalocenchrus Virginicus* (Willd.) Britton.
White-grass. Common.

L. oryzoides (L.) Sw. *Homalocenchrus oryzoides* (L.) Poll.
Rice Cut-grass. Common.

Phalaris arundinacea L. Reed Canary-grass.
In the Menomonee Valley and north of New Coeln. Bruhin.

P. cananariensis L. Canary-grass.
Found in several places in the city.

Hierochloe odorata (L.) Wahlenb. *Savastana odorata* (L.) Scribn.
Holy grass. Occasional in the Menomonee Valley.

Stipa spartea Trin. Porcupine grass.
Southern part of Bay View.

Oryzopsis asperifolia Michx. White-grained Mountain Rice.
Southern part of county.

Milium effusum (L.) Trin. Meadow Muhlenbergia.
Town of Lake.

Muhlenbergia mexicana (L.) Trin. Meadow Muhlenbergia.
Occasional in Wanwatosa.

M. sylvatica Torr. Minnesota Muhlenbergia.
Wauwatosa.

Brachyelytrum erectum (Schreb.) Beauv. Brachyelytrum.
In Town of Lake.

Phleum pratense L. Timothy.
Common everywhere.

Alopecurus geniculatus L. Marsh Fox-tail.
Common.

Sporobolus cryptandrus (Torr.) Gray. Sand Dropseed.
In Bay View.

Agrostis alba L. Red top. Herd-grass.
Within the city.

A. perennans (Walt.) Tuckerm. Thin-grass.
Wauwatosa.

A. hyemalis (Walt.) B. S. P. Rough Hair-grass.
Common in Town of Lake.

Calamagrostis canadensis (Michx.) Beauv. Blue Joint-grass.
Near New Coeln.

Ammophila arenaria (L.) Link. Sea Sand-reed.
Occasional.

Avena sativa L. Oat.
Occasionally escaped from cultivation.

Melica striata (Michx.) Hitch. *Avena striata* Michx. Purple Oat.
Town of Greenfield.

Danthonia spicata (L.) Beauv. Wild Oat-grass.
Common throughout county.

Spartina cynosuroides (L.) Roth. Tall Marsh-grass.
Milwaukee river, north of city limits.

Phragmites vulgaris (Lam.) B. S. P. *Phragmites Phragmites* (L.) Karst. Reed. Southern part of county.

Eragrostis capillaris (L.) Nees. Capillary Eragrostis.
Near New Coeln.

E. **minor** Host. *E. Eragrostis* (L.) Karst. Low Eragrostis.
Bay View.

E. **major** Host. Strong-scented Eragrostis.
Reported by W. J. Bennetts from Menomonee Valley, near Sixth St. viaduct.

E. **hypnoides** (Lam.) B. S. P. Creeping Eragrostis.
Near Forest Home Cemetery.

Dactylis glomerata L. Orchard grass.
Throughout county. Rare.

Poa annua L. Low Spear-grass.
Throughout county.

P. **triflora** Gilib. *P. flava* L. False Red-top.
Within city limits.

P. **pratensis** L. Kentucky Blue-grass. June-grass.
Common everywhere.

P. **glauca** Vahl. Glaucous Spear-grass.
Reported by Dr. L. Sherman.

P. **debilis** Torr. Weak Spear-grass.
Reported by Lapham.

P. **compressa** L. Wire grass.
Near New Coeln.

Glyceria nervata (Willd.) Trin. *Panicularia nervata* (Willd.) Kuntze.
Nerved Manna-grass. Southern part of county.

G. grandis Wats. *Panicularia Americana* (Torr.) Mac M.
Reed Meadow-grass.
Reported by A. Conrath as found in county.

G. septentrionalis Hitch. *Panicularia fluitans* (L.) Kuntze.
Floating Manna-grass.
Reported by A. Conrath as found in county.

Festuca ovina var. **duriuscula** (L.) Koch. Sheep's Fescue-grass.
Reported by A. Conrath as within city limits.

F. nutans Spreng. Nodding Fescue-grass.
Near New Coeln.

Bromus ciliatus L. Fringed Brome-grass.
Throughout county.

B. Kalmii Gray. Kalm's Chess.
Near New Coeln.

B. hordeaceus L. Soft Chess.
In Menomonee Valley.

B. secalinus L. Cheat. Chess.
Throughout county.

Lolium perenne L. Ray grass.
Town of Franklin.

Agropyron repens (L.) Beauv. Couch grass.
Menomonee Valley.

Hordeum jubatum L. Squirrel-tail grass.
Abundant in northern part of county.

Elymus virginicus L. Terrell-grass.
Town of Lake.

E. canadensis L. Nodding Wild-rye.
Near New Coeln.

E. arenarius L. Downy Lyme-grass.
Bay View.

Hystrix patula Moench. *Hystrix Hystrix* (L.) Mills.
Bottle-brush grass. Throughout county. Common.

CYPERACEÆ.

Cyperus flavescens L. Yellow Cyperus.
Town of Greenfield.

C. **diandrus** Torr. Low Cyperus.
Common in south and west part of county.

C. **esculentus** L. Yellow Nut-grass.
Milwaukee River, north of city limits.

C. **Engelmanni** Steud. Engelmann's Cyperus.
Milwaukee River, north of city limits.

C. **strigosus** L. Straw-colored Cyperus.
Near New Coeln.

Dulichium arundinaceum (L.) Britton. Dulichium.
Common throughout county.

Eleocharis palustris (L.) R. & S. Creeping Spike-rush.
Common throughout county.

E. **palustrus** var. **glaucescens** (Willd.) Gray.
Milwaukee River, north of city limits.

E. **acicularis** (L.) R. & S. Needle Spike-rush.
National Ave., just west of city limits.

E. **tenuis** (Willd.) Schultes. Slender Spike-rush.
Town of Lake.

E. **acuminata** (Muhl.) Nees. Flat-stemmed Spike-rush.
Reported by Dr. L. Sherman.

Scirpus americanus Pers. Three-square. Chair-maker's rush.
Locally common.

S. **validus** Vahl. *S. lacustris* L. Great Bulrush.
Wauwatosa.

S. **atrovirens** Muhl. Dark-green Bulrush.
Common everywhere.

S. **cyperinus** (L.) Kunth. Wool-grass.
In southern part of county.

S. **Eriophorum** (L.) Michx. *S. cyprinus Eriophorum* (Michx.) Britton.
Dark-green Bulrush. Common everywhere.

Eriophorum polystachyon L. Tall Cotton-grass.
In southern and western parts of county.

E. gracile Roth. Slender Cotton grass.
Reported from Sec. 1, Town of Greenfield.

Rynchospora glomerata (L.) Vahl. Clustered Beaked-rush.
South side of Menomonee Valley, near city limits.

Cladium mariscoides (Muhl.) Torr. Twig-rush.
Reported by Dr. L. Sherman.

Carex intumescens Rudge. Bladder Sedge.
Near New Coeln.

C. lupulina Muhl. Hop Sedge.
Common.

C. lupuliformis Sartwell. Hop-like Sedge.
Occasional.

C. vesicaria L. var. **monile** (Tuckerm.) Fernald. *C. monile* Tuckerm.
Necklace Sedge. Near New Coeln.

C. lurida Wahlenb. Sallow Sedge.
Occasional south.

C. hystricina Muhl. Porcupine Sedge.
Whitefish Bay and Menomonee Valley.

C. trichocarpa Muhl. Hairy-fruited Sedge.
Sec. 1. Town of Greenfield.

C. Houghtonii Torr. Houghton's Sedge.
Occasional.

C. filiformis L. Slender Sedge.
Southern part of the city.

C. stricta Lam. Tussock Sedge.
Locally common.

C. gracillima Schwein. Graceful Sedge.
Near New Coeln.

C. granularis Muhl. Meadow Sedge.
Near New Coeln.

C. conoidea Schk. Field Sedge.
Near Wauwatosa.

C. laxiflora Lam. Loose-flowered Sedge.
Lake Woods.

C. aurea Nutt. Golden-fruited Sedge.
Wauwatosa and along lake shore.

C. pennsylvanica Lam. Pennsylvania Sedge.
Common.

C. novæ=angliæ Schwein. New England Sedge.
National Ave., near city limits.

C. præcox Jacq. Vernal Sedge.
New Coeln, according to T. A. Bruhin.

C. pubescens Muhl. Pubescent Sedge.
New Coeln. Rare.

C. scirpoidea Michx. Scirpus-like Sedge.
Sec. 1, Town of Greenfield.

C. leptalea Wahlenb. Bristle-stemmed Sedge.
Sec. 1, Town of Greenfield.

C. stipata Muhl. Awl-fruited Sedge.
Within city limits.

C. vulpinoidea Michx. Fox Sedge.
Common, especially south.

C. setacea Dewey. Bristly-spiked Sedge.
Common.

C. Sartwellii Dewey. Sartwell's Sedge.
In a tamarack swamp Sec. 5, Town of Greenfield.

C. tenella Schk. Soft-leaved Sedge.
Occasional in southern part of county.

C. rosea Schk. Stellate Sedge.
National Ave., near city limits.

C. sparganoides Muhl. Bur-reed Sedge.
New Coeln.

C. cephalophora Muhl. Oval-headed Sage.
New Coeln.

C. stellulata Good. *C. sterilis* Willd. Little Prickly-sedge.
Sec. 1, Town of Greenfield.

C. stellulata Good. var. **cephalantha** Bailey. *C. sterilis cephalantha* Bailey. Sec. 1, Town of Greenfield.

C. interior Bailey. Inland Sedge.
Fish Creek.

C. tenuiflora Wahlenb. Sparse-flowered sedge.
Same locality as above.

C. trisperma Dewey. Three-fruited Sedge.
Same locality as above.

C. Deweyana Schwein. Dewey's Sedge.
National Ave., near city limits.

C. bromoides Schk. Brome-like Sedge.
New Coeln.

C. siccata Dewey. Hillside Sedge.
Sec. 1, Town of Greenfield.

C. scoparia Schk. Pointed Broom Sedge.
Within city limits, according to A. Conrath.

ARACEÆ.

Arisæma triphyllum (L.) Schott. Indian Turnip.
Common.

Calla palustris L. Water Arum.
Reported by T. Bruhin from near New Coeln.

Symplocarpa fœtida (L.) Nutt. *Spathyema fœtida* (L.) Raf.
Skunk Cabbage. Common.

Acorus Calamus L. Sweet Flag.
Occasional throughout county.

LEMNACEÆ.

Spirodela polyrhiza (L.) Schleid. Greater Duckweed.
Common.

Lemna trisulca L. Ivy-leaved Duckweed.
Common.

L. minor L. Lesser Duckweed.
Common.

COMMELINACEÆ.

Tradescantia virginiana L. Spiderwort.
Occasional in south and west parts of county.

PONTEDERIACEÆ.

Heteranthera dubia (Jacq.) Mac M. Water Star-grass.
In Milwaukee River, near city limits.

JUNCACEÆ.

Juncus effusus L. Common Rush.
Locally common.

J. bufonius L. Toad Rush.
Locally common.

J. marginatus Rostk. Grass-leaved Rush.
Reported by Dr. L. Sherman.

J. alpinus Vill. var. **insignis** Fries. *J. Richardsonianus* Schult.
Richardson's Rush. Lake shore, south of city.

J. nodosus L. Knotted Rush.
Common.

Luzula pilosa Willd. *Juncoides pilosum* (L.) Kuntze.
Hairy Wood-rush.
Lake Woods, Whitefish Bay and Fish Creek. Occasional.

L. campestris (L.) DC. var. **multiflora** (Ehrh.) Celak. *Juncoides campestre* (L.) Kuntze. Common Wood-rush. Occasional.

LILIACEÆ.

MELANTHACEAE.

Tofieldia glutinosa (Michx.) Pers. Tofieldia.
Locally along bluffs of lake shore.

Uvularia perfoliata L. Perfoliate Bellwort.
Whitefish Bay.

U. grandiflora J. E. Smith. Large-flowered Bellwort.
Common.

LILIACEAE.

Allium tricoccum Ait. Wild Leek.
Common.

A. cernuum Roth. Nodding Wild Onion.
Locally common.

A. canadense L. Meadow Garlic.
Common.

Lilium philadelphicum L. var **andinum** (Nutt) Ker. *L. umbellatum* Pursh. Western Red Lily.
Bluffs of lake shore, north of Whitefish Bay.
Reported by Wheeler as L. Philadelphicum L.

L. canadense L. Canada Lily.
Common.

L. superbum L. Turk's-cap Lily.
Reported by Bennetts. No specimen in Public Museum. Not found since.

Erythronium americanum Ker. Yellow Adder's tongue.
Common.

E. albidum Nutt. White Adder's-tongue.
Common.

CONVALLARIACEAE.

Asparagus officinalis L. Asparagus.
Common.

Clintonia borealis (Ait.) Raf. Yellow Clintonia.
Locally common.

Smilacina racemosa (L.) Desf. *Vagnera racemosa* (L.) Morong.
Wild Spikenard. Common.

S. stellata (L.) Desf. *V. stellata* (L.) Morong.
Star-flowered Solomon's Seal. Common.

S. trifolia (L.) Desf. *V. trifolia* (L.) Morong.
Three-leaved Solomon's Seal. Common.

Majanthemum canadense Desf. *Unifolium Canadense* (Desf.) Greene.
False Lily-of-the-Valley. Common.

Streptopus roseus Michx. Sessile-leaved Twisted-stalk.
Whitefish Bay and Wauwatosa. Not Common.

Polygonatum biflorum (Walt.) Ell. *Salomonia biflora* (Walt.) Britton.
Hairy Solomon's Seal. Common.

P. commutatum (R. & S.) Dietr. *Salomonia commutata* (R. & S.) Britton. Smooth Solomon's Seal. Common.

Trillium recurvatum Beck. Prairie Trillium.
In western part of county.

T. nivale Riddell. Early Trillium.
Wauwatosa, Very local, rare.

T. grandiflorum (Michx.) Salisb. Large-flowered Trillium.
Abundant in most woods.

T. erectum L. Ill-scented Trillium.
Reported from several parts of county.

T. cernuum L. Nodding Trillium.
Fairly common.

SMILACEAE.

Smilax herbacea L. Carrion Flower.
Fairly common.

S. ecirrhata (Engelm.) S. Wats. Upright Smilax.
Common.

S. hispida Muhl. Hispid Greenbrier.
Fairly common.

AMARYLLIDACEÆ.

Hypoxis hirsuta L. Coville. Star-grass.
Not common.

DIOSCOREACEÆ.

Dioscorea villosa L. Wild Yam-root.
Not uncommon.

IRIDACEÆ.

Iris versicolor L. Larger Blue Flag.
Common.

I. lacustris Nutt. Dwarf Lake Iris.
Wauwatosa. One station.

Sisyrinchium angustifolium Miller. Northern Blue-eyed Grass.
Locally common.

S. gramineum Curtis. *S. graminoides* Bicknell. Common Blue-eyed Grass. Reported from Wauwatosa by John A. Brandon.

ORCHIDACEÆ.

Cypripedium acaule Ait. Stemless Ladies Slipper.
Reported by W. M. Wheeler. Not now found in county.

C. hirsutum Mill. *C. reginae* Walt. Showy Ladies Slipper.
In a few places. Becoming very rare.

C. parviflorum Salisb. Small Yellow Ladies Slipper.
Very rare.

C. parviflorum Salisb. var. **pubescens** (Willd.) Knight. *C. hirsutum* Mill. Large Yellow Ladies Slipper.
Throughout county. Not common.

Orchis spectabilis L. *Galeorchis spectabilis* (L.) Rybd.
Showy Orchis. Throughout county. Not common.

Habenaria bracteata (Willd.) R. Br. *Coeloglossum bracteatum* (Willd.) Parl. Low Bracted Orchis.
Throughout county. Not common.

H. hyperborea (L.) R. Br. *Limnorchis hyperborea* (L.) Rybd.
Tall Leafy Green Orchis.
Reported by Wheeler. Probably the following.

H. media Rybd. *Limnorchis media* Rybd. Intermediate Bog Orchis.
Throughout county. Common.

H. dilatata (Pursh.) Gray. *Limnorchis dilatata* (Pursh.) Rybd.
Tall White Bog Orchis.
Reported by Wheeler. Not reported recently.

H. Hookeri Torr. *Lysias Hookeriana* (Gray.) Rybd.
Hooker's Orchis. South and west parts of county. Rare.

H. lacera (Michx) R. Br. *Blephariglottis lacera* (Michx.) Rybd.
Ragged Orchis. In Wheeler's list, as from Sec. 1, Greenfield.

H. psycodes (L.) Gray. *Blephariglottis psycodes* (L.) Rybd.
Smaller Purple-fringed Orchis.
Throughout county. Occasional.

Pogonia ophioglossoides (L.) Ker. Rose Pogonia.
Reported by T. A. Bruhin. Probably not now found in county.

Calopogon pulchellus (Sw.) R. Br. *Limodorum tuberosum* L.
Grass-pink. Calopogon. Reported by T. A. Bruhin. Probably not now found in county.

Spiranthes Romanzoffiana Cham. *Gyrostachys stricta* Rybd.
Hooded Ladies Tresses. One locality near Whitefish Bay.

S. latifolia Torr. *Gyrostachys plantaginea* (Raf.) Britton.
Wide-leaved Ladies Tresses. Along Milwaukee River. Rare.

S. cernua (L.) Richard. *Gyrostachys cernua* (L.) Kuntze.
Nodding Ladies Tresses.
Reported by Phillip Wells from Greenfield.

Goodyera pubescens (Willd.) R. Br. *Peramium pubescens* (Willd.) Mac M. Downy Rattlesnake Plantain.
Sec. 32, Town of Oak Creek.

Acroanthes monophylla (L.) Greene. White Adders mouth.
Collected in county by Dr. H. E. Hasse.

Aplectrum spicatum (Walt.) B. S. P. Putty-root. Adam and Eve.
Two localities in Wauwatosa and Greenfield. Becoming rare.

Corallorrhiza neottia Scop. *C. Corallorhiza* (L.) Karst.
Early Coral-root. Reported by Wheeler from Sec. 1, Greenfield. Not reported since.

C. multiflora Nutt. Large Coral-root.
Collected in county by Dr. H. E. Hasse.

SALICACE.

Populus alba L. White or Silver Poplar.
Escaping from cultivation. Planted along streets.

P. candicans Ait. Balm of Gilead.
Escaping from cultivation. Planted as a shade tree.

P. balsamifera L. Balsam Poplar.
In Wheeler's list. Not reported since.

P. nigra L. var. **italica** Du Roi. Lombardy Poplar.
Escaping from cultivation. Formerly planted extensively.

P. deltoides Marsh. Cottonwood. Occasional throughout county. Common in Menomonee Valley.

P. grandidentata Michx. Large-toothed Aspen.
Common throughout county.

P. tremuloides Michx. American Aspen.
Common throughout county.

Salix nigra Marsh. Black Willow.
Throughout county. Not common.

S. nigra var. **falcata** (Pursh.) Torr.
Probably conspecific with S. nigra.

S. amygdaloides Anders. Peach-leaved Willow.
Abundant throughout county.

S. lucida Muhl. Shining Willow.
Common.

S. serissima (Bailey.) Fernald.
Whitefish Bay. Near New Coeln.

S. fragilis L. Crack Willow. Sparingly planted.
Occasionally escaped from cultivation.

S. alba L. White Willow.
Cultivated in city parks under name of S. regalis.

S. alba var. **vitellina** (L.) Koch. *S. vitellina* L. White Willow.
A shade tree throughout city.

S. pentandra L. *S. laurifolia* Hort.
Cultivated in city parks.

S. babylonica L. Weeping Willow.
Cultivated. Occasionally escaped.

S. babylonica var. **dolorosa.** Wisconsin Weeping Willow.
Cultivated in city parks.

S. glaucophylla Bebb. Broad-leaved Willow.
Common in neighborhood of lake shore.

S. cordata Muhl. Heart-leaved Willow.
Common throughout county.

S. pedicellaria Pursh. *S. myrtilloides* L. Bog Willow.
In Wheeler's list. Not reported since.

S. longifolia Muhl. *S. fluviatilis* Nutt. Sand-bar Willow.
Common.

S. petiolaris J. E. Smith. Slender Willow.
Throughout county. Fairly common.

S. discolor Muhl. Glaucous Willow.
Very common.

S. rostrata Richards. *S. Bebbiana* Sarg. Bebb's Willow.
Common.

S. tristis Ait. Dwarf Gray Willow.
Reported by J. A. Brandon in 1900. Not reported since.

S. candida Fluegge. Hoary Willow.
Reported from Greenfield and Oak Creek. Very rare, if not now extinct in county.

S. viminalis L. Osier Willow.
In Wheeler's list. Probably confused with the following species.

S. purpurea L. Purple Willow.
Escaped from cultivation. Locally common throughout county.

JUGLANDACEÆ.

Juglans nigra L. Black Walnut.
Formerly abundant. Not common now.

J. cinerea L. Butternut.
Throughout county. Occasional.

Carya cordiformis (Wang.) K. Koch. *Hicoria minima* (Marsh.) Britton. Bitter-nut. Throughout county. Not common.

C. ovata (Mill.) K. Koch. *Hicoria ovata* (Mill.) Britton. Shag-bark Hicory. Throughout county. Fairly common. Given in Wheeler's list as C. alba Nutt.

C. glabra (Mill.) Spach. *Hicoria glabra* (Mill.) Britton. Pignut.
Reported from Wauwatosa. Probably planted.

BETULACEÆ.

Carpinus caroliniana Walt. Blue Beech. Hornbeam.
Throughout county. Occasional.

Ostrya virginiana (Mill.) K. Koch. Iron-wood. Hop-hornbeam.
Throughout county. Common.

Corylus americana Walt. Hazel-nut.
Common.

C. rostrata Ait. Beaked Hazel-nut.
Not so commo as C. americana..

Betula alba var. **papyrifera** (Marsh.) Spach. *B. papyrifera* Marsh.
Paper Birch. Common near lake shore.

B. lenta L. Black Birch.
In northern part of county, also reported from Greenfield.

B. lutea Michx. f. Yellow Birch.
Throughout county. Occasional.

B. glandulosa Michx. Scrub Birch.
"Lincoln Ave. Swamps," Menomonee Valley in Wauwatosa and Kinnickinnic River, near Forest Home Cemetery.

B. pumila L. Low Birch.
Reported by W. M. Wheeler from Sec. 1, Greenfield.

Alnus mollis Fernald. *A. Alnobetula* (Ehrh.) K. Koch.
Green Alder. Near Oak Creek Station.

A. rugosa (Du Roi.) Spreng. Smooth Alder.
Common throughout county.

FAGACEÆ.

Fagus grandifolia Ehrh. *F. Americana* Sweet. Beech.
Throughout county. Common.

Quercus rubra L. Red Oak.
Common throughout county.

Q. coccinea Muench. Scarlet Oak.
Throughout the county.

Q. ellipsoidalis E. J. Hill. Hill's Oak.
Throughout county. Given as Q. palustris in Wheeler's list.

Q. velutina Lam. Black Oak.
Throughout county.

Q. alba L. White Oak.
Common.

Q. stellata Wang. *Q. minor* (Marsh.) Sarg. Post Oak.
Reported by Wheeler. Probably Q. alba L.

Q. macrocarpa Michx. Bur Oak.
Common throughout county.

Q. bicolor Willd. *Q. platanoides* (Lam.) Sudw. Swamp White Oak.
Common throughout county.

URTICACEÆ.

ULMACEAE.

Ulmus americana L. White Elm.
Common.

U. racemosa Thomas. Cork or Rock Elm.
In western part of county and occasional in eastern portion.

U. fulva Michx. Red or Slippery Elm.
Throughout county.

Celtis occidentalis L. Sugar-berry. Nettle-tree.
Along Milwaukee River in extreme northern part of county; also in Menomonee Valley.

MORACEAE.

Humulus Lupulus L. Hop.
Occasionally escaped from cultivation.

Cannabis sativa L. Hemp.
Occasionally escaped from cultivation.

URTICACEAE.

Urtica dioica L. Great Nettle.
Common.

U. gracilis Ait. Slender Nettle.
Common.

Laportea canadensis (L.) Gaud. *Urticastrum divaricatum* (L.) Kuntze.
Wood Nettle. Common sounth and west.

Pilea pumila (L.) Gray. *Adicea pumila* (L.) Raf.
Clear-weed. Richweed. Throughout county. Common.

Boehmeria cylindrica (L.) Sw. False Nettle.
Common.

Parietaria pennsylvanica Muhl. Pellitory.
A weed in gardens.

SANTALACEÆ.

Commandra umbellata (L.) Nutt. Bastard Toad Flax.
In southern part of county, in Menomonee Valley and at Whitefish Bay. Not common.

ARISTOLOCHIACEÆ.

Asarum canadense L. Wild Ginger.
In Menomonee Valley and along Milwaukee River. Not common.

A. canadense var. **acuminatum** Ashe. *A. acuminatum* (Ashe.) Bicknell. Long-tipped Wild Ginger. Reported by P. H. Dernehl from Sec. 29, Town of Milwaukee.

POLYGONACEÆ.

Rumex Acetosella L. Sheep Sorrel.
Common.

R. verticillatus L. Swamp Dock.
In Menomonee Valley and near New Coeln. Not common.

R. Patientia L. Patience Dock.
In yards in city. Not common.

R. crispus L. Curled Dock.
Common.

R. conglomeratus Murr. Clustered Dock.
Wauwatosa.

R. obtusifolius L. Bitter Dock.
Wauwatosa.

Fagopyrum esculentum Moench. *F. Fagopyrum* (L.) Karst.
Buckwheat. Occasionally escaped from cultivation.

Polygonum amphibium L. Water Persicaria.
Throughout county. Not common.

P. amphibium var. **Hartwrightii** (Gray.) Bissel. *P. Hartwrightii* Gray.
Hart Wrights' Persicaria. One locality in Wauwatosa.

P. Muhlenbergii (Meisn.) Wats. *P. emersum* (Michx.) Britton.
Swamp Persicaria. In Menomonee Valley.

P. lapathifolium L. *P. incarnatum* Ell. Slender Persicaria.
Town of Lake and Jones Island. Abundant.

P. pennsylvanicum L. Pennsylvania Persicaria.
Throughout county. Locally abundant.

P. Persicaria L. Lady's Thumb.
Common.

P. Careyi Olney. Carey's Persicaria.
Town of Lake.

P. hydropiperoides Michx. Mild Water Pepper.
Throughout county. Occasional.

P. Hydropiper L. Water Pepper. Smartweed.
Throughout county. Occasional.

P. acre HBK. *P. punctatum* Ell. Dotted Smartweed.
In Menomonee Valley, Wauwatosa.

P. orientale L. Prince's Feather.
Waste places throughout city.

P. virginianum L. Virginia Knotweed.
Spring Meadow and Williamsburg.

P. aviculare L. Doorweed.
Common everywhere.

P. maritimum L. Seaside Knotweed.
A single specimen reported from Bay View by T. Kumlien.

P. erectum L. Erect Knotweed.
Locally abundant.

P. Convolvulus L. Black Bindweed.
Common everywhere.

P. cilinode Michx. Fringed Black Bindweed.
On lake shore at Oak Creek. Cudahy.

P. dumetorum L. Hedge Buckwheat.
Near New Coeln.

P. sagittatum L. Arrow-leaved Tear-thumb.
Southern part of county.

CHENOPODIACEÆ.

Chenopodium album L. Lamb's Quarters.
Common everywhere.

C. glaucum L. Oak-leaved Goosefoot.
Gardens in city.

C. Boscianum Moq. Bosc's Goosefoot.
Occasional in western part of city.

C. hybridum L. Maple-leaved Goosefoot.
Gardens and waste places. Common.

C. Botrys L. Jerusalem Oak.
Forest Home Cemetery and along streets of city.

C. capitatum (L.) Asch. *Blitum capitatum* L. Strawberry Blite.
Throughout county. Not common.

Atriplex patula L. Spreading Orache.
Gardens and waste places throughout city.

A. patula var. **hastata** (L.) Gray. *A. hastata* L. Halberd-leaved Orache. Throughout city. Common.

Salsola Kali L. Saltwort.
Reported by Lapham along lake shore in 1852.

S. Tragus L. Russian Thistle.
Common nearly everywhere, in neighborhood of R. R. tracks.

AMARANTHACEÆ.

Amaranthus retroflexus L. Rough Pigweed.
Common.

A. hybridus L. Slender Pigweed.
Menomonee Valley. Sparse.

A. paniculatus L. Paniculate Pigweed.
Menomonee Valley. Sparse.

A. blitoides S. Wats. Prostrate Amaranth.
Common.

A. græcizans L. Tumble-weed.
Common.

Acnida tamariscina (Nutt.) Wood. Western Water-hemp.
Occurs within the city limits according to Conrath.

A. tuberculata Moq. *A. tamariscina tuberculata* (Moq.) U. & B.
Menomonee Valley. One locality.

NYCTAGINACEÆ.

Oxybaphus nyctagineus (Michx.) Sweet. *Allionia nyctaginea* Michx. Heart-leaved Umbrella-wort.
In several localities. Spreading rapidly.

O. hirsutus (Michx.) Sweet. *Allionia hirsuta* Pursh. Hairy Umbrella-wort. Along railway tracks. Local.

AIZOACEÆ.

Mullugo verticillata L. Carpet-weed.
In Menomonee Valley. Two localities.

PORTULACACEÆ.

Claytonia virginica L. Spring Beauty.
Common.

Portulaca oleracea L. Purslane. Pussley.
A weed in gardens.

CARYOPHYLLACEÆ.

Agrostemma Githago L. Corn Cockle.
In southern part of county. Not common.

Silene stellata (L.) Ait. Starry Campion.
Common.

S. vulgaris (Moench.) Garcke. Bladder Campion.
In southern part of county. Uncommon.

S. antirrhina L. Sleepy Catchfly.
A single specimen in Public Museum from Schweichert's woods. Menomonee Valley.

S. Armeria L. Sweet William Catchfly.
Escaped from gardens. Rare.

S. noctiflora L. Night-flowering Catchfly.
Common.

Lychnis alba Mill. White Campion.
Becoming common.

L. calcedonica L. Scarlet Lychnis.
Escaped from gardens. St. Francis.

Saponaria officinalis L. Soapwort. Bouncing Bet.
Throughout county. Locally abundant.

S. Vaccaria L. *Vaccaria Vaccaria* (L.) Britton. Cowherb.
Occasional along railroads. Common south among grain.

Stellaria media (L.) Cyrill. *Alsine media* L. Common Chickweed.
Abundant.

S. longifolia Muhl. *Alsine longifolia* (Muhl.) Britton. Long-leaved Stitchwort.
Menomonee Valley and Sec. 29, Town of Milwaukee.

S. longipes Goldie. *Alsine longipes* (Goldie.) Coville. Long-stalked Stitchwort. Menomonee Valley and Wauwatosa.

Cerastium viscosum L. Mouse-ear Chickweed.
Common.

C. vulgatum L. Larger Mouse-ear Chickweed.
Common.

Arenaria lateriflora L. *Moehringia lateriflora* (L.) Fenzl. Blunt-leaved Sandwort. Throughout county.

NYMPHÆACEÆ.

Nuphar advena Ait f. *Nymphaea advena* Soland. Large Yellow Pond Lily. Milwaukee River. Rare. Formerly in Menomonee and Kinnickinnic Rivers.

Nymphæa odorata Ait. *Castalia odorata* (Dryand.) Woodv. & Wood. White Pond Lily. Milwaukee River. Rare. Formerly in Menomonee and Kinnickinnic Rivers.

CERATOPHYLLACEÆ.

Ceratophyllum demersum L. Horn-wort.
In Menomonee Valley at foot of 18th Str.

MAGNOLIACEÆ.

Liriodendron tulipifera L. Tulip Tree.
A few in city parks.

RANUNCULACEÆ.

Hydrastis canadensis L. Golden Seal.
Wauwatosa and Oak Creek. Locally abundant.

Caltha palustris L. Marsh Marigold.
Common.

Coptis trifolia (L.) Salisb. Gold-thread.
Near Whitefish Bay.

Isopyrum biternatum (Raf.) T. & G. False Rue Anemone.
Wauwatosa. Not common.

Actæa rubra (Ait.) Willd. Red Baneberry.
Throughout county. Not common.

A. alba (L.) Mill. White Baneberry.
Throughout county. Occasional.

Aquilegia canadensis L. Wild Columbine.
Throughout county. Not common.

A. vulgaris L. European Columbine.
Reported by P. Dernehl from Milwaukee River.

Delphinium Consolida L. Field Larkspur.
Occasionally escaped from gardens.

D. azureum Michx. *D. Carolinianum* Walt. Carolina Larkspur.
Bennetts reports it from waste places in city.

Anemone cylindrica Gray. Long-fruited Anemone.
Throughout county.

A. virginiana L. Tall Anemone.
Throughout county.

A. canadensis L. Canada Anemone.
Throughout county. Occasional.

A. quinquefolia L. Wind-flower.
Throughout county. Locally abundant.

A. patens L. var. **Wolfgangiana** (Bess.) Koch. *Pulsatilla hirsutissima* (Pursh.) Britton. Nuttalls' Pasque Flower.
In Wheeler's list on authority of Mr. Wernich.

Hepatica triloba Chaix. *H. Hepatica* (L.) Karst. Round-leaved Hepatica. Common.

H. acutiloba DC. *H. acuta* (Pursh.) Britton. Sharp-lobed Hepatica.
Very common.

Anemonella thalictroides (L.) Spach. *Syndesmon thalictroides* (L.) Hoffmg. Rue Anemone. Common.

Clematis virginiana L. Virgin's Bower.
Throughout county. Occasional.

Ranunculus delphinifolius Torr. Yellow Water Crowfoot.
Common.

R. laxicaulis (T. & G.) Darbey. *R. obtusiusculus* Raf. Water-plantain Spearwort.
Reported by T. Bruhin from southern part of county.

R. rhomboideus Goldie. *R. ovalis* Raf. Prairie Crowfoot.
Wauwatosa.

R. abortivus L. Kidney-leaved Crowfoot.
Common.

R. micranthus Nutt. Rock Crowfoot.
Occasional.

R. sceleratus L. Celery-leaved Crowfoot.
Occasional in south and west parts of county.

R. recurvatus Poir. Hooked Crowfoot.
Throughout county.

R. acris L. Tall Buttercup.
Throughout county.

R. bulbosus L. Bulbous Buttercup.
Wauwatosa.

R. pennsylvanicus L. f. Bristly Buttercup.
Southern part of county.

R. repens L. Creeping Buttersup.
Common.

R. septentrionalis Poir. Marsh Buttercup.
Wauwatosa.

R. fascicularis Muhl. Tufted Buttercup.
Throughout county.

R. aquatilis var. **capillaceus** DC. *Batrachium tricophyllum* (Chaix.) Bossch. White Water Crowfoot. South and west.

Thalictrum dioicum L. Early Meadow-Rue.
Common.

T. revolutum DC. *T. purpurascens L.* Purplish Meadow Rue.
Common.

T. polygamum Muhl. Tall Meadow-Rue.
Throughout county.

BERBERIDACEÆ.

Berberis vulgaris L. European Barberry.
Occasionally escaped from cultivation.

Caulophyllum thalictroides (L.) Michx. Blue Cohosh.
West and south. Not common.

Jeffersonia diphylla (L.) Pers. Twin-leaf.
Wauwatosa. One locality. Abundant.

Podophyllum peltatum L. May Apple. Mandrake.
Abundant.

MENISPERMACEÆ.

Menispermum canadense L. Canada Moonseed.
Throughout county. Not common.

PAPAVERACEÆ.

Papaver somniferum L. Garden Poppy.
Occasionally escaped from cultivation.

P. Rhœas L. Field Poppy.
Rarely escaped from cultivation.

Argemone mexicana L. Prickly Poppy.
A single specimen in Public Museum herbarium. Reported from south side of city.

Sanguinaria canadensis L. Bloodroot.
Common.

Dicentra Cucullaria (L. Bernh. *Bicuculla Cucullaria* (L.) Millsp.
Dutchman's Breeches. Throughout county. Local.

D. canadensis (Goldie.) Walp. *Bicuculla Canadensis* (Goldie.) Millsp.
Squirrel Corn. Menomonee Valley.

Corydalis aurea Willd. *Capnoides aureum* (Willd.) Kuntze.
Golden Corydalis. Reported by Wheeler from lake beach in northeast part of county.

Fumaria officinalis L. Fumitory.
Near Forest Home Cemetery.

CRUCIFERÆ.

Lepidium ruderale L. Roadside Pepper-grass.
Waste-places in the city.

L. virginicum L. Wild Pepper-grass.
A weed along roads.

L. apetalum Willd. Apetalous Pepper-grass.
Waste-places and roadsides. Greenfield. Locally abundant.

Thlaspi arvense L. Penny-cress.
Menomonee Valley.

Sisymbrium officinale (L.) Scop. var. **leiocarpum** DC. *Sisymbrium officinale* (L.) Scop. Hedge Mustard. Common.

S. altissimum L. Tall Sisymbrium.
Common.

Cakile edentula (Bigel.) Hook. Sea Rocket.
Common in sand along lake shore.

Brassica nigra (L.) Koch. Black Mustard.
Common.

B. juncea (L.) Cosson. Indian Mustard.
Common.

B. arvensis (L.) Kuntze. Charlock.
Common.

B. campestris L. Turnip.
Occasionally escaped from cultivation.

Diplotaxis bracteata Gren. & Godr.
Menomonee Valley. One locality.

Raphanus sativus (L.) Garden Radish.
Occasionally escaped from cultivation.

Roripa palustris (L.) Bess. Yellow Water-cress.
Not common.

R. Nasturtium (L.) Rusby. Water-cress.
Common.

R. Armoracia (L.) A. S. Hitchcock. Horse-radish.
Occasionally escaped from cultivation.

Cardamine pratensis L. Meadow Bitter-cress.
Menomonee Valley and Johnson's Woods.

C. hirsuta L. Hairy Bitter-cress.
Wauwatosa. Sec. 6, Greenfield.

C. pennsylvanica Muhl. Pennsylvania Bitter-cress.
South and west. Occasional.

C. parviflora L. *C. arenicola* Britton. Sand Bitter-cress.
Menomonee Valley.

C. purpurea (Torr.) Britton. Purple Cress.
Common.

C. bulbosa (Schreb.) B. S. P. Bulbous Cress.
Throughout county. Occasional.

Dentaria laciniata Muhl. Cut-leaved Pepper-root.
Wauwatosa and Oak Creek.

D. maxima Nutt. Large Toothwort.
Wauwatosa and Greenfield.

Capsella Bursa-pastoris Moench. *Bursa Bursa-pastoris* (L.) Britton.
Shepherd's Purse. Everywhere.

Camelina sativa (L) Crantz. False Flax.
Reported by Wheeler from south and west.

Arabis lævigata (Muhl.) DC. Smooth Rock-cress.
Southern part of county and in Wauwatosa.

A. canadensis L. Sickle-pod.
Throughout county.

A. brachycarpa (T. & G.) Britton. Purple Rock-cress.
Menomonee Valley.

A. glabra (L.) Bernh. Tower Mustard.
North of Whitefish Bay.

Erysimum cheiranthoides L. Worm-seed.
Not common.

Berteroa incana (L.) DC. Hoary Alyssum.
Wauwatosa.

Hesperis matronalis L. Dame's Rocket.
Occasionally escaped from cultivation.

Conringia orientalis (L.) Dumort. Hare's-ear.
Along lake shore. Rare.

CAPPARIDACEÆ.

Cleome spinosa L. Spider-flower.
Reported by Dr. L. Sherman.

Polanisia graveolens Raf. Clammy-weed.
Reported from Menomonee Valley by F. Runge. Specimen in Public Museum herbarium.

SARRACENIACEÆ.

Sarracenia purpurea L. Pitcher-plant.
Once abundant. Now probably extinct.

DROSERACEÆ.

Drosera rotundifolia L. Round-leaved Sundew.
Reported by T. A. Bruhin. Probably now extinct.

CRASSULACEÆ.

Sedum Telephium L. Live Forever.
Occasionally escaped from cultivation.

PENTHORACEAE.

Penthorum sedoides L. Ditch Stone-crop.
Common.

PARNASSIACEÆ.

Parnassia caroliniana Michx. Grass of Parnassus.
Throughout county. Locally abundant.

SAXIFRAGACEÆ.

Saxifraga pennsylvanica L. Swamp Saxifrage.
Common.

Heuchera hispida Pursh. Rough Heuchera.
Occasional throughout county.

Mitella diphylla L. Two-leaved Mitrewort.
Common.

M. nuda L. Naked Mitrewort.
North of Whitefish Bay and near New Coeln.

GROSSULARIACEAE.

Ribes Cynosbati L. Wild Gooseberry.
Common.

R. oxyacanthoides L. Hawthorn Gooseberry.
In southern parts of county and in Wauwatosa.

R. rotundifolium Michx. Eastern Gooseberry.
Common.

R. gracile Michx. Slender Gooseberry.
Common.

R. prostratum L'Her. Fetid Currant.
Wauwatosa.

R. rubrum L. Red Currant.
Throughout county. Not common.

R. floridum L'Her. Wild Black Currant.
Not uncommon.

HAMAMELIDACEÆ.

Hamamelis virginiana L. Witch Hazel.
Common.

PLATANACEÆ.

Platanus occidentalis L. Sycamore. Button-wood.
Planted in city parks.

ROSACEÆ.

Physocarpus opulifolius (L.) Maxim. *Opulaster opulifolius* (L.) Kuntze. Ninebark.
Wauwatosa and Milwaukee River.

Spiræa salicifolia L. Willow-leaved Meadow-sweet.
Throughout county. Common.

Rubus triflorus Richardson. *R. Americanus* (Pers.) Britton. Dwarf Raspberry. Throughout county. Not common.

R. strigosus Michx. Wild Red Raspberry.
Throughout county. Common.

R. occidentalis L. Blackcap. Thimble-berry.
Throughout county. Not common.

R. nigrobaccus Bailey. High-bush Blackberry.
Occasional. A division of R. villosus Ait.

R. canadensis L. Dewberry.
Throughout county.

R. Baileyanus Britton. Bailey's Blackberry.
Milwaukee River.

R. hispidus L. Running Swamp Blackberry.
Occasional throughout county.

Fragaria virginiana Duchesne. Scarlet Strawberry.
Throughout county. Common.

F. vesca L. Wood Strawberry.
Throughout county. Common.

Potentilla arguta Pursh. *Drymocallis arguta* (Pursh.) Rybd.
Tall Cinquefoil. Northeast portion of county.

P. fruticosa L. *Dasiphora fruticosa* (L.) Rybd. Shrubby Cinquefoil.
Wauwatosa, also reported by F. Runge from Menomonee Valley.

P. palustris L. Scop. *Comarum palustre* L. Purple Cinquefoil.
In south and west parts of county.

P. Anserina L. *Argentina Anserina* (L.) Rybd. Silver-weed.
Along railroad tracks and on lake shore.

P. argentea L. Silvery Cinquefoil.
Near Hales Corners.

P. monspeliensis L. Rough Cinquefoil.
Throughout county. Common.

P. canadensis L. Five-finger.
Throughout county.

Geum canadense Jacq. White Avens.
Common.

G. virginianum L. Rough Avens.
Southern part of county and Whitefish Bay.

G. macrophyllum Willd. Large-leaved Avens.
Whitefish Bay.

G. strictum Ait. Yellow Avens.
Throughout county. Common.

G. rivale L. Purple Avens.
Throughout county. Not uncommon.

Agrimonia gryposepala Wallr. *A. hirsuta* (Muhl.) Bicknell. Tall Agrimony. Very common.

Rosa blanda Ait. Smooth Rose.
Common.

R. acicularis Lindl. *R. Sayi* Schwein. Prickly Rose.
Common.

R. carolina L. Swarmp Rose.
Common.

R. virginiana Mill. *R. lucida* Ehrh. Glossy Rose.
Reported by Wheeler. Not reported since.

R. humilis Marsh. Pasture Rose.
Common.

R. rubiginosa L. Sweetbrier.
Reported by Bennetts from Oak Creek and Wauwatosa.

POMACEAE.

Pyrus americanus (Marsh.) DC. *Sorbus Americanus* Marsh.
Mountain Ash. Known here only in cultivation.

P. coronaria L. *Malus coronaria* (L.) Mill. Crab Apple.
Common.

P. arbutifolia (L.) L. f. *Aronia arbutifolia* (L.) Medic. Chokeberry.
Reported from two localities, south and west.

Amelanchier canadensis (L.) Medic. Service-berry.
Throughout county.

A. canadensis (L.) Medic. var. **Botryapium** (L. f.) T. & G. *A. Botryapium* (L. f.) DC. Shad-bush.
Throughout county. Locally abundant.

A. spicata (Lam.) C. Koch. *A. rotundifolia* (Michx.) Roem. Round-leaved June-berry. Northeast portion of county. "A. spicata (Lam.) Dec. Low June-berry." Reported by Bennetts from top of bluff just northwest of Wells Str. viaduct.

Cratægus punctata Jacq. Large-fruited Thorn.
Throughout county. Very common.

C. sertata Sarg. *C. flabellata* (Spach.) Rybd. Fan-leaved Thorn.
Fox Point.

C. cordata (Mill.) Ait. Washington Thorn.
Reported by F. Runge from Greenfield.

C. conjuncta Sarg. *C. pruinosa* (Wendl.) Beadle. Pruinose Thorn.
Johnson's Woods. Abundant.

C. coccinea L. Scarlet Thorn.
Johnson's Woods.

C. subrotundifolia Sarg. *C. coccinea* L. Scarlet Thorn.
Honey Creek in Wauwatosa.

C. tarda Sarg. *C. tenuifolia* Britton. Thin-leaved Thorn.
Fox Point. Abundant.

C. cyanophylla Sarg. *C. tenuifolia* Britton.
Throughout county. Abundant.

C. lucorum Sarg. *C. tenuifolia* Britton.
Honey Creek in Wauwatosa.

C. macracantha Lodd. Long-spined Thorn.
In southern part of county. Occasional.

C. sera Sarg. *C. mollis* (T. & G.) Scheele. Red-fruited Thorn.
Throughout county. Common.

C. tomentosa L. Pear Thorn.
Throughout county. Common.

C. rutila Sarg. *C. tomentosa* L.
Along Milwaukee River. Occasional.

DRUPACEÆ.

Prunus americana Marsh. Wild plum.
Throughout county. Common.

P. spinosa L. Blackthorn.
One specimen reported by T. Bruhin.

P. pennsylvanica L. f. Wild Red Cherry.
Not common.

P. virginiana L. Choke Cherry.
Throughout county. Common.

P. serotina Ehrh. Wild Black Cherry.
Very common.

LEGUMINOSÆ.

CAESALPINIACEAE.

Cassia Chamæcrista L. Partridge Pea.
Reported from one location in city.

Gleditsia triacanthos L. Honey Locust.
Along several roads leading to city. Probably planted.

PAPILIONACEAE.

Baptisia leucantha T. & G. White Indigo.
A few specimens reported from Bay View.

Genista tinctoria L. Dyeweed.
Reported from lake shore, Seventh Ward.

Medicago sativa L. Alfalfa.
Becoming common.

M. lupulina L. Black Medic.
Very common.

Melilotus alba Desr. White Sweet-clover.
Very common.

M. officinalis (L.) Lam. Yellow Sweet-clover.
Not uncommon.

Trifolium agrarium L. *T. aureum* Poll. Hop Clover.
Menomonee Valley and Oak Creek. Occasional.

T. procumbens L. Low Hop-clover.
Throughout county.

T. dubium Sibth. Least Hop-clover.
North Greenfield. Occasional.

T. incarnatum L. Italian Clover.
One locality in Wauwatosa. Escaped from cultivation.

T. arvense L. Rabbit-foot Clover.
Menomonee Valley and Whitefish Bay. Not common.

T. pratense L. Red Clover.
Everywhere.

T. hybridum L. Alsatian Clover.
Common.

T. repens L. White Clover.
Everywhere.

Psoralea Onobrychis Nutt. Sainfoin Psoralea.
Reported by E. Brunken from lake bluffs near county line.

Amorpha canescens Pursh. Lead-plant.
Wauwatosa. Probably elsewhere.

Robinia Pseudacacia L. Locust.
Common along roads. Planted.

Astragalus canadensis L. *A. Carolinianus* L. Milk Vetch.
Throughout county.

A. neglectus (T. & G.) Sheldon. *Phaca neglecta* T. & G.
Coopers Milk Vetch. Throughout county.

Desmodium grandiflorum (Walt.) DC. *Meibomia grandiflora* (Walt.) Kuntze. Large flowered Tick-trefoil. Everywhere.

D. pauciflorum (Nutt.) DC. *Meibomia pauciflora* (Nutt.) Kuntze.
Few-flowered Tick-trefoil. Lake Woods. Rare.

D. paniculatum (L.) DC. *Meibomia paniculata* (L.) Kuntze.
Panicled Tick-trefoil. Wauwatosa and Whitefish Bay.

D. canadense (L.) DC. *Meibomia Canadensis* (L.) Kuntze.
Showy Tick-trefoil. Common.

Lespedeza repens (L.) Bart. Creeping Bush-clover.
Wauwatosa.

L. capitata Michx. Round-headed Bush-clover.
Bay View.

Vicia Cracca L. Tufted Vetch.
Whitefish Bay, Town of Oak Creek, Town of Greenfield. Rare.

V. americana Muhl. American Vetch.
Throughout county. Common.

V. caroliniana Walt. Carolina Vetch.
Throughout county. Common.

V. sativa L. Common Vetch. Tare.
Whitefish Bay. Common.

V. sativa L. var. **nigra** L. *V. angustifolia* Roth. Smaller Common Vetch. Whitefish Bay and vacant lots in city.

Lathyrus maritimus (L.) Bigel. Beach Pea.
Along lake beach. Abundant.

L. venosus Muhl. Veiny Pea.
Throughout county. Common.

L. palustris L. Marsh Vetchling.
Throughout county. Not uncommon.

L. ochroleucus Hook. Cream-colored Vetchling.
Very common.

Amphicarpa comosa (L.) G. Don. *Falcata comosa* (L.) Kuntze.
Hog Peanut. Throughout county. Common.

A. Pitcheri T. & G. *Falcata Pitcheri* (T. & G.) Kuntze. Pitcher's Hog Peanut. Lake Woods and Whitefish Bay. Abundant.

Apios tuberosa Moench. *Apios Apios* (L.) Mac M. Ground-nut.
Wauwatosa and Milwaukee River. Not common.

GERANIACEÆ.

Geranium maculatum L. Wild Crane's-bill.
Everywhere.

G. carolinianum L. Carolina Crane's-bill.
National Ave., east of Soldiers' Home.

OXALIDACEÆ.

Oxalis repens Thumb. *O. corniculata* L. Procumbent Wood-sorrel.
A weed in city gardens.

O. stricta L. Upright Wood-sorrel.
Common.

LINACEÆ.

Linum usitatissimum L. Flax.
Throughout county. Occasional along R. R. tracks.

L. Lewisii Pursh. Lewis' Wild Flax.
Reported by Bennetts from a vacant lot on east side of city.

RUTACEÆ.

Xanthoxylum americanum Mill. Prickly Ash.
Common in open woods, south and west.

Ptelea trifoliata L. Three-leaved Hop-tree.
Common in Menomonee Valley.

SIMARUBACEÆ.

Ailanthus glandulosa Desf. Ailanthus.
Cultivated as a shade tree.

POLYGALACEÆ.

Polygala Senega L. Snakeroot.
Wauwatosa and Whitefish Bay. Locally abundant.

P. Senega var. **latifolia** T. & G.
In woods near waterworks at Wauwatosa.

EUPHORBIACEÆ.

Croton texensis (Klotzsch.) Muell. Arg. Texas Croton.
Near Kinnickinnic River. Reported from one locality.

Acalypha virginica L. Three-seeded Mercury.
Reynolds' Woods. Copious.

Ricinus communis L. Castor-bean.
Occasionally escaped from cultivation.

Euphorbia polygonifolia L. Knotted Spurge.
In sand of lake beach. Locally abundant.

E. glyptosperma Englm. Ridge-seeded Spurge.
In sand of beach and along R. R. tracks. Locally abundant.

E. glyptosperma var. **pubescens** Engelm.
Along railroad tracks. Locally abundant.

E. maculata L. Spotted Spurge.
Common in sand.

E. Preslii Guss. *E. nutans* Lag. Large Spotted Spurge.
Western and southern parts of county. Locally abundant.

E. corollata L. Flowering Spurge.
Throughout county. Common.

E. marginata Pursh. White-margined Spurge.
Reported from one locality in Cudahy. Probably escaped from cultivation.

E. Helioscopia L. Sun Spurge.
Collected in county by Dr. Hasse.

E. Peplus L. Petty Spurge.
City gardens and waste places. Sparse.

E. Cyparissias L. Cypress Spurge.
Wauwatosa. Along roadsides. Gregarious.

CALLITRICHACEÆ.

Callitriche verna L. *C. palustris* L. Water Starwort.
Southern part of county.

LIMNANTHACEÆ.

Flœrkea proserpinacoides Willd. False Mermaid.
Reynolds' Woods. Sec. 21, Greenfield. Dominant and copious.

ANACARDIACEÆ.

Rhus typhina L. *R. hirta* (L.) Sudw. Staghorn Sumac.
Eastern portion of county. Common.

R. glabra L. Smooth Sumac.
Western portion of county. Common.

R. Vernix L. Poison Sumac.
Near St. Francis and New Coeln. Rapidly disappearing.

R. Toxicodendron L. var. **radicans** Torr. *R. radicans* L. Poison Ivy.
Reynolds' Woods and New Coeln. Not common.

R. microcarpa (Michx.) Steud. Northern Poison Oak.
Throughout county. Common.

AQUIFOLIACEÆ.

ILICACEAE.

Ilex verticillata (L.) Gray. Black Alder.
In southern part of county and formerly near Whitefish Bay, also in Town of Granville. Rare.

I. lævigata (Pursh.) Gray. Smooth Winter-berry.
Specimen in Public Museum herbarium, collected at New Coeln by T. A. Bruhin.

CELASTRACEÆ.

Euonymus atropurpureus Jacq. Burning Bush.
Sec. 27, Wauwatosa; Secs. 11 and 12, Greenfield; Sec. 22, Oak Creek. Sparse.

Celastrus scandens L. Bittersweet.
Throughout county. Locally abundant.

ACERACEÆ.

Acer saccharinum L. Silver Maple.
Planted as a shade tree along streets.

A. rubrum L. Red Maple.
Throughout county. Not uncommon.

A. saccharum Marsh. Sugar Maple.
Throughout county. Common.

A. Saccharum var. **nigrum** (Michx.) Britton. *A. nigrum* Michx. Black Sugar Maple.
Throughout county. Not uncommon.

A. spicatum Lam. Mountain Maple.
One locality in Sec. 29, Town of Milwaukee. Numerous.

A. Negundo L. Box Elder.
Occasionally escaped from cultivation.

SAPINDACEÆ.

HIPPOCASTANACEAE.

Aesculus Hippocastanum L. Horse-chestnut.
Commonly planted as a shade tree.

Ae. glabra Willd. Fetid Buckeye.
Rarely planted as a shade tree.

Ae. octandra Marsh. Yellow Buckeye.
Rarely planted as a shade tree.

BALSAMINACEÆ.

Impatiens biflora Walt. Spotted Touch-me-not.
Throughout county. Abundant.

I. pallida Nutt. *I. aurea* Muhl. Pale Touch-me-not.
Secs. 18 and 29, Town of Milwaukee. Not abundant.

RHAMNACEÆ.

Rhamnus cathartica L. Buckthorn.
Escaped from cultivation. Wauwatosa and Town of Milwaukee.

R. alnifolia L'Her. Alder-leaved Buckthorn. Merrill Park. West end of Wells Str. viaduct. Formerly in Sec. 1, Greenfield.

Ceanothus americanus L. New Jersey Tea.
In south and west parts of county. Locally abundant.

VITACEÆ.

Vitis æstivalis Michx. Summer Grape.
Throughout county. Not common.

V. cordifolia Michx. Frost Grape.
Menomonee Valley.

V. vulpina L. Riverside Grape.
Menomonee Valley.

Ampelopsis quinquefolia (.L) Michx. *Parthenocissus quinquefolia* (L.) Planch. Virginia Creeper. Throughout county. Common.

TILIACEÆ.

Tilia americana L. Basswood. Linden.
Throughout county. Common.

MALVACEÆ.

Malva sylvestris L. High Mallow.
A garden weed, escaping to woods.

M. rotundifolia L. Cheeses. Dwarf Mallow.
A common weed.

M. moschata L. Musk Mallow.
In southern part of county. Common.

Abutilon Theophrasti Medic. *A. Abutilon* (L.) Rusby. Velvet Leaf.
A weed in gardens and along roads.

Hibiscus Trionum L. Bladder Ketmia.
Escaped from gardens in southern part of county.

HYPERICACEÆ.

Hypericum Ascyron L. Great St. John'swort.
Throughout county. Occasional.

H. perforatum L. Common St. John's-wort.
Near Forest Home Cemetery.

H. maculatum Walt. Spotted St. John's-wort.
Wauwatosa.

H. canadense L. Canadian St. John's-wort.
Wauwatosa.

H. virginicum L. *Triadenum virginicum* (L.) Raf.
Marsh St. John's-wort. Near New Coeln.

VIOLACEÆ.

Viola sororia Willd. *V. cuspidata* Greene. Common Blue Violet.
Abundant throughout county.

V. subsagittata Greene. (Western form of V. sagittata Ait.)
Arrow-leaved Violet. Reported from one locality in Wauwatosa and one in Oak Creek.

V. cucullata Ait. Marsh Blue Violet.
In open grassy marshes. Rare.

V. affinis Le Conte. Thin-leaved Wood Violet.
In rich wet woods. Not common.

V. conspersa Reichenb. *V. labradorica* Schrank. Dog Violet.
Common.

V. pubescens Ait. Hairy Yellow Violet.
Not common.

V. scabriuscula Schwein. Smoother Yellow Violet.
Abundant throughout county.

V. blanda Willd. Woodland White Violet.
Abundant locally in cold damp woods.

V. lanceolata L. Lance-leaved Violet.
Given in Wheeler's list on authority of Dr. L. Sherman. Not reported since.

THYMELEACEÆ.

Dirca palustris L. Leather-wood.
Occasional throughout county.

ELÆAGNACEÆ.

Shepardia canadensis (L.) Nutt. *Lepargyraea Canadensis* (L.) Greene.
Canadian Buffalo-berry. Banks of Milwaukee river and bluffs of lake shore. Locally abundant.

LYTHRACEÆ.

Lythrum alatum Pursh. Wing-angled Loosestrife.
North line of Sec. 33, Town of Franklin.

ONAGRACEÆ.

Ludwigia palustris (L.) Ell. *Isnardia palustris* L. Marsh Purslane.
Southern part of county. Locally abundant.

L. polycarpa Short & Peter. Ludwigia.
Very common near New Coeln.

Epilobium angustifolium L. *Chamaenerion angustifolium* (L.) Scop.
Great Willow-herb. Fire-weed. North of Whitefish Bay and occasional elsewhere. Gregarious.

E. coloratum Muhl. Purple-leaved Willow-herb.
Throughout county. Common.

E. alpinum L. var. **fontanum** Wahlenb. *E. Hornemanni* Reichenb.
Alpine Willow-herb.
Reported from Sec. 18, Town of Milwaukee.

Oenothera cruciata Nutt. *Onagra cruciata* (Nutt.) Small.
Small-flowered Evening Primrose.
A single specimen from near Whitefish Bay.

Oe. biennis L. *Onagra biennis* (L.) Scop. Common Evening Primrose
Throughout county. Common.

Oe. biennis L. var. **Oakesiana** Gray. *Onagra Oakesiana* (Gray.) Britton. Oakes' Evening-Primrose.
In southern part of county. Not uncommon.

Oe. rhombipetala Nutt. Rhombic Evening-Primrose.
Railway tracks near Juneau Park.

Oe. pallida Lindl. *Anogra pallida* (Lindl.) Britton.
White-stemmed Evening Primrose.
Near the city limits and the Kinnickinnic River.

Gaura biennis L. Biennial Gaura.
In Menomonee Valley near Grant Marble Works.

Circæa Lutetiana L. Enchanter's Nightshade.
Throughout county. Common.

C. alpina L. Smaller Enchanter's Nightshade.
Throughout county. Common.

HALORAGIDACEÆ.

Proserpinaca palustris L. Mermaid-weed.
Swamps in Menomonee and Kinnickinnic Valleys.

Myriophyllum spicatum L. Spiked Water-milfoil.
Throughout county. Common.

ARALIACEÆ.

Aralia racemosa L. Spikenard.
Throughout county. Not uncommon.

A. nudicaulis L. Wild Sarsaparilla.
Throughout county. Occasional.

Panax quinquefolium L. Ginseng.
In southern part of county. Occasional.

P. trifolium L. Dwarf Ginseng.
Throughout county. Occasional.

UMBELLIFERÆ.

Sanicula marylandica L. Black Snake-root.
Common.

S. gregaria Bicknell. Clustered Snake-root.
Reynolds Woods. Town of Greenfield.

S. canadensis L. Short-styled Snake-root.
Locally abundant.

S. trifoliata Bicknell. Large-fruited Snake-root.
Throughout county. Rare.

Eryngium aquaticum L. Button Snake-root.
Southern part of county. Occasional.

Osmorhiza Claytoni (Michx.) Clarke. *Washingtonia Claytoni* (Michx.) Britton. Wooly Sweet-cicely. Throughout county. Common.

O. longistylis DC. *Washingtonia longistylis* (Torr.) Britton.
Smoother Sweet-cicely. Throughout county. Occasional.

Erigenia bulbosa (Michx.) Nutt. Harbinger of Spring.
Wauwatosa. Locally abundant.

Cicuta maculata L. Water Hemlock.
Menomonee Valley and Milwaukee River. Locally abundant.

C. bulbifera L. Bulb-bearing Water Hemlock.
Menomonee Valley.

Cryptotænia canadensis (L.) DC. *Deringia Canadensis* (L.) Kuntze.
Honewort. Throughout county. Common.

Carum Carui L. Caraway.
Escaped from cultivation. Common.

Tænidia integerrima (L.) Drude. Yellow Pimpernel.
Throughout county. Locally abundant.

Sium cicutæfolium Gmel. Hemlock Water-parsnip.
Southern and western parts of county. Common.

Thaspium aureum Nutt. var. **atropurpureum** Coult. & Rose. *T. trifoliatum* (L.) Britton. Purple Meadow Parsnip.
South and west. Locally abundant.

Conioselinum chinense (L.) B. S. P. Hemlock Parsley.
Throughout county. Not common.

Angelica atropurpurea L. Angelica.
Throughout county. Common.

Polytænia Nuttallii DC. Polytaenia.
Menomonee Valley.

Tiedemannia rigida Coult. & Rose. *Oxypolis rigidus* (L.) Raf.
Cowbane. Hemlock. Wauwatosa.

Pastinaca sativa L. Wild Parsnip.
Very common.

Heracleum lanatum Michx. Cow-parsnip.
Common.

CORNACEÆ.

Cornus canadensis L. Dwarf Cornel.
West of North Greenfield and north of Whitefish Bay. Once abundant in Sec. 1, Greenfield.

C. circinata L'Her. Round-leaved Dogwood.
Throughout county. Not common.

C. Amomum Mill. Kinnikinnik. Silky Dogwood.
Throughout county. Common.

C. stolonifera Michx. Red Osier Dogwood.
Throughout county. Common.

C. paniculata L'Her. *C. candidissima* Marsh. Panicled Dogwood.
Throughout county. Common.

C. alternifolia L. f. Alternate-leaved Dogwood.
Wauwatosa and Whitefish Bay.

ERICACEÆ.

PYROLACEAE.

Pyrola americana Sweet. *P. rotundifolia* L. Round-leaved Wintergreen.
Whitefish Bay. Formerly also Sec. 1, Greenfield.

P. elliptica Nutt. Shin-leaf.
Near lake, Whitefish Bay and Town of Lake.

P. asarifolia Michx. var. **incarnata** (Fisch.) Fernald. *P. uliginosa* Torr. Bog Wintergreen. Whitefish Bay. Locally abundant.

P. secunda L. Serrated Wintergreen.
Whitefish Bay.

MONOTROPACEAE.

Monotropa uniflora L. Indian Pipe.
Throughout county. Rare.

ERICACEAE.

Gaultheria procumbens L. Creeping Wintergreen.
North of Whitefish Bay.

Arctostaphylos Uva-ursi (L.) Spreng. Red Bearberry.
On bluff north of Whitefish Bay. Rare.

VACCINIACEAE.

Gaylussacia resinosa (Ait.) T. & G. High-bush Huckleberry.
Near New Coeln.

Vaccinium corymbosum L. Tall Blueberry.
Reported only from Sec. 1, Greenfield.

V. pennsylvanicum Lam. Dwarf Blueberry.
Near New Coeln and Whitefish Bay.

V. macrocarpon Ait. *Oxycoccus macrocarpus* (Ait.) Pers. Large Cranberry. Reported from a small lake in Sec. 1, Franklin.

PRIMULACEÆ.

Samolus floribundus H B K. Water Pimpernel.
Near Layton Park.

Steironema ciliatum (L.) Raf. Fringed Loosestrife.
Throughout county. Common.

S. quadriflorum (Sims.) Hitch. Prairie Moneywort.
Near the cement works on Milwaukee River.

Lysimachia thyrsiflora L. *Naumburgia thyrsiflora* (L.) Duby.
Tufted Loosestrife. South and west. Not common.

Trientalis americana (Pers.) Pursh. Star Flower.
Throughout county. Locally abundant.

Anagallis arvensis L. Scarlet Pimpernel.
Hawley Road south of National Ave.

Dodecatheon Meadia L. Shooting Star.
Throughout county. Occasional.

OLEACEÆ.

Fraxinus americana L. White Ash.
Throughout county. Common.

F. pennsylvanica Marsh. Red Ash.
Throughout county. Occasional.

F. pennsylvanica Marsh. var. **lanceolata** (Borck.) Sargent. *F. lanceolata* Borck. Green Ash. Lake Woods and Whitefish Bay.

F. nigra Marsh. Black Ash.
Throughout county. Common.

GENTIANACEÆ.

Gentiana crinita Froel. Fringed Gentian.
Throughout county. Locally abundant.

G. quinquefolia L. Stiff Gentian.
Milwaukee River near cement works, also Bay View near lake.

G. quinquefolia var. **occidentalis** (Gray.) A. S. Hitchcock.
Same as last.

G. saponaria L. Soap-wort Gentian. Specimen in Public Museum herbarium collected in Wauwatosa by W. M. Wheeler.

G. Andrewsii Griseb. Blind Gentian.
Throughout county. Occasional.

G. flavida Gray. Yellowish Gentian.
Fox Point. Sparse.

MENYANTHACEAE.

Menyanthes trifoliata L. Buckbean.
Reported from Sec. 1, Greenfield. Probably now extinct.

APOCYNACEÆ.

Apocynum androsæmifolium L. Spreading Dogbane.
Throughout county. Common.

A. cannabinum L. Indian Hemp.
Wauwatosa and Town of Milwaukee.

A. cannabinum L. var. **hypericifolium** (Ait.) Gray. *A. hypericifolium* Ait.
Near Pilgrims Rest Cemetery, according to Bennetts.

ASCLEPIADACEÆ.

Asclepias tuberosa L. Butterfly-weed.
Oak Creek. Reported once.

A. purpurascens L. Purple Milkweed.
Southwestern part of county. Occasional.

A. incarnata L. Swamp Milkweed.
Throughout county. Common.

A. phytolaccoides Pursh. *A. exaltata* (L.) Muhl. Poke Milkweed.
Throughout county. Common west.

A. syriaca L. Common Milkweed.
Throughout county. Common.

CONVOLVULACEÆ.

Ipomœa purpurea (L.) Roth. Morning Glory.
Escaped from cultivation. Occasional.

I. hederacea Jacq. Ivy-leaved Morning Glory.
Menomonee Valley, foot of 17th Str.

Convolvulus sepium L. Great Bindweed.
Throughout county. Common.

C. spithamæus L. Upright Bindweed.
Wauwatosa and Whitefish Bay. Locally abundant.

C. arvensis L. Small Bindweed.
On bank of Juneau Park and in neighboring gardens.

CUSCUTACEÆ.

Cuscuta obtusiflora HBK. *C. polygonorum* Engelm. Smartweed Dodder.
Menomonee Valley and near New Coeln.

C. Gronovii Willd. Love-vine.
Throughout county. Occasional.

POLEMONIACEÆ.

Phlox pilosa L. Downy Phlox.
Wauwatosa and Oak Creek. Locally common.

P. divaricata L. Blue Phlox.
Throughout county. Common.

Polemonium reptans L. Greek Valerian.
Throughout county. Common.

HYDROPHYLLACEÆ.

Hydrophyllum virginicum L. Water-leaf.
Throughout county. Common.

BORAGINACEÆ.

Cynoglossum officinale L. Hound's-tongue.
Common everywhere.

C. virginicum L. Wild Comfrey.
Bay View and lower part of 18th Ward, city. Not common.

Lappula Myosotis Moench. *L. Lappula* (L.) Karst. Stickseed.
Wauwatosa.

L. virginiana (L.) Greene. Virginia Stickseed.
Common everywhere.

Myosotis palustris (L.) Lam. Forget-me-not.
Bay View.

Lithospermum officinale L. Gromwell.
Wauwatosa, Menomonee Valley near Merrill Park.

L. latifolium Michx. American Gromwell.
Wauwatosa.

L. Gmelini (Michx.) A. S. Hitchcock. Hairy Puccoon.
Southern part of county. Occasional.

L. canescens (Michx.) Lehm. Hoary Puccoon.
West of North Greenfield along R. R. tracks. Not numerous.

Onosmodium carolinianum (Lam.) DC. False Gromwell.
Once found by T. A. Bruhin in Sec. 4, Oak Creek.

Symphytum officinale L. Comfrey. In southern and western parts of county and in waste places in city. Occasional.

Echium vulgare L. Blue-weed. Viper's Bugloss.
Formerly along C. & N. W. R. R. tracks near Mineral Spring Park. Now extinct in that locality.

VERBENACEÆ.

Verbena urticaefolia L. White Vervain.
Throughout county. Common.

V. hastata L. Blue Vervain.
Throughout county. Common.

V. stricta Vent. Mullen-leaved Vervain.
Along R. R. tracks. West of Layton Park, also Menomonee Valley near 21st Ave.

V. bracteosa Michx. Large-bracted Vervain.
Along R. R. tracks. Juneau Park, Bay View and Menomonee Valley, also west of Wauwatosa. Locally abundant.

LABIATÆ.

Teucrium canadense L. Wood Sage.
Throughout county. Occasional.

Scutellaria lateriflora L. Mad-dog Skullcap.
Wauwatosa and banks of Milwaukee River.

S. versicolor Nutt. *S. cordifolia* Muhl. Heart-leaved Skullcap.
Wauwatosa, Oak Creek and Franklin.

S. galericulata L. Marsh Skullcap.
In southern part of county.

Agastache scrophulariæfolia (Willd.) Kuntze. Giant Hyssop.
In southern and western parts of county. Occasional.

Nepeta Cataria L. Catnep.
Throughout county. Common.

N. Glechoma Benth. *Glechoma hederacea* L. Ground Ivy.
Throughout county. Locally abundant.

Prunella vulgaris L. Heal-all.
Everywhere.

Physostegia virginiana (L.) Benth. Lion's Heart.
Throughout county. Occasional.

P. parviflora Nutt. Purple Lion's Heart.
Menomonee Valley near Merrill Park.

Galeopsis Ladanum L. Red Hemp-nettle. Specimen in Public Museum herbarium, collected by F. Runge.

G. Tetrahit L. Hemp-nettle.
Once found by T. A. Bruhin near New Coeln.

Leonurus Cardiaca L. Motherwort.
Throughout county. Common.

Lamium amplexicaule L. Henbit.
City gardens and waste places. Locally abundant.

Stachys aspera Michx. Rough Hedge-nettle.
Throughout county. Locally abundant.

S. aspera Michx. var. **glabra** Gray. *S. tenuifolia* Willd.
Smooth Hedge-nettle. West of Village of Wauwatosa.

Monarda fistulosa L. Wild Bergamot.
Throughout county. Common.

Blephilia ciliata (L.) Raf. Downy Blephilia.
Wauwatosa.

B. hirsuta (Pursh.) Torr. Hairy Blephilia.
In southern and western parts of county. Occasional.

Hedeoma pulegioides (L.) Pers. American Pennyroyal.
Throughout county. Locally abundant.

H. hispida Pursh. Rough Pennyroyal.
Near Whitefish Bay. One locality.

Pycnanthemum lanceolatum Pursh. *Koellia Virginiana* (L.) Mac M.
Mountain Mint. One locality on bank of Milwaukee River.

Lycopus virginicus L. Purple Bugle-weed.
Menomonee Valley in Wauwatosa. Locally abundant.

L. rubellus Moench. Water Hoarhound.
Wauwatosa and Town of Milwaukee. Occasional.

L. europæus L. var. **sinuatus** Gray. *L. Americanus* Muhl.
Cut-leaved Water Hoarhound. Wauwatosa. Locally abundant.

Mentha viridis L. *M. spicata* L. Spearmint.
In southern part of county.

M. arvensis L. Corn Mint.
Near New Coeln.

M. arvensis var. **canadensis** (L.) Briq. *M. Canadensis* L. Wild Mint.
Throughout county. Common.

SOLANACEÆ.

Physalis pubescens L. Hairy Ground-cherry.
Whitefish Bay. Common.

P. virginiana Mill. Virginia Ground-cherry.
Sec. 34, Greenfield. Abundant.

P. heterophylla Nees. Clammy Ground-cherry.
Sec. 9, Oak Creek. Sparse.

Solanum nigrum L. Black Nightshade.
Everywhere.

S. triflorum Nutt. Cut-leaved Nightshade.
Waste places in city. Occasional.

S. carolinense L. Horse-nettle.
Waste places in city. Occasional.

S. rostratum Dunal. Sand Bur.
Waste places in city. Occasional.

S. Dulcamara L. Bittersweet.
Throughout county. Not uncommon.

Lycium halimifolium Mill. *L. vulgare* (Ait. f.) Dunal. Matrimony-vine.
Escaped from cultivation. Occasional.

Hyoscyamus niger L. Black Henbane.
A single specimen from Menomonee Valley reported by F. Runge.

Datura Stramonium L. Jimson-weed.
Throughout county. Rare.

D. Tatula L. Purple Stramonium.
Waste places in city. Rare.

D. Metel L. Entire-leaved Stramonium.
Waste places in city. Occasional.

Nicotiana rustica L. Wild Tobacco.
New Coeln and Menomonee Valley. Reported twice.

SCROPHULARIACEÆ.

Verbascum Thapsus L. Great Mullen.
Common.

V. Blattaria L. Moth Mullen.
Menomonee Valley near Merrill Park.

Linaria Cymbalaria (L.) Mill. *Cymbalaria Cymbalaria* (L.) Wettst.
Kennilworth Ivy. A weed in gardens.

L. vulgaris Mill. *L. Linaria* (L.) Karst. Toad-flax.
Throughout county. Common.

Scrophularia marylandica L. Figwort.
Locally common.

Chelone glabra L. Turtlehead.
Throughout county. Common.

Pentstemon hirsutus (L.) Willd. Hairy Beard-tongue.
Near Milwaukee River. Locally abundant.

P. lævigatus Soland. var. **Digitalis** (Sweet.) Gray. *P. Digitalis* (Sweet.) Nutt. Fox-glove Beard-tongue.
Wauwatosa and Whitefish Bay. Rare.

Mimulus ringens L. Monkey-flower.
Throughout county. Common.

Veronica Anagallis=aquatica L. Water Speedwell.
Sec. 1, Greenfield, and Sec. 32, Town of Milwaukee.

V. americana Schwein. American Brooklime.
Near New Coeln.

V. scutellata L. Skullcap Speedwell.
In southern and western parts of county. Common.

V. serpyllifolia L. Thyme-leaved Speedwell.
In lawns in city and near Soldiers' Home.

V. peregrina L. Purslane Speedwell. Neckweed.
Near Soldiers' Home.

V. arvensis L. Corn Speedwell.
Whitefish Bay and on National Ave.

V. Byzantina (Sibth. & Smith) B. S. P. Byzantine Speedwell.
A weed in city gardens and at Fox Point.

V. virginica L. *Leptandra Virginica* (L.) Nutt. Culver's Root.
Throughout county. Occasional.

Gerardia grandiflora Benth. *Dasystoma grandiflora* (Benth.) Wood.
Western False-Foxglove. Bay View. Rare.

G. tenuifolia Vahl. Slender Gerardia.
In northern and western parts of county. Not common.

Castilleja coccinea (L.) Spreng. Scarlet Painted-cup.
Throughout county. Not common.

Pedicularis lanceolata Michx. Swamp Lousewort.
Throughout county. Common.

P. canadensis L. Wood Betony. Lousewort.
Throughout county. Common.

Melampyrum lineare Lam. Cow-wheat.
Whitefish Bay.

LENTIBULARIACEÆ.

Utricularia vulgaris L. Greater Bladderwort.
"In a pool near Soldiers' Home." Wheeler.

OROBANCHACEÆ.

Orobanche uniflora L. *Thalesia uniflora* (L.) Britton. Broom Rape.
North of Whitefish Bay and banks of Milwaukee River.

Conopholis americana (L. f.) Wallr. Squaw-root. Oak Creek and banks of Milwaukee River, also Town of Greenfield.

Epiphegus virginiana (L.) Bart. *Leptamnium Virginianum* (L.) Raf. Beech Drops. Throughout county. Locally abundant.

PHRYMACEÆ.

Phryma Leptostachya L. Lopseed.
Throughout county. Common.

PLANTAGINACEÆ.

Plantago major L. Common Plantain.
Everywhere.

P. Rugelii Dec. Rugels' Plantain.
Throughout county. Fairly common.

P. lanceolata L. Ribwort.
In lawns in city. Along roadside Franklin. Occasional.

P. cordata Lam. Heart-leaved Plantain.
Wauwatosa and Oak Creek.

P. Purshii R. & S. Pursh's Plantain.
Whitefish Bay. One locality.

RUBIACEÆ.

Mitchella repens L. Partridge-berry.
Near New Coeln.

Cephalanthus occidentalis L. Button Bush.
Towns of Milwaukee, Greenfield, Oak Creek and Franklin. Occasional.

Galium verum L. Yellow Bed-straw.
Near Hopkins Road, Wauwatosa.

G. Aparine L. Cleavers. Goose-grass.
In southern and western parts of county. Occasional.

G. circæzans Michx. Wild Liquorice. Castalia Park and Black's Woods in Wauwatosa, also Bay View and St. Francis. Sparse.

G. boreale L. Northern Bedstraw.
Near the Cement Mills, Milwaukee River. Abundant.

G. triflorum Michx. Fragrant Bedstraw.
In southern and western parts of county. Common.

G. tinctorium L. Stiff Marsh Bedstraw.
Sec. 18, Town of Milwaukee.

G. trifidum L. Small Bedstraw.
Sec. 1, Greenfield.

G. concinnum T. & G. Shining Bedstraw.
Reported from Wauwatosa.

G. asprellum Michx. Rough Bedstraw.
In southern and western parts of county. Not uncommon.

CAPRIFOLIACEÆ.

Sambucus canadensis L. Sweet Elder.
Throughout county. Common.

S. racemosa L. *S. pubens* Michx. Red-berried Elder.
Common in Town of Milwaukee. Rare in southwestern part of county.

Viburnum Opulus L. High Bush-cranberry.
In southern and western parts of county. Not uncommon.

V. acerifolium L. Dockmakie.
Throughout county. Common.

V. pubescens (Ait.) Pursh. Downy-leaved Arrow-wood.
Town of Milwaukee and southern part of county. Occasional.

V. dentatum L. Arrow-wood.
Throughout county. Not uncommon.

V. cassinoides L. Withe-rod.
Whitefish Bay.

V. Lentago L. Nanny-berry.
Near New Coeln and Whitefish Bay. Occasional.

Triosteum perfoliatum L. Horse Gentian.
Throughout county. Common.

Linnæa borealis L. var. **americana** (Forbes.) Rehder. *L. Americana* Forbes. Twin-flower. Reported from Sec. 1, Town of Greenfield, also from New Coeln.

Symphoricarpos racemosus Michx. Snowberry.
Throughout county. Common.

S. **occidentalis** Hook. Wolfberry.
Menomonee Valley and North Greenfield. Abundant.

Lonicera dioica L. Smooth-leaved Honeysuckle.
Throughout county. Locally abundant.

L. **Sullivantii** Gray. Sullivant's Honeysuckle.
Throughout county. Common.

L. **flava** Sims. Yellow Honeysuckle.
Reported by Wheeler as common in southern part of county. Probably confused with L. Sullivantii.

L. **japonica** Thumb. Japanese Honeysuckle.
Occasionally escaped from cultivation.

L. **oblongifolia** (Goldie.) Hook. Swamp Fly-Honeysuckle.
New Coeln and Menomonee Valley. Occasional.

L. **canadensis** Marsh. *L. ciliata* Muhl. American Fly-Honeysuckle.
Throughout county. Common.

L. **tatarica** L. Tartarian Bush-Honeysuckle.
Occasionally escaped from cultivation.

Diervilla trifida Moench. *D. Diervilla* (L.) Mac M. Bush-Honeysuckle.
Throughout county. Common.

VALERIANCEÆ.

Valeriana edulis Nutt. Valerian.
Menomonee Valley. Occasional.

CUCURBITACEÆ.

Echinocystis lobata (Michx.) T. & G. *Micrampelis lobata* (Michx.) Greene. Mock Apple. Throughout county. Common.

Cyclanthera dissecta (T. & G.) Arn. Cyclanthera. Reported by W. J. Bennetts from Menomonee Valley, foot of 23rd Str.

CAMPANULACEÆ.

Campanula rotundifolia L. Harebell.
Menomonee Valley. Near Cement Mills on Milwaukee River, also Town of Milwaukee. Occasional.

C. rapunculoides L. Creeping Bell-flower. A single plant in a vacant lot on Prospect Ave. No longer there.

C. aparinoides Pursh. Marsh Bell-flower.
Sec. 1, Greenfield, and Secs. 15 and 22, Oak Creek.

C. americana L. Tall Bell-flower.
Throughout county. Locally abundant.

LOBELIACEÆ.

Lobelia cardinalis L. Cardinal Flower. Town of Granville. Lake bank north of Whitefish Bay. Reynolds Woods, (S. W. ¼ Sec. 12, Greenfield). Formerly in other parts of county.

L. syphilitica L. Great Lobelia.
Throughout county. Common.

L. spicata Lam. Pale Spiked Lobelia.
Oak Creek. Franklin. Whitefish Bay. Not common.

L. inflata L. Indian Tobacco.
Throughout county. Common.

L. Kalmii L. Brook Lobelia.
Near the Cement Mills on Milwaukee River.

COMPOSITÆ.

CICHORIACEAE.

Cichorium Intybus L. Chicory.
Throughout county. Locally abundant.

Lapsana communis L. Nipplewort.
In a vacant lot in 7th Ward. Copious.

Krigia virginica (L.) Willd. *Adopogon Virginicum* (L.) Kuntze. Cynthia.
Menomonee Valley and Whitefish Bay. Locally common.

Tragopogon pratensis L. Yellow Goats-beard.
Escaped from cultivation. Occasional.

T. porrifolius L. Oyster Plant. Menomonee Valley and along C. & N. W. R. R. tracks near lake. Occasional.

Taraxacum officinale Weber. *T. Taraxacum* (L.) Karst. Dandelion. Everywhere.

Sonchus arvensis L. Corn Sow-thistle.
Throughout county. Common.

S. oleraceus L. Annual Sow-thistle.
Throughout county. Common.

S. asper (L.) All. Spiny Sow-thistle.
Throughout county. Common.

Lactuca scariola var. **integrata** Gren. & Godr. Prickly Lettuce.
A weed everywhere. Incorrectly referred to as *L. virosa* L. in Britton's Manual.

L. ludoviciana (Nutt.) DC. Western Lettuce.
Near swamp at New Coeln. Occasional.

L. canadensis L. Tall Lettuce.
Throughout county. Common.

L. canadensis L. var. **integrifolia** (Bigel.) Gray. *L. sagittifolia* Ell. Arrow-leaved Lettuce.
Wauwatosa and Whitefish Bay. Not uncommon.

L. hirsuta Muhl. Hairy Wood Lettuce.
Wauwatosa. Occasional.

L. pulchella (Pursh.) DC. Large-flowered Blue Lettuce.
Near swamp at New Coeln. Rare.

L. floridana (L.) Gaertn. False Lettuce.
Near Milwaukee River above city limits.

Hieracium venosum L. Rattlesnake-weed.
Near New Coeln and in Lake Woods.

H. canadense Michx. Canada Hawkweed.
Wauwatosa and Whitefish Bay. Occasional.

H. scabrum Michx. Rough Hawkweed.
Wauwatosa, Oak Creek and Lake Woods.

Prenanthes alba L. *Nabulus albus* (L.) Hook. White Lettuce.
Throughout county. Common.

AMBROSIACEAE.

Iva xanthiifolia (Fresen.) Nutt. Marsh Elder.
Waste places in Menomonee Valley, also in Third and Fifth Wards. Locally abundant.

Ambrosia trifida L. Great Ragweed.
Throughout county. Locally abundant.

A. trifida var. **integrifolia** (Muhl.) T. & G.
Throughout county. With the preceding.

A. artemisiæfolia L. Ragweed.
Everywhere.

A. psilostachya DC. Western Ragweed.
Menomonee Valley. Not common.

Franseria Hookeriana Nutt. *Gaertneria acanthicarpa* (Hook.) Britton.
Franzeria. Menomonee Valley, along railroad tracks.

Xanthium strumarium L. *X. glabratum* (DC.) Britton.
Smootish Cocklebur. Throughout county. Common.

X. pennsylvanicum Wallr. Pennsylvania Clotbur.
Waste places and along railroad tracks. Occasional.

COMPOSITAE.

Vernonia fasciculata Michx. Western Iron-weed.
Menomonee Valley and Oak Creek. Locally abundant.

Eupatorium purpureum L. Joe-pye Weed.
Throughout county. Common.

E. perfoliatum L. Boneset.
Throughout county. Common.

E. ageratoides L. f. White Snake-root.
Throughout county. Not uncommon.

Liatris pycnostachya Michx. *Lacinaria pycnostachya* (Michx.) Kuntze.
Prairie Button Snake-root.
Menomonee Valley, Wauwatosa. Not common.

L. spicata Willd. *Lacinaria spicata* (L.) Kuntze. Gay Feather.
Bay View. Locally abundant.

Grindelia squarrosa (Pursh.) Dunal. Broad-leaved Gum-plant.
Granville. Wauwatosa. Becoming common.

Solidago cæsia L. Blue-stemmed Goldenrod.
Near New Coeln and Bay View.

S. latifolia L. *S. flexicaulis* L. Broad-leaved Goldenrod.
Throughout county. Locally abundant.

S. stricta Ait. Willow-leaved Goldenrod.
In southern part of county.

S. speciosa Nutt. Showy Goldenrod.
Bay View.

S. rugosa Mill. Hairy Goldenrod.
Wauwatosa, Granville & Milwaukee River near Cement W'ks.

S. patula Muhl. Rough-leaved Goldenrod.
Whitefish Bay and Wauwatosa. Locally abundant.

S. ulmifolia Muhl. Elm-leaved Goldenrod.
Whitefish Bay and Wauwatosa. Not uncommon.

S. neglecta T. & G. Swamp Goldenrod.
Bay View and Menomonee Valley.

S. juncea var. **scabrella** (T. & G.) Gray. Sharp-toothed Goldenrod.
Wauwatosa and Whitefish Bay. Locally abundant.

S. arguta Ait. Cut-leaved Goldenrod.
Wauwatosa and northern part of county.

S. serotina Ait. Late Goldenrod.
Occasional. North and south.

S. canadensis L. Canada Goldenrod.
Throughout county. Common.

S. nemoralis Ait. Field Goldenrod.
Throughout county. Not uncommon.

S. rigida L. Stiff Goldenrod.
Town of Franklin and Milwaukee River near Cement Works.

S. ohioensis Riddell. Ohio Goldenrod.
Menomonee Valley, Wauwatosa.

S. Riddellii Frank. Riddell's Goldenrod.
North of city.

S. Houghtonii T. & G. Houghton's Goldenrod.
Reported by Dr. L. Sherman.

S. graminifolia (L.) Ell. *Euthamia graminifolia* (L.) Nutt.
Fragrant Goldenrod.
Whitefish Bay and New Coeln. Locally abundant.

Boltonia asteroides (L.) L'Her. Aster-like Boltonia.
Sec. 21, Town of Lake; Sec. 33, Oak Creek. Abundant.

Sericocarpus linifolius (L.) B. S. P. Narrow-leaved White-topped Aster.
Near North Milwaukee.

Aster divaricatus L. White Wood Aster.
Banks of Milwaukee River.

A. leptocaulis Burgess. Smooth-stemmed Aster.
Lake Woods and Whitefish Bay.

A. macrophyllus L. Large-leaved Aster.
Throughout county. Locally abundant.

A. Shortii Hook. Short's Aster.
Throughout northern part of county. Locally abundant.

A. azureus Lindl. Sky-blue Aster.
Menomonee Valley and Milwaukee River. Occasional.

A. cordifolius L. Common Blue Wood Aster.
Throughout county. Locally abundant.

A. cordifolius L. var. **lævigatus** Porter. *A. Lowrieanus* Porter.
Smooth Wood Aster. Throughout county. Common.

A. sagittifolius Willd. Arrow-leaved Aster.
Reported by A. Conrath as found in county.

A. Drummondii Lindl. Drummond's Aster.
Wauwatosa and Whitefish Bay. Locally abundant.

A. undulatus L. Wavy-leaved Aster.
Whitefish Bay and New Coeln.

A. novæ=angliæ L. New England Aster. Near the Cement Works, at Lake Woods and Whitefish Bay. Locally abundant.

A. puniceus L. Red-stalk Aster.
Throughout county. Common.

A. puniceus var. **lucidulus** Gray.
Sec. 5, Greenfield.

A. prenanthoides Muhl. Crooked-stem Aster.
Throughout county. Not uncommon.

A. lævis L. Smooth Aster.
Throughout county. Abundant, especially north.

A. junceus Ait. Rush Aster.
In western part of county. Locally abundant.

A. longifolius Lam. Long-leaved Aster.
Whitefish Bay.

A. ptarmicoides (Nees.) T. & G. Upland White Aster.
Sec. 1, Greenfield.

A. paniculatus Lam. Panicled Aster.
Banks of Milwaukee River.

A. paniculatus var. **simplex** (Willd.) Burgess.
Sec. 1, Greenfield.

A. Tradescanti L. Michaelmas Daisy.
Wauwatosa and Whitefish Bay. Occasional.

A. ericoides L. Frost-weed Aster.
Cement Works on Milwaukee River. Sec. 6, Greenfield.

A. lateriflorus (L.) Britton. Starved Aster.
Throughout county. Locally common.

A. angustus (Lindl.) T. & G. *Brachyactis angustus* (Lindl.) Britton.
Rayless Aster. In waste places in city. Spreading.

Erigeron pulchellus Michx. Poor Robin's Plantain.
Menomonee Valley.

E. philadelphicus L. Philadelphia Fleabane.
Throughout county. Common.

E. annuus (L.) Pers. Sweet Scabious.
Throughout county. Common.

E. ramosus (Walt.) B. S. P. Daisy Fleabane.
Throughout county. Common.

E. canadensis L. *Leptilon Canadense* (L.) Britton. Horse-weed.
Everywhere.

Dœllingeria umbellata (Mill.) Nees. Tall Flat-top White Aster.
Menomonee Valley and Whitefish Bay. Locally abundant.

Antennaria neodioica Greene. Smaller Cat's-foot.
Throughout county. Common.

A. neglecta Greene. Field Cat's-foot.
Banks of Fish Creek, Town of Milwaukee.

A. petaloides Fernald.
Banks of Fish Creek, Town of Milwaukee.

A. plantaginifolia (L.) Richards. Plantain-leaf Everlasting.
Throughout county. Common.

Anaphalis margaritacea (L.) Benth & Hook.
Large-flowered Everlasting. New Coeln.

Gnaphalium polycephalum Michx. *G. obtusifolium* L.
Sweet Everlasting. Throughout county. Common.

G. decurrens Ives. Clammy Everlasting.
Near St. Francis Seminary.

G. uliginosum L. Low Cudweed.
Southern part of county.

Inula Helenium L. Elecampane.
Southern part of county, also Lake Woods. Locally abundant.

Polymnia canadensis L. Small-flowered Leaf-cup.
Wauwatosa.

Silphium perfoliatum L. Indian-cup.
Sec. 8, Greenfield, according to Bennetts.

S. integrifolium Michx. Entire-leaved Rosinweed.
Bay View and Sec. 20, Franklin. Locally common.

S. laciniatum L. Compass-plant.
Secs. 20, 32 and 33, Franklin. Occasional.

S. terebinthinaceum Jacq. Prairie Dock.
Bank of Milwaukee River and in Town of Franklin. Locally abundant.

Heliopsis scabra Dunal. Rough Ox-eye.
Throughout county. Common.

Rudbeckia hirta L. Black-eyed Susan.
Throughout county. Common.

R. laciniata L. Green-headed Cone-flower.
Throughout county. Locally abundant.

Lepachys pinnata (Vent.) T. & G. *Ratibida pinnata* (Vent.) Barnhardt. Gray-headed Cone-flower.
Menomonee Valley, Wauwatosa. Abundant.

L. columnaris (Sims.) T. & G. *Ratibida columnaris* (Sims.) D. Don.
Prairie Cone-flower. Menomonee Valley, Wauwatosa and Whitefish Bay. Locally abundant.

Helianthus annuus L. Common Sun-flower.
Escaped from cultivation. Occasional.

H. petiolaris Nutt. Prairie Sun-flower.
Menomonee Valley. Common.

H. scaberrimus Ell. Stiff Sunflower.
"Near C. & N. W. R. R. tracks, foot of Florida Str." Bennetts.

H. giganteus L. Giant Sunflower.
Menomonee Valley and Whitefish Bay. Occasional.

H. Maximiliani Schrad. Maximilian's Sunflower.
North Greenfield.

H. divaricatus L. Rough or Woodland Sunflower.
Southern and western parts of county. Common.

H. mollis Lam. Hairy Sunflower.
Menomonee Valley, near foot of 17th Str.

H. doronicoides Lam. Oblong-leaved Sunflower.
Reported by Mr. Runge.

H. decapetalus L. Thin-leaved Sunflower.
Throughout county. Common.

H. strumosus L. Pale-leaved Wood Sunflower.
In southern and western parts of county. Occasional.

H. tuberosus L. Jerusalem Artichoke. In Menomonee Valley and along Milwaukee River. Not uncommon.

Coreopsis palmata Nutt. Stiff Tickseed.
Wauwatosa.

C. lanceolata L. Lance-leaved Tickseed. Reported by C. E. Brown from S. E. ¼, Sec. 19, Town of Milwaukee.

Bidens chrysanthemoides Michx. *B. lævis* (L.) B. S. P.
Smooth Bur Marigold. Throughout county. Occasional.

B. cernua L. Nodding Bur Marigold.
Throughout county. Occasional.

B. connata Muhl. Purple-stemmed Beggar-ticks.
Reported by T. Bruhin from near New Coeln.

B. frondosa L. Black Beggar-ticks.
Everywhere. Common.

B. vulgata Greene. Tall Beggar-ticks.
Throughout county. Common.

B. trichosperma (Mich.) Britton. Tall Tickseed Sunflower.
Sec. 1, Greenfield.

B. aristosa (Michx.) Britton. Western Tickseed Sunflower.
Locally common.

Galinsoga parviflora var. **hispida** DC. Galinsoga.
Throughout city. Locally abundant. Spreading.

Helenium autumnale L. Swamp Sunflower. Sneezeweed.
Throughout county. Common.

Achillea Millefolium L. Yarrow. Milfoil.
Everywhere. Common.

Anthemis Cotula L. Mayweed.
Everywhere. Common.

A. arvensis L. Field Camomile.
"Along Lincoln Ave. west of Forest Home Cemetery." Bennetts.

Chrysanthemum Leucanthemum L. Ox-eye Daisy.
Throughout county. Locally abundant.

C. Balsamita L. Costmary.
Escaped from gardens. Occasional.

Matricaria inodora L. Scentless Camomile.
"Forest Home Ave. opposite Pilgrims Rest Cemetery." Bennetts.

M. Chamomilla L. Wild Camomile.
Along streets of city.

Tanacetum vulgare L. Tansy. Menomonee Valley, Fond du Lac road, Mineral Spring road and elsewhere. Locally copious.

Artemisia caudata Michx. Tall Wormwood.
Waste places in city, also on lake shore.

A. canadensis Michx. Canada Wormwood.
Along lake shore, south of city.

A. Absinthium L. Common Wormwood or Absinth.
Escaped from cultivation. Occasional.

A. biennis Willd. Biennial Wormwood.
Waste places in city. Common.

A. vulgaris L. Common Mugwort.
Throughout county. Common.

A. Pontica L. Roman Wormwood.
Escaped from gardens. Rare.

A. ludoviciana Nutt. Lobed Cudweed. Menomonee Valley and waste places in city, also recorded as *A. gnaphalodes* Nutt.

Erechtites hieracifolia (L.) Raf. Fireweed.
Whitefish Bay.

Cacalia reniformis Muhl. *Mesadenia reniformis* (Muhl.) Raf.
Great Indian Plantain. Menomonee Valley. Common.

C. atriplicifolia L. *Mesadenia atriplicifolia* (L.) Raf.
Pale Indian Plantain. Throughout county. Occasional.

C. suaveolens L. *Synosma suaveolens* (L.) Raf.
Sweet-scented Indian Plantain.
Milwaukee River near city and near Whitefish Bay.

Senecio Balsamitæ Muhl. Balsam Groundsel.
"West of National Home." Occasional.

S. aureus L. Golden Ragwort.
Menomonee Valley and southern part of county.

S. palustris (L.) Hook. Marsh Fleawort.
Throughout county. Occasional.

S. vulgaris L. Common Groundsel.
In southern part of county. Common.

Arctium Lappa L. Great Burdock.
Everywhere.

Cirsium lanceolatum (L.) Scop. *Carduus lanceolatus* L.
Common Thistle. Everywhere.

C. altissimum (L.) Spreng. *Carduus altissimus* L. Tall Thistle.
Menomonee Valley and Whitefish Bay. Not uncommon.

C. discolor Spreng. *Carduus discolor* (Muhl.) Nutt. Field Thistle.
Throughout county. Common.

C. muticum Michx. *Carduus muticus* (Michx.) Pers. Swamp Thistle.
"A mile east of New Coeln." (T. Bruhin.)

C. arvense (L.) Scop. *Carduus arvensis* (L.) Robs. Canada Thistle.
Everywhere.

Centaurea Cyanus L. Blue-bottle.
In southern and western parts of county.

INDEX TO FAMILIES.

INDEX TO GENERA AND SPECIES.

A NEW SPECIES OF PSEN.

By Henry L. Viereck.

Psen (Mimesa) barthi n. sp.

Wings brownish transparent, nervures and stigma dark brown. Belongs to Fox's group *Kohli*, but clypeus subbidentate.

Female. 10 mm. *Head*: Pretty much the same as in *simplicicornis;* polished portions with a steel blue reflection.

Thorax: Dorsulum approximately as in *simplicicornis;* scutel punctured and striate; mesopleura distinctly but sparsely punctured; dorsulum and mesopleura with a steel blue reflection; knees black, spurs whitish, tarsi brownish testaceous to brown; otherwise as in *simplicicornis.*

Abdomen: Pygidium bounded by a distinct carina; otherwise as in *simplicicornis.*

Barring the exceptions already alluded to, this insect is almost uniformly black.

Type Public Museum, Milwaukee, Wis. Type locality, Milwaukee, Wis. One specimen collected by Dr. Geo. P. Barth.

ON THE NESTING HABITS OF *PSEN BARTHI* VIERECK

By George P. Barth.

Revenge is sweet. This spirit may have tinged the feeling of satisfaction which was derived from demolishing the abiding place of the above described intruder on what I fondly regarded as my crabro preserve. During the years 1905 and 1906 this old log in Bradley's Woods, on the Milwaukee-Waukesha County line, had been a continuous source of pleasure and profit to me in my

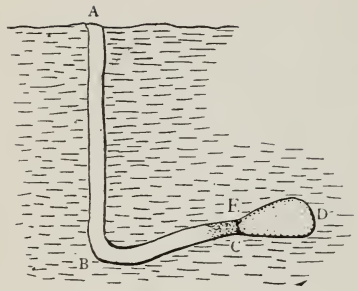
growing intimacy with the habits of the Crabronidœ and a feeling of disappointment and chagrin was experienced when it was seen that a colony of slender, black wasps had usurped this haunt of a more beautiful though coarser structured family. Nothing remained of the numbers of *Crabro obscurus, chrysarginus, sexmaculatus* and *montanus* which formerly nested here. During the summer but one *Crabro brunneipes* ventured to dispute the right of possession with Psen and built her nest in the log. One specimen of Psen was caught carrying a leaf-hopper to this log last year, but others must have builded to account for the numbers that chose this for a nesting site during the present season.

The flight of the wasp is rather slow and not graceful. When hunting for a place to begin excavations she frequently alights and tests rather methodically here and there, walking from place to place, occasionally taking wing along the log in arcs with the side of the log. She is not at all shy, seemingly indifferent as to whether she is being watched or not even though the observer be quite close to the nest. The numerous parasitic flies which were constantly about the nests also did not seem to be a disturbing factor, although several times the returning wasp lunged at one which happened to be too close to the entrance. The prey of the wasp seems to be exclusively adult leap-hoppers, of which the following species were found in the nests: *Cyrtolobus fenestratus* Fitch and *Atyma inornata* Say.

The method of carrying the hopper was practically the same in all instances. It was firmly grasped at the neck or anterior part of the thorax by the middle legs, ventral or lateral side uppermost, and projected backwards under the abdomen of the wasp. Occasionally the body was carried somewhat to the right side and below thus pushing the abdomen of the wasp to the left. In no instance was the wasp seen to fly directly into the nest, but alighted some inches away and deliberately walked in without shifting its grasp on its victim.

NEST.

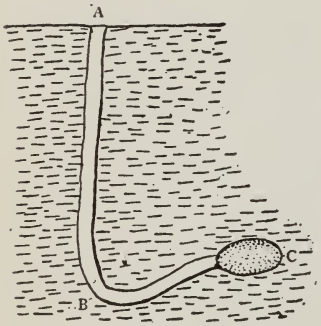
The entrance to the nest was usually marked by a quantity of sawdust scattered about without definite form or arrangement. The nest remained open during the absence of the wasp though material was at hand with which it might easily have been closed to intruders. Frequently the entrance was in the side of a crack which extended into the log and in this event the sawdust was in large part carried to the surface and deposited there. A short gallery, smooth and evenly rounded, from three to four millimeters in diameter, led perfectly straight or rather tortuously to the cells. The accompanying drawings and measurements will illustrate. In all nests the cell was rather sharply divided from the gallery by a ridge formed by the abrupt incline into the bowl of the cell. In shape these varied to a considerable degree, the oval in some form being maintained however. The cell was provisioned with from three to five leaphoppers which were in the majority of cases mixed with a little sawdust. These, presumably, were stung to death as neither the ones taken from the wasp immediately on her return from a hunting expedition nor those in any of the cells responded to stimulation with forceps, fingers or alcohol and they soon dried up. All the nests except number three were in the log. This nest was found in the debris which littered the ground about one foot from the log proper, the entrance being concealed under several chips of wood. Thence it took its course downward irregularly, then horizontally and finally in a sweeping curve downward to the cell. This irregularity was not due to a desire on the part of the wasp to avoid obstructions as where a piece of wood was encountered the wasp bored its way through instead of around it, at least three pieces of wood, none larger than three-fourths of an inch in any diameter being thus perforated. The cell itself occupied the center of a small square piece not over one inch each way.



Nest No. 1.

Gallery A to C 0.4 cm. in diameter.
B to D 4.5 cm.
At E 0.8 cm. of packed sawdust.

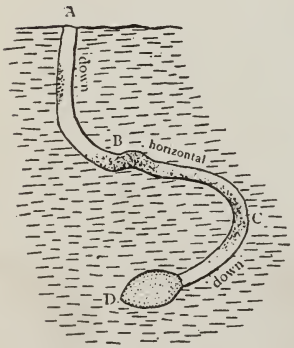
Cell 1.2x0.6 cm; irregularly oval. Entrance 0.3 cm.
4-leaf hoppers.



Nest No. 2.

Gallery A to B extending vertically. 0.4 cm. in diameter; B to C = 4 cm. horizontally.

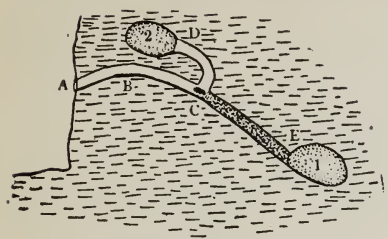
Cell regularly oval; 1.0x0.7 cm. Entrance 0.4 cm. Contained 2 hoppers.



Nest No. 3.

Gallery C to D = 5 cm. in a sweeping curve. C to B = 6 cm., also curved. B to A = 5 cm., almost straight. A to D in a straight line = 11 cm.

Cell Egg-shaped as drawn; 1.3x0.7 cm. Entrance 0.4 cm. Contained 2 hoppers.

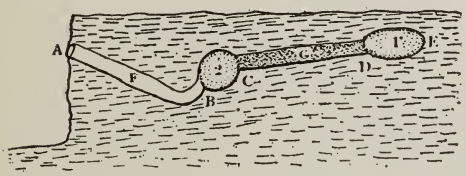


Nest No. 4.

Gallery E filled with sawdust and 0.3 cm. in diameter. D and B open. D = 1½ cm. long.

Cell 1 Irreg. oval; 1.2x0.7 cm.; clean and contained a cocoon very lightly attached to the walls.

Cell 2 regularly oval; empty and clean; 1.0x0.6 cm.



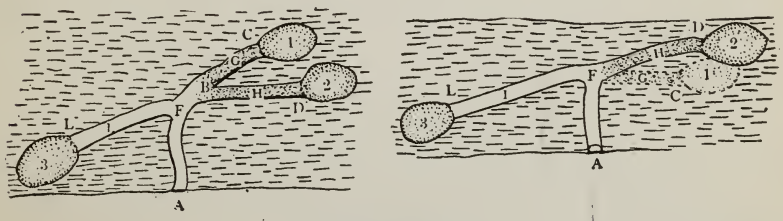
Nest No. 5.

Gallery A to B = 2.2 cm.
C to D = 1.5 cm.
A to E = 5.9 cm.
A to D = 4.6 cm.
G = 0.3 cm. in diam. and packed with sawdust.
F = 0.4 cm. in diam. and open.

Cell 1 1.3x0.7 cm.; 3 hoppers; egg on left thorax at edge of wing beginning at neck and extending parallel to the body.

Cell 2 practically spherical; 0.8 cm. in diameter. Empty.

Wasp caught in gallery F.



Nest No. 6.

TOP VIEW. LATERAL VIEW.

A to D = 4 cm.
A to C = 3 cm.
A to L = 3.7 cm.
A to F = 1.2 cm.
D to B = 1.7 cm.
C to B = 0.6 cm.
F to L = 2.5 cm.

Cell 1 1.0x0.6 cm.; 3 hoppers; contents mildewed.

Cell 2 1.3x0.6 cm.; rather flat on one side, dome-like on other; cocoon.

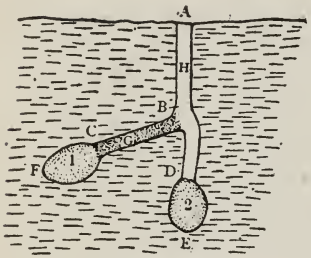
Cell 3 1.2x0.6 cm.; empty.

Gallery H 0.3 cm. in diam.; filled with sawdust.

Gallery G 0.4 cm.; filled with sawdust.

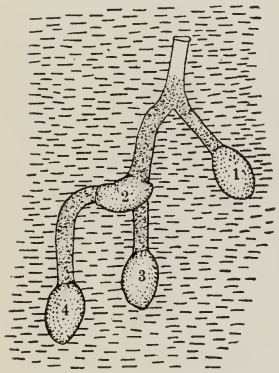
Gallery I 0.4 cm.; open.

Wasp caught in nest. Entrance in a crack.



Nest No. 7.

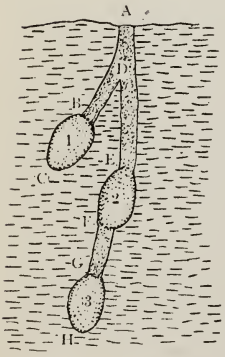
A to B = 1.8 cm.
B to C = 2 cm.
B to D = 1 cm.
A to F = 5 cm.
A to E = 4 cm.
Gallery H = 0.4 cm. in diam.; open.
Gallery G = 0.3 cm. in diam.; packed.
Cell 1 a cocoon.
Cell 2 1.1x0.7 cm. Empty.



Nest No. 8.
SURFACE VIEW.

Galleries and cells were practically on the same horizontal plane, the entrance being in a crack in the log. All the galleries were packed with sawdust.

Cell 1 1.2x0.7 cm.; contained a cocoon.
Cell 2 very irregular in shape; contents mildewed.
Cell 3 1.3x0.6 cm.; regularly oval; contained a cocoon.
Cell 4 1.2x0.6 cm.; regularly oval; contained a cocoon.



Nest No. 9.

All the cells and galleries on practically the same vertical plane. All galleries packed with sawdust.

A to D = 1.5 cm. A to B = 2.7 cm.
A to C = 3.8 cm. A to E = 3.7 cm.
A to H = 7.0 cm. F to G = 1.2 cm.

Cell 1 1.1x0.7 cm.; regularly oval; 3 hoppers; entrance 0.3 cm. in diam.
Cell 2 1.1x0.5 cm.; regularly oval; 4 hoppers.
Cell 3 1.1x0.6 cm.; one side considerably flatter than the other; 4 hoppers; egg on right thorax along the edge of the wing; contents beginning to mildew.

MISCELLANEOUS CELLS OF WHICH THE NEST STRUCTURE WAS NOT TRACED.

Cell No. 1: 1.1x0.5 cm.; empty; sharply differentiated from gallery; regularly oval; 0.35 cm. at entrance; gallery 0.4 cm. not packed.

Cell 2. 1.2x0.7; 4 hoppers somewhat mildewed; regularly oval; gallery to cell packed with sawdust.

Cell 3. 1.1x0.7 cm.; regularly oval; 4 hoppers.

Cell 4. 1.1x0.6 cm.; regularly oval; 5 hoppers; a small fly larva crawling about.

Cell 5. 1.0x0.6 cm.; regularly oval; 3 hoppers; egg on right thorax along edge of wing.

Cell 6. 1.2x0.7; egg shaped; entrance packed with sawdust and somewhat smaller than the gallery beyond; 3 hoppers.

Cell 7. 1.0x0.6 cm.; irregularly oval, one side being somewhat flattened; 3 hoppers; 3 fly larvae in cell.

Cell 8. Very irregular; contents mildewed.

Cell 9. Irregularly oval; 1.2x0.6 cm.; 3 hoppers; 2 fly larvae.

Cell 10. 1.1x0.5 cm.; regularly oval; cell and gallery empty; sharply differentiated by ridge; 0.35 cm. at entrance to cell; 0.4 cm. in gallery.

In no case did the hoppers completely fill the cell, being gathered in a ball either at one end or in the middle. Most of the cocoons, however, filled the cell and were lightly attached to its walls with the hopper rests attached to its outer surface.

The cocoons are buff or yellowish buff in color, frequently with whitish fibres or masses of fibre scattered over the surface. One larva in an artificial glass cell spun a cocoon which is entirely paper white. They are rather tough, tearing with difficulty, though quite thin.

Nests one, two and three were excavated August 4th. The remainder were obtained September 1st. On this day but two wasps were seen about the log, one resting in the gallery of Nest No. 5 and the other carrying prey into Nest No. 6.

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