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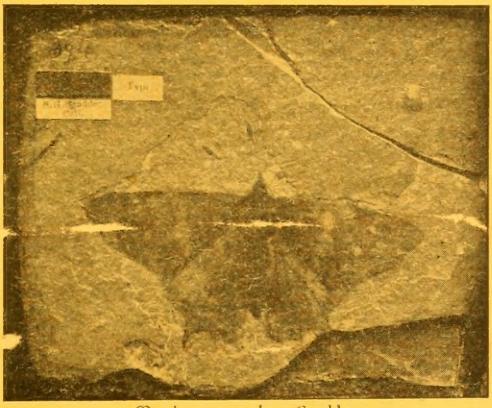

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ATHERIX BRAUNSI NOV. SP., A SOUTH AFRICAN LEPTID WITH GREGARIOUS HABITS (DIPTERA).

By J. Bequaert,

American Museum of Natural History, New York City.

The genus *Atherix* is unique among the Leptidæ on account of the remarkable, gregarious habits exhibited by the adults of certain, if not all, of its members. These have been repeatedly described for the Ibis fly, *Atherix ibis* (Fabricius), the commonest of the European species. "The female of this fly," says Walker,[1] "is gregarious, and attaches its eggs in large clusters to boughs hanging over streams, and there remains, and shortly dies. The cluster is generally pear-shaped, and sometimes contains many thousands of dead flies, and continually receives accessions by new comers settling upon it. When the larva is hatched it falls into the water, its future residence; it has a forked tail about one-third the length of the body, and has the power of raising itself in the water by an incessant undulating motion in a vertical plane."[2]

I am not aware that similar observations have been made on other European species, nor that the metamorphoses of any of these have ever been elucidated. In North America, however, *A. variegata* Walker, a close ally of *A. ibis,* also oviposits in dense clusters.

[1] Walker, F. Insecta Britannica. Diptera. Vol. 1, 1851, p. 70.

[2] D. Sharp (The Cambridge Natural History, Insects, Vol. 2, 1909, p. 489, fig. 227) has given a good figure of the egg and fly clusters of **A. ibis.** Of the many naturalists who have observed the habits of this fly I may mention the following:

Egger, J. Verh. Zool. Bot. Ges. Wien, 4, 1854, p. 7.

Schiner, J. R. Fauna Austriaca, Die Fliegen. Vol. 1, 1862, pp. 177-178.

Chapman, A. Masses of Diptera collected on twigs of alder. Ent. Mo. Mag., 3, 1866, pp. 94-95.

Tournier, H. and Preudhomme de Borre, A. Ann. Soc. Ent. Belgique, 17, 1874, C. R., pp. lxxxix-xci.

Pérez, J. Actes Soc. Linn. Bordeaux, 32, 1878, C. R., p. xliii.

Billups, T. R. Note upon **Atherix Ibis,** Fabricius. Entomologist, 22, 1889, pp. 193-194, Pl. 7; also mentions and figures parasitic Hymenoptera obtained from the egg cluster; W. H. Ashmead (p. 290) and F. W. Frohawk (pp. 290-291) comment further on these parasites.

Giard, A. Note sur la larve de **l'Atherix Ibis** Fabr. Bull. Soc. Ent. France, 1902, pp. 220-222.

Ives[1] describes "a dried-up mass of dead flies, about the size of a man's fist. Throughout it were scattered light-colored fragments, which had somewhat the appearance of empty egg-cases. The whole mass was very brittle, and readily crumbled to pieces. It was obtained (at Pemberton, N. J.) from the under surface of a trunk overhanging a small stream." The flies were recognized by Williston as females of a species belonging to the genus *Atherix,* probably to *Atherix variegata.*[2] In referring to Ives' observations, C. V. Riley and L. O. Howard[3] add the following remarks: "Some thirteen years ago we collected a large number of these eggs (of *Atherix*) upon the piling of Lake Minnetonka, near Minneapolis, and they have formed an interesting part of the Dipterological collection of the National Museum, while more recently we received a bit of piling from the shores of Lake Ontario which were covered with these eggs, from which larvæ hatched which we were able to determine as belonging to this genus by comparison with the figures in Dr. Brauer's Monograph of Dipterous Larvæ. Our correspondent stated that wharf piles for hundreds of feet were covered with these eggs."

I am much indebted to Mr. Geo. P. Engelhardt, of the Brooklyn Institute of Arts and Sciences, for the following notes on *Atherix variegata,* which he observed first at Beaver Creek, Beaver County, Utah, in July, 1904:[4] "The flies were present by thousands in dense clusters attached to the under side of logs and tree trunks a few inches above the water of Beaver Creek, a turbulent mountain stream well stocked with mountain trout. By far the greater part of the flies in the cluster were dead, only a few on the outside being alive. The altitude was about 7,000 feet." Mr. Engelhardt further writes me that "on June 10, 1920, while wading the Carman River, at Yaphank, Long Island, N. Y., a large cluster of leptid flies was observed under about the same conditions as in

[1] Ives, J. E. An interesting method of egg deposition. Ent. News, 1, 1890, p. 39.

[2] **Atherix variegata** Walker occurs in New Jersey. I have seen a number of female specimens of this species in the collections of the American Museum of Natural History, New York; they were taken by Mr. A. J. Weidt, at Singac, N. J., in July. It is not included in J. B. Smith's List of New Jersey Insects (1910).

[3] The eggs of **Atherix.** Insect Life, 2, Nos. 11-12, 1890, pp. 386-387.

[4] Some of the specimens collected on that occasion are preserved in the entomological collections of the Brooklyn Institute, where I have been able to examine them through the kindness of Mr. Chas. S. Schaeffer.

Beaver Creek, Utah. The time was late afternoon and all the flies were dead." Though, in this last instance, no specimens were collected, this observation most probably also refers to *A. variegata.*

The gregarious habit of the western *Atherix* has also been observed in Utah and Idaho by Aldrich, who gives an interesting account of the manner in which certain California Indians collect and prepare the masses of these flies for food.[1] The American Museum of Natural History possesses additional specimens of *Atherix variegata* obtained by Dr. F. E. Lutz at Pagosa Springs, Colorado (7,200 ft.), June 22 to 24, 1919, and on the Green River, Wyoming (6,100 ft.), July 2, 1920.

It is indeed well worthy of notice that the same gregarious behavior of the adult flies has now been noted in one of the African species, which I have named *Atherix braunsi,* in honor of its discoverer. There is thus reason to suppose that this curious and thus-far mysterious habit will eventually be observed in many other, if not all, members of the genus. In a recent letter, Dr. H. Brauns, of Willowmore, describes the habits of *A. braunsi* as follows: "This fly is of peculiar interest. It is at home along the margin of swiftly running brooks near Cape Town. One finds females and males of it on stones that emerge above the water (the female is smaller and black), bunched together in masses as large as a man's head; every moment pieces the size of a fist break away from the mass and, as soon as they drop in the water, are greedily eaten by the trout with which the streams have been stocked."

Atherix braunsi sp. nov.

Male. Length 6 mm. Wing, length 7 mm., width 2.4 mm.

Head (Fig 1*a*) broadly elliptical, as wide as the thorax; one and one-third times as wide as high when seen in front; hemispherical in profile. Inner orbits gradually divergent from the vertex to the side-cheeks. Front very broad; at its narrowest part, the vertex, about half the width of one eye; at the antennæ nearly half the width of the head. Face short, only half as long as the front, obliquely receding below; the antennæ inserted on the lower third of the head. Epistoma with a deep depression below each of the

[1] Aldrich, J. M. Flies of the Leptid genus **Atherix** used as food by California Indians. Ent. News, 23, 1912, pp. 159-163.

antennal sockets, slightly raised on the middle line. Posterior orbits moderately broad, gradually narrowed toward the vertex. Ocelli placed in an equilateral triangle, on a slightly raised tubercle which is widely removed from the inner orbits. Proboscis large and thick, slightly shorter than the head; with broad and long labella which are obtusely pointed at the apex. Palpi comparatively short and thick, barely one-third the length of the proboscis. Eyes bare, with all the facets approximately equal in size. Antennæ about as long as the face, of the usual shape in the genus (very much like the drawing of the male antennæ of *A. ibis* in Verrall, British Flies, Vol. 5, 1909, p. 242, fig. 171); the two basal joints almost of equal length; the third a little longer, of swollen kidney-shape; arista slender, about one and one-half times the length of the antennæ, bare. Thorax and scutellum of the usual shape.

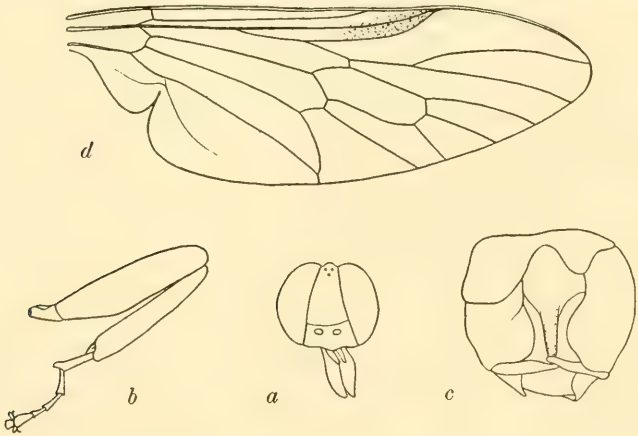

Fig. 1. **Atherix braunsi** sp. nov. Male: **a,** head seen in front; **b,** hind leg; **c,** hypopygium from above; **d,** wing. All X 10.

Legs comparatively long and thick. Femora distinctly swollen and feebly flattened, especially those of the middle and hind legs. Fore and middle tibiæ feebly broadened, much narrower than their femora; the hind tibiæ heavier, but a little narrower than their femora; fore tibiæ without, middle and hind tibiæ with two spurs. Fore tarsi slender, slightly longer than their tibiæ; their basal joint cylindrical, not thickened, about as long as the following four

joints together. Middle tarsi distinctly shorter than their tibiæ; their basal joint about the length of the following three together and with a feebly projecting, obtuse, apical expansion on the under side. Hind tasi slightly shorter than their tibiæ; their basal joint very short, but a little longer than the following joint; this basal joint is slightly thickened, cylindrical, and ends at the apex in a heavy, broadly obtuse, spur-like expansion which extends on the under side considerably beyond the insertion of the second tarsal joint (Fig. 1*b*). Pulvilli and claws of the normal shape, even on the fore legs, not distorted as in the male of *A. ibis*. Abdomen short and broad, but a little longer than the thorax. Hypopygium large, completely exserted; both parts of the forceps elliptical, thick, with a simple, finger-like apical appendage which is folded inward to cover the apex of the penis (Fig. 1*c*). Wing venation (Fig. 1*d*) as in other members of the genus; the third longitudinal vein forked much before the apex of the discal cell, its basal petiole not half the length of the two branches; anal cell closed far from the margin of the wing.

Head and thorax dull dark brown (nearest "mummy brown" of Ridgway's color nomenclature); the antennæ, epistoma and mouth parts pale yellowish; the posterior half of the scutellum dirty ocher yellow. Abdomen, including the hypopygium, uniformly bright ocher yellow. Legs dirty yellow, the coxæ and tips of tarsal joints slightly infuscate; the spur-like processes of basal joints of hind tarsi blackish. Halteres white, with a faint yellowish tinge. Wings hyaline, somewhat milky white, with a feebly marked, pale brown stigma which extends between the first and second longitudinal veins, from slightly before the anterior cross-vein to the apex of the first vein; wings otherwise entirely without spots or bands.

Pubescence concolorous, short but rather abundant on head and thorax; covering the entire vertex, front and side cheeks; face around the antennal sockets and epistoma bare. Hairs much longer and denser on the abdomen, bright yellow with a slight golden suffusion. Upper side of the femora with long, pale pubescence; the hairs of the legs otherwise short and black. No tactile hairs on the fore tarsi; but on the fore femora an irregular, transverse row of five long, pale colored bristles, which are placed before the

middle at the lower edge and are directed obliquely towards the apex of the femur; these bristles are in all probability tactile hairs.

Described from two males taken by Dr. H. Brauns at Stellenbosch, Cape Province, South Africa, November, 1915.

According to Dr. H. Brauns, females, seen at the same place and under the same conditions, therefore evidently of the same species, were smaller and black. I have not seen examples of that sex.

The salient characters of *A. braunsi* are found in the broad front of the male, the spur-like apex of the hind metatarsus, the unicolorous ocher yellow abdomen, and the milky white, unspotted wings. By these characters it differs conspicuously from all other described species and can easily be distinguished from the two previously known in the Ethopian Region: *Atherix binominata* J. Bequaert (= *Atherix longipes* Lœw, *nec* Bellardi)[1] from Bloemfontein, Orange River Colony; and *A. disciclara* Speiser,[2] from Tiko, near Victoria, Kamerun. Lœw campares *A. binominata* with *A. crassipes* Meigen, but that species has been made the type of *Atrichops* Verrall[3] on account of the front in the male and the side-cheeks in both sexes being practically bare. Whether *A. binominata* agrees in this respect with *A. crassipes* seems extremely doubtful; but *A. braunsi* has the front densely hairy from the ocelli to a short distance above the antennæ and the side-cheeks also are pubescent.

The genus *Atherix* Meigen (including *Atrichops* Verrall) is known from all over the world with the exception of South America. Of the thirty-one described species two are doubtful, seven occur in the Palearctic Region, three in the Ethiopian, eleven

[1] **Atherix longipes** H. Loew, Wiener Ent. Monatschr., 7, 1863, p. 12. This specific name being preoccupied in the genus by **Atherix longipes** Bellardi (1861) of Mexico, I propose that Loew's South African species be called **Atherix binominata.**

For the convenience of South African entomologists Loew's brief description of **A. binominata** is reproduced here: " —Ex **Ather. crassipedis** affinibus. Fusco-nigra ,tertio antennarum articulo, scutelli margine abdomineque subfulvis, primo hujus segmento praeter marginem apicalem atro, segmento secundo maculis tribus atris ornato, segmentis tribus sequentibus atro-fasciatis, segmento sexto subtiliter atro-marginato; pedes longi, cum coxis fulvo-testacei, tibiis tarsisque anterioribus tarsisque posticas praeter basim nigris, tibiis posticis tarsorumque posticorum basi fuscis; alae infuscatae, in disco subnebulosae, stigmate fusco, furca venae longitudinalis tertiae perlonga. Long. corp. 3¾ lin.—Long. al. 3¼ lin."

[2] Deutsch. Ent. Zeitschr., 1914, p. 3 ( ).

[3] British Flies. Vol. 5. Stratiomyidæ. 1909. p. 291.

in the Oriental, one in Australia, and seven in North and Central America. To these should be added three Oriental species of *Suragina* Walker, which, according to Bezzi,[1] is not generically distinct from *Atherix*. In addition, a number of fossil species have been described from Baltic amber (Lower Oligocene) and from the Miocene shales of Florissant, Colorado.[2]

As suggested by Knab,[3] it is by no means certain that all the species included at present in *Atherix* are congeneric. In this connection it is of considerable interest that the female of the Mexican *Atherix longipes* Bellardi has been reported as a fierce biter and blood-sucker, a habit unknown in the common European *A. ibis* and in the North American *A. variegata*.[4]

[1] Ann. Mus. Nat. Hungarici, 10, 1912, p. 445.
[2] **Atrichops hesperius** Cockerell, Canadian Entomologist, 46, 1914, p. 101.
[3] Proc. Ent. Soc. Washington, 14, 1912, pp. 186-187.
[4] Knab, F. Blood-sucking and supposedly blood-sucking Leptidæ. Proc. Ent. Soc. Washington, 14, 1912, pp. 108-110.

A NEW PTINID FOR NEW ENGLAND.

On November 3rd, Dr. J. Payson Clark of Boston brought to the Boston Society of Natural History a small beetle that he was frequently finding in his house. I could not name it at the time, but a few days later, Mr. H. C. Fall determined it as *Niptus hololeucus* Hald., a European species, the only previous record for North America being Montreal, Canada. Dr. Clark continued finding a few each week, and as late as December 27. In all, some thirty-five specimens were obtained.

C. W. Johnson.

SYMPETRUM CORRUPTUM IN MASSACHUSETTS.

On September 10, 1911, I took two males and one female of this dragonfly at the south end of Plum Island, Ipswich, Mass. This is, I believe, the first record of this species in Massachusetts. At the same time and place I also secured a female of *Tramea lacerata*, making the second record of that species for New England, the first having been taken at Chelsea Beach about fifty years ago, and the specimen being now in the collection of the Boston Society of Natural History. The first specimens referred to are in the Essex County collection of the Peabody Museum of Salem, Mass.

A. P. Morse.

DISTRIBUTIONAL NOTES ON HEMIPTERA, WITH THE DESCRIPTION OF A NEW GERRIS.[1]

By Roland F. Hussey, Forest Hills, Mass.

During the past three years I have collected Hemiptera in various parts of Michigan, and in the vicinity of Minneapolis and St. Paul, in Minnesota, and during this time several noteworthy captures have fallen to my lot. Some of these are reported below; records from Berrien County, in the extreme southwestern part of Michigan, have largely been omitted, however, in view of a forthcoming list of the Hemiptera taken there. I have also included here a few records, based on specimens in the collections of the Museum of Zoology of the University of Michigan, which yield important information as to the ranges of a few species. Inasmuch as the distribution of the various known species of Hemiptera in North America is as yet very imperfectly known, such records as these are of considerable value.

Published records of Hemiptera from Michigan are very few indeed—and the records from Minnesota are equally unsatisfactory. Occasional references to species which have been taken in Michigan are scattered among the reports of the proceedings of various entomological societies, but the only important list including non-aquatic forms which has appeared is that of Townsend,[2] who reported about eighty-five species from Constantine, St. Joseph County. Some of his records, however, must be regarded as doubtful: the species reported as *Neottiglossa sulcifrons* Stal is undoubtedly *N. undata* (Say), which he does not list; I have taken *Phymata erosa fasciata* Gray and *P. e. wolfi* Stal in southern Michigan, but I have seen nothing which could be considered *P. acutangula* Guérin, a Neotropical form which finds its way into Texas; the species listed as *Coriscus inscriptus* Kirby is probably one of the allied species of Nabis, possibly *N. roseipennis* Reuter. The Notonectæ of Townsend's list, reported as the Palaearctic

[1] Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 179.

[2] Hemiptera Collected in Southern Michigan. Proc. Ent. Soc. Wash., ii, pp. 52-56, 1891.

N. fabricii Fieber (= *glauca* Linné) and as *N. americana* Fabricius (= *indica* Linné), a species occurring in the southwestern United States and Mexico, can be identified only by examination of the specimens. The same is true of the single Corixid species listed, *Arctocorisa calva* (Say).

However, recent work in various parts of Michigan has added materially to our knowledge of the Hemipterous fauna of the state. Collections have been made in four localities in the lower peninsula, and in the western part of the upper peninsula, along the Wisconsin border. These studies will be reported separately in the near future.

Acknowledgements are due to Messrs. H. G. Barber, J. R. de la Torre Bueno, H. M. Parshley, and H. H. Knight for identification of several of the species listed below, and to Mr. F. M. Gaige of the Museum of Zoology of the University of Michigan for permission to include several records here.

Sciocoris microphthalmus Flor. This Pentatomid, which was first described in 1860 from the Baltic region, is widely distributed in the Palæarctic region, where it has been recorded from Europe, Russia, the Caucasus district, Siberia and China. It was first reported in America by Van Duzee in 1904, from Mt. Washington, New Hampshire, and it has since been recorded twice from Maine. Hart[3] lists it as occurring at Duluth, Minnesota, and in the "Lake Superior region." Stoner[4] has recently given an account of its capture at Douglas Lake, Cheboygan County, Michigan.

I have also taken this species at Douglas Lake, from roadside grasses in a lowland stand of arbor-vitæ, balsam fir, birch, and aspen; and, while I was at the University of Minnesota, Professor O. W. Oestlund very kindly gave me one of five specimens which he took in the vicinity of Minneapolis a number of years ago.

Very recently I have received from the Museum of Zoology of the University of Michigan a number of Hemiptera collected in North Dakota by Mr. T. H. Hubbell during the summer of 1920. Among these was a single specimen of *S. microphthalmus*, taken on the arid top of a butte in the Bad Lands near Amidon, Slope County, in the southwest corner of the state, August 21, 1920.

[3] The Pentatomoidea of Illinois. Bull. Ills. Nat. Hist. Surv., xiii, p. 175, 1919.
[4] Ent. News, xxxi, p. 141, May 1920.

It appears probable, therefore, that this is another of the holarctic species of Hemiptera, and that its range will some day be shown to extend entirely across the American continent, as it is already known to extend across Eurasia.

Ploiariola hirtipes Banks. A specimen of this Emesine was taken from a spider-web in a cottage on Lindsley Lake, Gogebic County, Michigan, July 20, 1919 (T. H. Hubbell). This species has been reported from a number of localities in New England, but this is the first record from the central part of the continent.

Sirthenea carinata (Fabricius). There is a single specimen in the Museum of the University of Michigan, collected near Ann Arbor, August 22, 1916 (F. M. Gaige). This species has recently been reported from Illinois by Malloch,[5] but without definite locality, and Osborn and Drake have recorded its occurrence in southern and central Ohio.

Atrachelus cinereus (Fabricius). During the summer of 1918 Mr. A. W. Andrews obtained two specimens of this little Reduviid near Detroit, Michigan (July 4, August 4). This species was previously known only from the southern and southeastern part of the United States.

Pagasa pallipes Stal. This Nabid, originally described from Texas, has since been reported from Kansas and Utah. On August 14, 1918, I took a single specimen at Ingleside, Cheboygan County, near the tip of the lower peninsula of Michigan. This individual lacks the obsolete pale marking on the anterior margin of the pronotum, but otherwise it agrees perfectly with the description given by Reuter and Poppius.[6]

Sericophanes heidemanni Poppius (= *noctuans* Knight). One specimen of this pretty little Mirid came to my light at Minneapolis, Minnesota, June 13, 1920. This record extends the known range of this form far to the westward. I am indebted to Dr. Knight for identification of this form.

Gerris argenticollis Parshley. This species is distributed over the eastern part of North America, from the Atlantic seaboard west at least to Michigan and Indiana. I have taken specimens in Michigan at Ann Arbor (April 19, 1919), and in the extreme

[5] Ent. News, xxxi, p. 240, Oct. 1920.
[6] Acta Soc. Sci. Fenn., ix, p. 29, 1909.

southwestern part of the state, near Three Oaks (June to September). These were all taken from woodland pools, or from the slow-flowing stretches of the Galien River in dense woods.

Gerris alacris, sp. nov. (Fig. 1).

Facies of *G. marginatus* Say, a little smaller than that species, females larger and more robust than the males; commonly brachypterous. Males readily distinguished from the other North American species by the prominent omphalium of the metasternum; female easily distinguished from *G. marginatus* by the shorter spines of the sixth abdominal segment, which only slightly surpass the middle of the first genital segment.

Black above, the pronotum and the veins of the hemielytra with fine sparse golden pubescence, anterior lobe of the pronotum with a yellow median line, two small oblique yellowish marks on the base of the vertex. Bucculæ yellow, throat slate-gray; prosternum yellow, the coxal cavities with a black spot outside. Mesosternum blackish, often yellow posteriorly, commonly with two diverging yellow lines extending backward from between the anterior coxæ. Metasternum and venter yellowish, median line obsoletely carinate, the sides of the abdomen below and the region about the metasternal orifice (omphalium Bergroth 1902) blackish. The color of the ventral surface is variable: sometimes it is entirely black. Connexivum narrowly yellow outside.

Antennæ dark testaceous, first and second joints with a narrow piceous apical ring, middle of the first joint darker; apical half of the third and the entire fourth joint piceous. Relative lengths of the segments, 43:21:20:30 (average of 15 specimens). These ratios vary within narrow limits: sometimes the third segment is very slightly longer than the second, and sometimes the first is slightly shorter than the second and third together.

Legs colored as in *marginatus,* the middle and hind legs slightly longer than in that species. In the brachypterous form the hemielytra commonly reach to about the middle of the third abdominal segment.

Male: sinus of the sixth ventral segment similar to that of *marginatus,* but with the sides of the median emargination somewhat more parallel. Female: genital segment broad at the base,

more narrowed apically than in *marginatus;* the spines of the sixth ventral segment rather blunt, barely surpassing the middle of the genital segment.

Length, ♂, 7-8 mm., ♀, 9-10 mm.; greatest width (across the middle coxæ), ♂, 2.1–2.3 mm., ♀, 2.7–2.9 mm.

Holotype, macropterous ♂, allotype, machopterous ♀, in coll. Museum of Zoology, University of Michigan. Paratypes, 12 ♂♂ and 18 ♀♀, macropterous and brachypterous, in coll. University of Michigan Museum and R. F. Hussey.

Described from 32 specimens taken from a small pond at the foot of a sand dune on the shore of Lake Michigan near Sawyer,

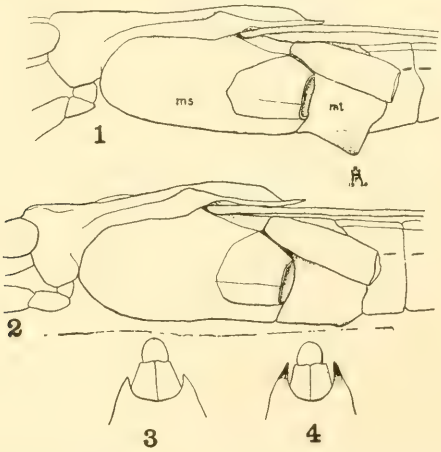

Fig. 1. 1. Thorax of **Gerris alacris**, n. sp., from left side. 2. Thorax of **G. marginatus** Say. 3. **Gerris alacris**, sp. nov., female genital segments, ventral aspect. 4. **G. marginatus** Say, female genital segments.

Berrien County, Mich., July 19 and July 26, 1920 (R. F. Hussey). This species was by far the most common water-strider here, and both adults and nymphs were seen. In company with it were *G. marginatus* and a few specimens of *G. rufoscutellatus.*

Tenagogonus hesione Kirkaldy. One adult and three nymphs of this water-strider were secured by Miss E. P. Butler at Vicksburg, Kalamazoo County, Michigan, August 21, 1920. The previous North American records were from Florida and Ohio.

Microvelia circumcincta Champion. The University of Michigan

Museum has one specimen of this species, taken at Fort Davis, Texas, during the summer of 1914 (M. M. Sampson). This Mexican Veliid is a new addition to the Hemipterous fauna of the United States.

Microvelia buenoi Drake. This little water-strider, recently described[7] from the Adirondack Mountains, was taken on a small woodland pool near Three Oaks, Michigan, July 4, 1919; and I also found it common at Minneapolis and St. Paul during May and June, 1920. I have compared these specimens with a paratype kindly given me by Professor Drake, and can find no significant differences.

Microvelia fontinalis Bueno. I have taken this species in Michigan at Ann Arbor (June 10, 1919), from a small pool in a roadside ditch below a spring, and in Berrien County (July, 1919).

Merragata foveata Drake. Apparently generally distributed over the United States east of the Rocky Mountains. I have taken it in Michigan; and I found several specimens at Minneapolis, Minnesota, on November 19, 1918—a cold, bleak day, when no other surface-dwelling Hemiptera were to be found.

Merragata brunnea Drake. The range of this species extends from Florida to New England, and west at least to Minnesota. I have taken specimens at St. Paul (Nov. 11, 1918), in Berrien and Washtenaw Counties, Michigan, and Miss Butler found it abundant at Battle Creek, Michigan, in August, 1920.

Ranatra protensa Montandon. This species has been much confused with the other two species of Ranatra which occur in northeastern North America. Its range extends from the Atlantic coast west at least to Minnesota. My Michigan specimens are from Washtenaw and Calhoun Counties, and I have seen it from St. Paul and from Cass County in Minnesota. The forms which I reported as this species from Douglas Lake[8] are *R. americana edentula* Montandon.

The present species, as I distinguish it, can be separated from *R. kirkaldyi* Bueno by its somewhat larger size, its more slender form, and its long and very slender fore femora, which are unbanded; it is smaller than most specimens of *R. americana* Mon-

[7] Bull. Brookl. Ent. Soc., xv, p. 20, 1920.
[8] Occ. Papers Mus. Zool. Univ. Mich., No. 75, p. 19, 1919.

tandon, the fore femora are more slender and have no trace of the subapical notch commonly present in that species, and the pronotum is more distinctly carinate on the posterior part of the anterior lobe. The hind legs of *protensa* are longer than in either of the other species, reaching to the tip of the air-tube, the femora reaching to the apices of the hemielytra, whereas in *americana* the legs reach only to about the middle of the air-tube and the hind femora only to the penultimate segment of the abdomen; the hind legs of *kirkaldyi* slightly surpass the middle of the tube.

R. americana is easily the most abundant species of the genus in Michigan and in Minnesota; *R. kirkaldyi* is much less generally distributed, but is sometimes locally common, especially in waters containing a relatively high content of calcium salts in solution; and *R. protensa* is the least common of the three species.

Palmacorixa buenoi Abbott. This is a common Corixid in the Atlantic states, but has not hitherto been reported west of Ithaca, N. Y. During August, 1920, I took two specimens at Ann Arbor, Michigan, from among waterweeds in the Huron River.

Palmacorixa gillettei Abbott. During June and September, 1919, I found this Corixid abundant in the Galien River a few miles north of Three Oaks, Michigan. The species was previously reported only from Colorado.

Corixa verticalis (Fieber). The range of this species extends from the Atlantic coast west at least to Missouri. I found it abundant in the Galien River in June, in company with *P. gillettei,* but it was not taken here in September. In Mr. Bueno's collection there are two specimens from Creve Cœur Lake, Missouri, labelled *Arctocorisa calva* (Say) by Professor Abbott.

In his description of *Palmacorixa gillettei* Professor Abbott says,[9] "Superficially it resembles *calva* Say." I believe that the *calva* to which Professor Abbott compares his new species is certainly *Corixa verticalis*—especially since I have seen the specimens referred to above—since this species does have a superficial resemblance to *P. gillettei,* whereas the true *calva* is a very different insect.

Corixa macroceps (Kirkaldy). This species was described from

[9] Ent. News, xxiii, p. 339, 1912.

North Carolina, and was subsequently reported by Abbott from Georgia. Mr. Bueno has a number of specimens taken in the vicinity of New York, and Miss E. P. Butler found it abundant in a small pond near Battle Creek, Michigan, in August, 1920.

Callicorixa praeusta (Fieber). This holarctic species has several times been reported from the northern parts of America, but the only record from the United States is that of Parshley from Maine. I have seen two specimens from the Pacific coast states, one from Lake Cushman, Washington, July 3, 1919 (F. M. Gaige), in the Museum of the University of Michigan, the other from San Francisco, in Mr. Bueno's collection.

The three females which I reported from northern Michigan[10] as "probably *C. kollarii* Fieber," should in all probability be placed in *præusta*. I seriously question the northern records of *kollarii*, which was originally described from Cuba and from Brazil.

[10] Occ. Papers Mus. Zool. Univ. Mich., No. 75, p. 21, 1919.

OKANAGANA RIMOSA (SAY) IN NOVA SCOTIA.

During the past summer (1920), Mr. David H. Linder, while botanizing in southern Nova Scotia, found this little Cicada at several places. In a letter he says: "It appeared to be quite common, especially in dry clearings where white birch and maple is found. About a mile north of Meteghan they were quite common in a dry clearing that had grown up to white birch and were almost numerous enough to be called a swarm. At Argyle, though not quite so thick, they were nevertheless quite common, as was also the case at Barrington, where I captured the specimen." Mteghan and Barrington are about fifty miles apart, while Argyle is nearly midway between the two places. In Nova Scotia, Mr. W. T. Davis (Journ. N. Y. Ent. Soc., 1919, vol. 27, p. 205) records it only from Truro.

C. W. Johnson.

PROFESSOR EMERY'S SUBGENERA OF THE GENUS CAMPONOTUS MAYR.

By William Morton Wheeler,
Bussey Institution, Harvard University.

The great cosmopolitan ant-genus *Camponotus,* now comprising fully 500 species and as many subspecies and varieties, has become so unwieldy that subdivision has become imperative. As long ago as 1896 Emery[1] made a serious attempt to render it more manageable by dividing it into three cohorts (Arcuati, Capitati and Angulosi) and numerous maniples based for the most part on geographical groups of species. Forel finally grasped the nettle in 1912[2] and established 16 subgenera in addition to *Colobopsis* Mayr, which had long been accorded subgeneric rank. Although he cited species under each subgenus he failed to designate any subgenotypes. I undertook to supply this omission in 1913.[3] In 1914 he issued a more extensive account of his subgenera,[4] increased their number to 24, and appended an extensive list of the known species. In this paper he cited a type for each subgenus but paid no attention to my designations. It happened, however, that in all but eight of the subgenera we had selected the same species. Now Emery[5] has issued a most painstaking study of the genus and has increased the number of subgenera to 34, excluding the monotypic *Phasmomyrmex* Stitz, which he has elevated to generic rank. He has also established a new genus, *Notostigma,* for three Australian species (*carazzii, foreli* and *podenzanai*); two of which were formerly included by Forel in his subgenus *Myrmosphincta.* The outlines of the various subgenera have been more accurately defined, much use has been made of the geographical distribution of the species, and the characters of the male *Camponoti,* which

[1] Saggio di un Catalogo Sistematico dei Generi Camponotus, Polyrhachis e Affini. Mem. R. Accad. Sc. Ist. Bologna (5) 5, 1896, pp. 761-780.

[2] Formicides Néotropiques Part VI, Mém. Soc. Ent. Belg. 20, 1912, pp. 59-92.

[3] Corrections and Additions to "List of Type Species of the Genera and Subgenera of Formicidae," Ann. N. Y. Acad. Sc. 23, 1913, pp. 77-83.

[4] Le Genre Camponotus Mayr et les Genres Voisins. Rev. Suisse Zool. 22, 1914, pp. 257-276.

[5] Le Genre "Camponotus" Mayr, Nouvel Essai de sa Subdivision en Sous-Genres. Rev. Zool. Africaine 8, 1920, pp. 229-260, 1 fig.

no one had seen fit to study heretofore, have been scrutinized. In Emery's classification only five of the subgenera are represented in both hemispheres, whereas 11 include only New World, and 19 only Old World species. Unfortunately, a certain amount of confusion has been introduced by Emery's overlooking my designations of the types of Forel's subgenera. It becomes necessary, therefore, to discuss very briefly the subgeneric names that are affected by this oversight. These are listed in the following paragraphs, together with the cases in which Forel's types are invalidated by my previous designations:

Subgenus *Camponotus* Mayr. When Mayr established the genus *Camponotus* in 1861, he designated no type but placed *Formica ligniperda* Latr., first on his list of species, just as he had placed it first in the genus *Formica* in his work on the Austrian ants (1855). Bingham, perhaps for that reason, selected *ligniperda* as the type of *Camponotus* in 1903, ignoring the fact that Forel and Emery had long regarded this ant as a mere sub-species of *herculeanus* L., which they therefore cite as the genotype. I am not aware that our codes make any provision for such cases.

Subgenus *Myrmothrix* Forel. I designated *Formica abdominalis* Fabr. as the type (1913), but Forel chose *F. rufipes* Fabr. (1914). Both are retained in the subgenus as accepted by Emery.

Subgenus *Myrmolophus* Emery. Emery has split this subgenus off of Forel's *Myrmepomis* and based it on the Neotropical *Formica sericeiventris* Guérin, leaving the remainder of the species, which are African and Malagasy, in *Myrmepomis*. I had designated *sericeiventris* as the type of *Myrmepomis* in 1913, and Forel had cited the Ethiopian *F. fulvopilosus* DeGeer as the type in 1914. As the latter designation is invalid, *Myrmolophus* becomes a synonym of *Myrmepomis*, and it is necessary to replace Emery's name for the Old World species. I propose the name **Myrmopiromis** nom. nov.

Subgenus *Myrmotarsus* Forel. I designated *Formica mistura* F. Smith as the type of this subgenus, whereas Forel selected *F. irritabilis* F. Smith. Both are included in the group as emended by Emery. He includes also *F. quadrisectus* F. Smith, which was cited by Forel as the type of *Myrmophyma*. Since I had previously designated *Camponotus capito* Mayr as the type of the latter genus,

and Forel's designation is invalid, there can be no objection to Emery's procedure.

Subgenus *Myrmosphincta* Forel. I designated the Neotropical *Formica sexguttata* Fabr. as the subgenotype, Forel the Malayan *F. cinerascens* Fabr. Emery has now transferred *sexguttata* to his subgenus *Myrmotemnus* and has retained the name *Myrmosphincta* for the Malayan, Australian and Malagasy species. It is clear that a new name is required for *Myrmosphincta* Emery (1920). I propose **Myrmosaulus** nom. nov.

Subgenus *Myrmophyma* Forel. As already stated, I designated *Camponotus capito* as the type, but Forel selected *quadrisectus*. Emery also designates *capito* as the type. Forel's *Myrmocamelus* becomes a synonym of *Myrmophyma*, because he selected as its type *Formica ephippium* F. Smith, which is merely one of a number of Australian species closely related to *capito*. Thus owing to my prior designation of the type of *Myrmophyma* it is unnecessary for Emery to violate the code of nomenclature (1912), according to which genotypes are stable and cannot be changed.

Subgenus *Myrmosaga* Forel. Here, too, there is a discrepancy in the types selected, as I had designated *Camponotus kelleri* Forel and Forel had selected *C. quadrimaculatus* Forel. Both are included in the subgenus as emended by Emery.

Subgenus *Myrmentoma* Forel. This subgenus, established by Forel in 1912, was in 1914 regarded by him as a synonym of Ashmead's *Orthonotomyrmex* (1906). I had designated *Formica lateralis* Olivier as the type of *Myrmentoma* in 1913, and Forel had designated the same type for *Orthonotomyrmex* in 1914, overlooking the fact that Ashmead had designated *Formica sericea* Fabr. Emery has resuscitated *Myrmentoma* and defined it and *Orthonotomyrmex* more precisely.

Subgenus *Myrmepomis* Forel. See *Myrmolophus*, above.

Subgenus *Myrmacantha* Emery. This is a synonym of *Myrmorhachis*, for in 1913 I designated as the sub-genotype of the latter the Ethiopian *Camponotus polyrhachioides* Forel, which is closely related to *C. aberrans* Mayr designated as the type. Forel in 1914 selected the Neotropical *Camponotus latangulus* Roger as the type of *Myrmorhachis*. Since Emery restricts the latter name to the American forms it becomes necessary to replace it by a new term.

I propose **Myrmocladœcus** nom nov., since all or nearly all the species live in hollow twigs.

Subgenus *Myrmamblys* Forel. Here, too, difficulties arise owing to the fact that Emery has restricted the name to American species, I designated an East Indian species, *Camponotus reticulatus* Roger as the type (1913), but Forel selected a Neotropical form, *C. fastigatus* Roger. As Emery has placed *reticulatus* in *Myrmotemnus,* the latter would seem to be a synonym of *Myrmamblys* Forel (1912 and 1913), and the selection of a new name for *Myrmamblys* Emery (1920) is made necessary. For this I propose **Neomyrmamblys** nom. nov. I have already explained why the small group of American species including *sexguttatus* must be retained as *Myrmosphincta* Forel (*vide supra*).

Subgenus *Myrmorhachis* Forel. Discussed above in connection with *Myrmacantha* Emery.

Subgenus *Myrmeurynota* Forel. I designated *Camponotus eurynotus* Forel as the type of this subgenus but Forel cites *C. gilviventris* Roger. Both are included in Emery's list of species.

Subgenus **Manniella** subgen. nov. I propose this name for the small group comprising the Cuban *sphaericus* Roger (subgenotype) and its subspecies *sphaeralis* Roger. Mann has recently discovered and described the maxima worker of these forms.[6] Both Forel and Emery include them in *Myrmeurynota,* whereas Mann assigns them to *Colobopsis.* The structure of the head, pronotum, etc., of the large worker is so aberrant that they cannot be included in these subgenera, nor in Emery's *Hypercolobopsis, Pseudocolobopsis* nor *Paracolobopsis.*

The changes suggested above increase the number of subgenera of *Camponotus* to 36.

[6] Additions to the Ant Fauna of the West Indies and Central America. Bull. Amer. Mus. Nat. Hist. 42, 1920, pp. 403-439, 10 figs.

A REVIEW OF THE AMERICAN SPECIES OF THE GENUS PALLOPTERA.

By Charles W. Johnson,
Boston Society of Natural History, Boston, Mass.

In a recent study of the species of Palloptera, including the type of *P. jucunda* Loew, in the Museum of Comparative Zoölogy, it seemed that some discrepancies existed that should be corrected. Prior to Dr. A. L. Melander's paper[1] no figures accompanied the original descriptions, and this may account for some of the errors. A comparison of the figure of the wing of *P. jucunda* by Melander with the type shows a marked difference (although the series of *P. jucunda* shows some variation) and is apt to be misleading, especially since there is a much larger species having practically the same wing pattern as that figured for *P. jucunda*. The wing figured as *P. jucunda* in Williston's Manual of North American Diptera, 3d edition, page 80, is *P. superba*. I have been unable to find an American species agreeing with the European *P. arcuata* Meig. It was determined by Coquillett and recorded from Mt. Washington, N. H., by Mrs. Annie T. Slosson, but none of the specimens I have collected there and at Mt. Desert, Me., agree with that species. Submitting a sketch of the wing of a specimen taken at Base Station, Mt. Washington, to Mrs. Slossom, she writes: "I have looked up the unique specimen of *P. arcuata*. It is in poor condition, abdomen missing, but wings perfect. They are exactly like your figure, clouded at the tip, not extending along the costa."

Table of Species.

1. Cross-veins not bordered with brown, auxillary and first vein, and apex of wing brownish; thorax grayish-pollinose. *terminalis* Loew.

   Only the posterior cross-vein and tip of the wing bordered with brown; thorax yellow (Fig. 1) ..... *subarcuata* sp. nov.

   Both of the cross-veins, tip of the wing, and costal margin partly or entirely bordered with brown 2

[1] Psyche, 1913, Vol. 20, p. 80, pl. 3, figs. 16-21.

2. Costal margin interrupted and the brown clouding of the anterior cross-vein not connected.....3
   Costal margin broad and continuous, covering the anterior cross-vein 4
3. First and auxillary veins brown only at the costa, leaving the base and middle of the costal margin hyaline; length 4 mm. (Fig. 2).....*jucunda* Loew
   First and auxillary veins included in the brown costal margin; first and basal half of the second costal cell yellow; length 7 mm. (Fig 3).....*albertensis* sp. nov.
4. Thorax and abdomen largely cinerous-pruinose; abdominal segments setose; four rows of acrosticals; wing pattern resembling *similis;* length 3.5 mm. .....*setosa* Mel.
   Thorax and abdomen shining yellow, brown of the posterior cross-vein not connected with the costal margin; abdominal segments narrowly margined with black, setæ small; length 6 mm. (Fig. 4).....*similis* Johns.
   Thorax and abdomen yellow, subshining; thorax with two pruinose subdorsal stripes; brown of the posterior cross-vein connected with the costal margin; abdominal segments with large marginal setæ, arising from black spots. .*superba* Lœw.

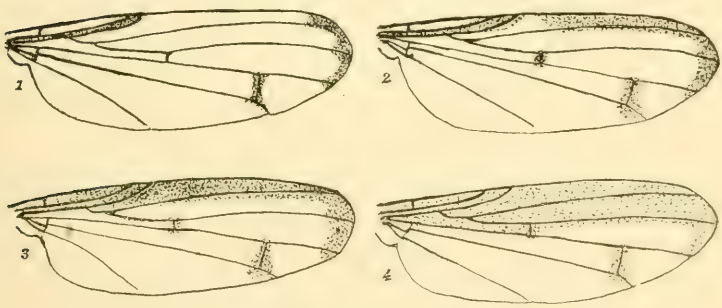

Fig. 1. Wings of Palloptera.

Palloptera subarcuata sp. nov. (Fig. 1).

P. arcuata Slosson, Ent. News, 1895, vol. 6, p. 7 (determined by Coquillett) and Johnson, Psyche, 1910, vol. 17, p. 233 (not Meigen).

Male. Front yellow opaque, vertical margin, frontal orbits, face

and lower half of the occiput whitish, ocellar triangle black, first and second joints of the antennæ yellow, third brownish, arista brown and pubescent. Thorax and scutellum yellow, shining, with fine brown hairs, one prominent dorso-central and four large marginal scutellar bristles. Abdomen yellow, third, fourth, and fifth segments brown. Legs including the coxæ light yellow, halteres yellow. Wings hyaline, first veins but slightly clouded, tip of wing and posterior cross-vein broadly clouded with brown. Length, male 4.5 mm., female, including ovipositor, 5 mm.

Seven specimens. Holotype, Bar Harbor, Me., Aug. 10, 1920 (C. W. J.). Allotype, Northeast Harbor, Me., July 1, 1909 (Dr. C. S. Minot), and two paratypes, Bar Harbor, Aug. 15, and Base Station, Mt. Washington, N. H., Aug. 15, 1916 (C. W. J.), in the collection of the Boston Society of Natural History. Paratypes are also in the Museum of Comparative Zoölogy, U. S. National Museum, Mrs. Slosson's and the author's collections.

Palloptera jucunda Loew (Fig. 2).

In addition to the type locality, Sitka, Alaska, and the localities recorded by Melander, I have specimens before me from Parroquet Island, Labrador, July 21, 1887 (S. Henshaw), Mus. Comp. Zoöl.; Midvale, Montana, Aug. 25 (C. E. Brown); Logan, Utah, Sept. 1915 (H. B. Hagan). Cranbrook, B. C., Sept. 12 (C. Garrett).

Palloptera albertensis sp. nov. (Fig. 3).

Front dark yellow, opaque, orbits, face and occiput light yellow, antennæ yellow (third joint wanting). Thorax and scutellum yellow, subshining, with macrochætæ similar to *P. jucunda.* Abdomen yellow, with a narrow black dorsal line expanding toward the top, ovipositor brown, forming about two-fifths the length of the entire abdomen. Legs and halteres yellow. Wings, near the end of the first vein and base of the costal margin, yellowish. Length, including the ovipostor, 7 mm.

One specimen, Calgary, Alberta, Canada, collected by Mr. Owen Bryant.

The larger size, black dorsal line on the abdomen, and heavier

markings on the wings, separate this from *P. jucunda.* The wing figured by Melander resembles this more than it does the typical *jucunda,* yet there are variations of the latter in which the wing markings approach this species. The brown costal margin has a spot of slightly lighter shade just beyond the tip of the first vein, scarcely noticeable to the naked eye. In *jucunda* this spot in the costal margin is usually much larger and hyaline.

Palloptera similis Johnson (Fig. 4).

Since describing this species from Fort Kent, Me. (Psyche, 1910, vol. 17, p. 233), I have taken it on the carriage road, Mt. Washington, N. H., at about 2,500 feet, July 24, 1915. The wing pattern resembles that of *P. setosa* Melander.

SPECIFIC NAMES REPEATED IN THE LINNEAN GENUS FORMICA.

By Carlo Emery,
Bologna, Italy.

My friend Mr. Donisthorpe published, nearly three years ago,[1] an article on a well-known list of ants from the environs of Nice, inserted by Leach in 1825 into the "Zoölogical Record." Mr. Donisthorpe has been no more successful than myself in solving the enigmas which, under the title of descriptions, were submitted by the old English author to his readers.

I should have had no occasion to revert to the matter had not Mr. Donisthorpe decided to replace the name *Formica picea* Nylander (1846) by *F. transkaukasica* Nassonow (1889), because the name *F. picea* Leach antedates *F. picea Nyl.*, and notwithstanding the fact that both insects, in our present nomenclature, have been placed in very different genera.

To be consistent, however, it would be necessary to change many other names, and, not to go beyond the list of Leach's names, also the following:

F. affinis Leach (1825), Myrmicinarum genus? and *F. affinis* Le Guillou (1841), *Polyrhachis,* have priority over *F. affinis* Schenck (1851), *Lasius.*

F. testaceipes Leach (1825), Myrmicinarum genus? has priority over *F. testaceipes* F. Smith, *Camponotus.*

There are, I believe, certain principles which should be applied only *cum grano salis, i. e.,* only when they are practical and useful, and should be abandoned when they merely create embarrassment and confusion. Such is the principle of priority in zoological nomenclature, which certain entomologists have pushed to most regrettable extremes.

For my part, I shall continue to designate *Formica picea* by the name which was applied to it by Nylander in 1846; *Lasius affinis* Schenck and *Camponotus testaceipes* F. Smith, by the names consecrated by the usage of more than half a century, and I count

[1] The Entom. Record, Vol. 30, p. 8-9 (1918).

on the assent of the majority of entomologists, at least in continental Europe.

I have carefully gone over the seventh volume of the "Catalogus Hymenopteronum" of Dalla Torre, in quest of names of the Linnean genus *Formica* which have been repeated, and have found the following interesting particulars:

F. longipes Latr. (1802), *Pheidole,* has priority over *F. longipes* Jerdon (1851), *Plagiolepis,* and *F. longipes* Gerstæcker (1858), *Camponotus.* Through my attribution of Latreille's species to the genus *Pheidole, Ph. longipes* Pergande will have to take the new name, *Ph. grallipes,* proposed by Wheeler.

F. pilosa Olivier (1791), synonym of *Camponotus fulvopilosus* De Geer, has priority over *F. pilosa* F. Smith (1857), *Camponotus* (*Colobopsis*) = *Colobopsis pubescens* Mayr (*nec* Fabricius) = *C.* (*Colobopsis*) *leonardi* Emery (1889). This species should take the latter name.

F. pallens Le Guillou (1841) = *Camponotus* sp., near *chloroticus* Emery, has priority over *F. pallens* Nylander (1849), *Camponotus.* The latter should take a new name. I propose *C. nylanderi.*

F. thoracica Olivier (1791), genus? has priority over *F. thoracica* Fabricius (1804), *Camponotus.* This case is identical with the homonymies of Leach's species and of subsequent authors, noted at the beginning of this article. I therefore propose that *C. thoracicus* Fabr. be retained.

Nearly the same state of affairs is encountered in the following cases:

F. abdominalis Latreille (1802), genus? Formicinarum seu Dolichoderinarum, and *F. abdominalis* Fabr. (1804), *Camponotus.*

F. badia Latreille (1802), *Pogonomyrmex,* and *F. badia* F. Smith (1857), *Camponotus.*

F. carinata Fabricius (1804), *Polyrhachis,* and *F. carinata* Brullé (1840), *Camponotus.*

F. erythrocephala Fabricius (1775), *Leptomyrmex,* and *F. erythrocephala* Christ, *Camponotus.*

F. fervens Drury (1782), *Atta,* and *F. fervens* F. Smith, *Camponotus.*

F. foetida Linne (1758), Olivier (1791), *Neoponera, F. foetida*

De Geer (1773), Myrmicinarum genus, and *F. foetida* Buckley (1866), *Forelius.*

F. incisa Schenck (1852), *Lasius,* and *F. incisa* F. Smith (1858), *Formica?*

F. nana Latreille (1802), *Pheidole, F. nana* Jerdon (1851) = *Tapinoma melanocephalum,* and *F. nana* F. Smith (1858), *Camponotus.*

F. nitida Razoumowsky (1789), genus? and *F. nitida* F. Smith (1858), *Camponotus.*

F. vagans Olivier (1791), *Eciton,* and *F. vagans* Jerdon (1851), *Prenolepsis.*

These examples will suffice, I believe, to prove the inadvisability of changing the names of these ants, merely because they were classed, at the time of the publication of their descriptions, in the Linnean genus *Formica,* though at the present time relegated to the most diverse genera and even to different subfamilies.

There are also other names which are repeated twice or several times by ancient authors in the genus *Formica,* but as they furnish material for no discussion of interest, I pass over them in silence.[1]

[1] For example:
F. bicolor Fabricius (1793), Latreille (1798), Leach (1825), Schilling (1858).
F. megacephala Fabricius (1793), Leach (1825), Losana (1834), etc., etc.

MONECPHORA BICINCTA (SAY) IN NEW ENGLAND.

By Albert P. Morse,
Wellesley College, Wellesley, Mass.

The black frog-hopper or spittle-bug, *Monecphora bicincta* var. *ignipecta* Fitch, is a common insect locally in New England (Wellesley,—A. P. M.; Dedham and Bridgewater, Mass., and Squam Lake, N. H.—Boston Soc. Nat. Hist.) and I have an example from Harrisburg, Pa. From southern New Jersey (*t.* C. W. Johnson) southward its place is taken by the typical banded form (*M. bicincta*), marked by several narrow transverse vermilion stripes, of which the two crossing the elytra are especially noticeable.

Van Duzee records the species (Cat. Hemipt., p. 509) from sixteen states (Mass. to Iowa, Fla., Tex., also Mex. and W. I.), but does not say which form is referred to.

During the past summer, while collecting orthoptera in Maine, I found the banded form at Norridgewock (Aug. 19) in the central western part of the state, and later took the unmarked variety at Naples, Norway, and several points between there and Norridgewock. Finding that the species was not reported by Prof. Osborn in his life-histories of the Cercopidæ of Maine, I paid more attention to it thereafter, and secured specimens at various additional points in southwestern Maine, including Gorham, Standish, Limington, Lyman, Sanford, Lebanon and Eliot. All were of the unmarked variety.

Why the banded form alone should be found at the Norridgewock locality, and only there (in New England), at the northern limit of the distribution of the species (as far as now known), is as yet an unsolved problem.

An examination of the material at the Museum of Comparative Zoology at Cambridge resulted in finding a single additional example from New England of the banded form, labeled, "Mass., S. Henshaw." Mr. Henshaw tells me that this was doubtless secured in Brookline, Mass., in the early period of his collecting.

So far as my memory recalls in the past, and certainly from

observations made this summer, this insect is associated with the bunch-grass (Andropogon scoparius) and feeds on its sap. This grass is often the dominant species on the sterile, gravelly soils of the coastal plain of New England and is widely distributed in the region inhabited by the insect. Adult insects were commonly observed (Aug. 19 to Sept. 18, 1920) perched upon the flowering stalks one to two feet from the ground. On one occasion the stalk was even plucked and the bug examined through a half-inch lens while still busily sucking, during which time, at irregular intervals (5 to 50 seconds) it discharged from its abdomen tiny droplets of a clear liquid.

Adults have been taken in New England from the last week in July till the latter part of September. They could not be found this year at Wellesley in mid-October, perhaps because the grass stems were then hard and dry. The young stages will probably be found, if looked for, in the leafy tufts that characterize the growth of this grass earlier in the season. All of the New England specimens which I have seen are decidedly smaller in size than those from the South.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

At the meeting November 9th, Mr. L. R. Reynolds spoke of his insect collecting around the City of Mexico, where he spent the last winter. Many of the insects were similar to those of Arizona and southern California, but with them were others of more tropical kinds, as the Heliconid butterflies, which came in large numbers to the garden flowers. Many flying insects were caught in the evening by holding a fine net from a moving street-car. A large beetle larva from cactus is sold in the markets for food. Mr. Reynolds met several local entomologists and visited the collection at the National Museum.

Mr. C. W. Johnson told of a visit last summer to Mt. Desert on the coast of Maine, where he took part in the preparation of a catalogue of the animals of the island. Thus far about 1,400 species of insects have been found at Mt. Desert.

At the meeting of December 14th, Prof. C. T. Brues read a paper on microörganisms living within the bodies of Coccidæ, on which he and Dr. Glaser have lately made some new observations. Some can be cultivated in suitable media outside the body of the insect. Experiments suggest that the growth of these plants modifies the fluids around them in such a way as to promote the digestion of plant juices eaten by the insect and to aid in the rapid changes

Mr. J. H. Emerton spoke of the unusually small amount of which take place during the growth of the eggs.

flying of spiders during the autumn just passed, although there was much pleasant weather.

Mr. L. R. Reynolds demonstrated a method which he uses for mounting small Coleoptera between two pieces of thin glass.

CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p. m. at the Bussey Institution, Forest Hills, Boston. The Bussey Institution is one block from the Forest Hills station of both the elevated street cars and the N. Y., N. H. & H. R. R. Entomologists visiting Boston are cordially invited to attend.

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CONTENTS

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PSYCHE

VOL. XXVIII APRIL, 1921 No. 2

NEW SPECIES OF EMPHYTINAE AND SELANDRIINAE—HYMENOPTERA.

By Alex. D. MacGillivray,
University of Illinois, Urbana, Ill.

The adults of the following new species of Tenthredinidæ were all bred from larvæ. The specimens from New York were collected and bred by Dr. H. Yuasa, and the Maine specimens by the Maine Agricultural Experiment Station at Orono.

Strongylogastroidea depressata sp. nov.

Female. Body black with the following parts whitish: labrum, tegulæ, procoxæ, mesocoxæ, spot on metacoxæ, and trochanters; with the following parts rufous: mandibles, angles of clypeus, distal three or four segments of the antennæ, legs beyond the trochanters except the metatarsi which are fuscous to black, abdominal segments three and four, terga and sterna, and saw-guides in great part; third segment of antennæ distinctly longer than fourth and not as long as fourth and fifth together; clypeus very shallowly emarginate; ocellar basin deep with vertical walls, surrounding median ocellus, extending between antacoriæ; median fovea obscure; surface of ocellar basin and its bounding walls finely punctate; postocellar area polished; mesoscutellum with lateral portions coarsely punctate; saw-guides with dorsal margin concave and ventral margin convex, distal end bluntly rounded; wings hyaline; veins including costa pale, stigma infuscated. Length 7 mm.

Habitat: Orono, Maine. Sub. 39.

This species is similar to *unicincta* Nort. The black collar, the pale femora, and the difference in the saw-guides will separate them.

Emphytus yuasi sp. nov.

Female. Body black with the following parts white: clypeus, labrum, mandibles in great part, tegulæ, collar, ventral half of

mesopleuræ and extending over mesosternum, coxae, trochanters, femora except distal ends of mesofemora and metafemora, more or less suffused with rufous, tibiæ except narrow band on caudal margin and a ring at the distal end, protarsi and mesotarsi except narrow band on caudal margin, narrow band on proximal end of basitarsi of metatarsi, ventral aspect of abdomen, and caudal tergum except at sides; mesal portion of terga with a yellowish mark, largest on second to fifth, extending along caudal margin; clypeus deeply squarely emarginate; third segment of antennæ distinctly longer than fourth; antennal furrows broadly rounded, indistinct; ocellar area elevated, ocellar basin a rounded furrow; median fovea indistinct; head punctate below lateral ocelli; oblique depression extending from lateral ocelli toward compound eye; mesonotum polished; wings hyaline, costal and proximal spot on stigma yellowish, veins and stigma black; saw-guides convex on dorsal and ventral margins, distal end obliquely rounded. Length 6.5 mm.

Habitat: Ithaca, New York. No. 171-1.

This species is similar to *apertus* Nort., but the difference in the length of the third segment of the antennæ will separate them.

Unitaxonus Gen. nov.

Front wings with the radial and radio-medial cross-veins distinct, free part of subcosta one apparently wanting, free part of second anal vein present, slightly oblique, located some distance nearer the proximal end of the wing than media four plus cubitus one; hind wings with the free part of radius four and the transverse part of media two wanting, the second anal cell petiolate; antennæ with nine segments; clypeus nearly truncate in the female; the basitarsus of each metatarsus about subequal in length to the four following segments. Type, *Unitaxonus repentinus* MacG.

Unitaxonus repentinus sp. nov.

Female. Body black with the following parts rufous; mandibles, femora, tibiæ, protarsi, mesotarsi, and abdominal segments two to four, including terga and sterna; with the following parts whitish: labrum, tegulæ, procoxæ, distal portion of mesocoxæ, and trochanters; antennæ with third segment distinctly longer than fourth; clypeus faintly broadly emarginate, almost truncate; supraclypeal

area elevated; median fovea broad, shallow, almost obsolete; ocellar basin oval, not deep; head including postocellar area polished; median and lateral lobes of the mesonotum polished, mesocutellum in part punctate; wings slightly infuscated, stigma and costa yellowish infuscated, veins black; saw-guides with dorsal margin straight, ventral margin convex, converging toward distal end, distal end truncately rounded. Length 7 mm.

Habitat: Ithaca, New York. No. 129-1-2.

The male differs only in having the clypeus more deeply emarginate, limited on each side by slight projections and the bottom of the emargination straight.

Unitaxonus rumicis spec. nov.

Female. Body black with the following parts rufous: labrum, mandibles, distal two-thirds to one-half of coxæ, trochanters, femora, tibiæ, protarsi, mesotarsi, and abdominal segments two to four; third segment of antennæ nearly twice as long as the fourth; clypeus only slightly emarginate; median fovea wanting; ocellar basin oval, deep, surrounding median ocellus, limited at ventral end by a round flat area between antacoriæ; head polished; median and lateral lobes of mesonotum polished; mesopleuræ densely setaceous and finely punctate; wings infuscated, costa pale, veins and stigma black; saw-guides with margins straight and distal end broadly bluntly rounded. Length 8 mm.

Habitat: Ithaca, New York. No. 91-2-1.

The length of the third antennal segment and the shape of the saw-guides will separate this species from *repentinus* MacG. Described from a single specimen in poor condition.

Empria cetaria sp. nov.

Female. Body black with the following parts white: labrum, tegulæ, and legs except proximal two-thirds of coxæ, distal third of metafemora, and distal end of metatibæ; metatarsi infuscated; head polished, densely setaceous, punctate with numerous fine calices; clypeus flat, squarely shallowly emarginate, lateral projecting angles bluntly pointed; ocellar basin a shallow shield-shaped depression including median ocellus; median fovea very minute, slight pit-like depression at ventral end of ocellar basin; antennæ with

segments four and five subequal, three distinctly longer than four and not as long as four and five together; head with a convex ridge between antennal furrows; ocellar and interocellar furrows obsolete; mesonotum polished, mesoscutellum with caudal half punctured; saw-guides with dorsal margin concave, ventral margin convex, converging toward bluntly rounded distal end; wings hyaline, veins, costa, and stigma brownish. Length 6 mm.

Habitat: Ithaca, New York. No. 119-1-2.

This species is related to *celsa* MacG., from which it can be differentiated by lack of ocellar and interocellar furrows.

Empria cerina sp. nov.

Female. Body black with the following parts white: labrum in part, collar narrowly, tegulæ, distal ends of femora, protibiæ, mesotibiæ, proximal and distal ends of metatibiæ, proximal end broader than distal, protarsi, and proximal portion of mesobasitarsi; clypeus with a fine mesal ridge and tooth, ventral margin narrow, emargination shallow; antennæ with third and fourth segments subequal, short; ocellar basin shallow, extending between antacoriæ and bearing pit-like median fovea and median ocellus, latter bounded by distinct Y-shaped furrow; ocellar and interocellar furrows distinct; antennal furrows interrupted near middle; postocellar area broader than long; median and lateral lobes of mesonotum polished; mesocutellum finely punctate; wings hyaline; veins brownish, costa and stigma infuscated; saw-guides with dorsal margin straight, ventral margin convex, rapidly converging to obliquely, bluntly pointed distal end. Length 6 mm.

Habitat: Ithaca, New York. No. 107-5-2 and 107-3.

This species can be separated from *canduca* MacG. by the shallow emargination of the clypeus and the form of the median fovea.

Thrinax pullatus sp. nov.

Male. Body black with the following parts rufous: collar narrowly, trochanters, femora, tibiæ, and tarsi except two or three distal segments of the metatarsi; abdominal terga with caudal portion with a narrow linear yellowish or rufous margin; antennae with third and fourth segments subequal; labrum densely setaceous; clypeus broadly, roundly, shallowly emarginate; median

fovea punctiform; ocellar basin broadly limited by a distinct frontal crest, surrounding the median ocellus; antennal furrows obscure, interrupted near middle of their length; vertical furrows deep, broad, longer than broad; postocellar area with a deep mesal furrow connecting with shallow inconspicuous ocellar furrow; surface of head dull; mesonotum dull, indefinitely punctate or striate; mesoscutellum with distinct furrows on each side, polished on meson; metascutellum polished, impunctuate; mesopleura dull, sparsely sericeous; cerci distinct, short, porrect; caudal margin of caudal sternum rounded; wings hyaline, costa reddish, veins and stigma infuscated. Lenth 8 mm.

Habitat: Ithaca, New York. No. 20-1.

The general appearance of this species, the arrangement of the pale color and the line of the abdominal segments is similar to that of *Strongylogaster politus* Prov. The difference in the coloration of the abdomen will differentiate it from *Thrinax impressatus* Prov.

NEW UNITED STATES ZOOCECIDIA.

By B. W. Wells,

State College, Raleigh, North Carolina.

In the descriptions below, the author has indicated in each case whether the gall is a kataplasma or a prosoplasma. These terms of Küster's pertaining to the lower and higher galls respectively, deserve a prominent place in gall descriptions, for they connote very significant conditions. The writer has pointed out (Botanical Gazette, May, 1921) that these groups have an evolutionary relationship. By "kataplasma" Küster means those indefinite galls whose structure is developed through hyperplasia of embryonic tissue, the end product not becoming in its differentiation, orientation and form of tissues, fundamentally different from the normal plant part; they represent inhibitions of the normal differentiations, the more advanced ones thus approach homogenity. "Prosoplasmas," on the other hand, are definite galls whose structure differs fundamentally from the normal plant part, the tissues

in their form and orientation characters constituting an aggregation of new qualities.

In presenting these descriptions, it is with the hope that these forms may again be collected and the adult stages of the cecidozoons be obtained.

Not until the descriptions of the adults appear should names be attached to galls; in the present paper the forms have been given a number which can readily be referred to by any future investigator. I should like to here repeat a statement made in an earlier paper: "The custom on the part of some, of applying a specific name to an insect or mite, merely on the basis of the intimately associated gall, is to be deplored."

The familiar "catch-all" generic names have been used in those cases in which the nature of the parasitic organism was determined, viz., "Cecidomyia" for an itonidid form, "Cynips" for a cynipidous form, and "Eriophyes" for a mite gall-maker.

The galls herein described and believed to be heretofore unreported, are arranged on the basis of the plant affected. The plant genera are arranged alphabetically, Gray's Manual being followed in the matter of nomenclature.

Amelanchier

Cecidomyia sp. Cecidium nov. Fig. 1.

1. On *Amelanchier canadensis* (L) Mefic., leaf; prosoplasma, appendicular, diverticulum type; stout balloon-shape with attenuate tip, 3-5 mm. long, 2-3 mm. wide, reddish purple, surface, however, with bloom which gives it a bluish tinge; galls commonly found in groups of two, on under side of leaf, each gall tilted out of the perpendicular position; opening in leaf-blade on side opposite the gall, minute, slit-like with definitely raised lips; cavity small in the broader, distal part connected with opening by a relatively narrow canal, walls thick with rather prominent veins; not common, Cedar Point, O. Types in author's collection.

Cecidomyia sp. Cecidium nov. Fig. 2.

2. On intervenal areas of leaf of *Amelanchier canadensis* (L) Medic. (service berry); prosoplasma, sub-ovid, laterally flattened, the sides paralleling the secondary veins, extending from both sides of the leaf, long axis perpendicular to the blade, 2-3 mm. long,

upper side rounded, yellow or red, lower side truncate with slit-like opening, yellowish, surface smooth; monothalamous, chamber in upper half of gall connected with slit-like opening by narrow, flattened canal, walls firm; locally abundant, Hocking Co., Ohio, Cedar Point, Ohio. Types in collection of author.

Amorpha.

Cecidomyia sp. Cecidium nov. Fig. 3.

3. On *Amorpha canescens* Pursh, leaf rachis, leaflet either side or flower stalks; prosoplasma, up-walled type; cone-shaped with truncate ends, more or less curved, when on leaflet, base projects as a rounded prominence beyond the blade, 4-12 mm. long, larger when on leaf or floral axes, galls of leaflets exposed to light distinctly red in color, pubescence similar to that of normal plant; chamber shape conforms to that of gall; fairly common, numerous on particular plants, Manhattan, Kan. Types in collection of writer.

Cecidomyia sp. Cecidium nov. Fig. 4.

4. On *Amorpha canescens* Pursch, leaflet; kataplasma, edge-roll type; revolute leaf edge, yellow, 3-5 mm. long, pubescent like normal leaf; fairly common, Manhattan, Kan. Types in collection of writer.

Albizzia.

Coccid sp. Cecidium nov. Fig. 5.

5. On *Albizzia julibrissin* Durazzini, stem surface; kataplasma; simple, circular elevations with depression in center containing coccid, 5.8 mm. dia., lighter in color than surrounding bark, the color of the new hyperplastic tissue which has become exposed; locally common, Raleigh, N. C. Types in collection of the writer.

The above gall may be found on stems of widely varying age. It may be formed on trunks measuring 7-8 cm. dia. The figure is from a stem measuring 3 cm. in dia. and which is 7 years old.

Azalea.

Coccid sp. Cecidium nov. Fig. 6.

6. On *Azalea nudiflora* (L) Torr., stem surface; kataplasma; simple diamond-shaped elevations with rounded corners with depression in center containing coccid, 1 cm. long, elevation about

2 mm. above twig surface. Surface of raised portion coarsely striate due to splitting of original epidermis; abundant locally, Raleigh, N. C. Types in collection of the writer.

Castanea.

Cecidomyia sp. Cecidium nov. Fig. 7.

7. On *Castanea pumila* (L) Mill., leaf; prosoplasma, asymmetric up-walled type; arises from vein (under side) and curls in toward leaf forming pocket, blade above gall pressed upward forming umbo as seen from above, gall flattened parallel to blade, 4 mm. long, 2 mm. wide, surface same as leaf or lighter; chamber ovoid, wall thick especially on vein side: abundant on certain trees, Carolina Beach, N. C. Types in collection of writer.

This gall is of especial interest for the reason that it is a striking asymmetric variant of the up-walled type. It appears to be produced by an upgrowth from the vein which instead of being equal on all sides of the larva is distinctly one-sided, resulting in the strongly curled or revolute structure observed. I know of no other gall like it in this respect; it constitutes a new fundamental gall type.

A relatively large itonidid larva was constantly present in the galls.

Chenopodium.

Cecidozoon undetermined. Cecidium nov. Fig. 8.

8. On Chenopolium ambrosiodes var. anthelminticum (L) Gray, stem gall; kataplasma; simple fusiform enlargement of the stem, 1–1.5 cm. long, color and texture same as stem, single chamber elongate, relatively large with irregularly pitted walls; not common, Toledo, O. Types in the collection of the writer.

Cunila.

Cecidomyia sp. (?) Cecidium nov. Fig. 9.

9. On *Cunila origanooides* (L) Britt. (Dittany), bud gall, on ends of aborted upper branches; prosoplasma, up-walled type; subspherical, tipped with short point, 2–3.5 mm. dia., green at first early becoming bluish-purple, surface glandular same as leaves, sessile on branch end, invested below by an involucre of a few inconspicuous, foliaceous bracts; chamber large, same shape as gall,

wall thin, similar to leaf in texture though slightly thicker than leaf; few on any one plant. Martin Co., Ind. Types in collection of writer.

This gall was collected by Mr. Chas. C. Deam, to whom I am indebted for its study.

Gleditsia.

Cecidomyia sp. Cecidium nov. Fig. 10.

10. On *Gleditsia triacanthos* L., leaf rachis; kataplasma; simple elongate swelling of leaf rachis, commonly the secondary axes, 5-10 mm. long, about 1 mm. dia., surface same as normal rachis; monothalamous, the chamber a mere capillary tube; not uncommon, Toledo, O. Types in collection of writer.

Grindelia.

Cecidomyia sp. Cecidium nov. Fig. 11.

11. On *Grindelia lanceolata* Nutt. (Rosin weed), a modification of the floral head; kataplasma, rosette type; a mass of overlapping involucral bracts (each external bract much thicker than normal ones), the whole assuming an ovoid shape, 2.4–3.5 cm. long; single chamber at center surrounded by much reduced bracts, elongate-ovoid; one or few galls on single plant, infrequent; Fayetteville, Ark. Types in collection of writer.

The characteristic salmon-covered larva of the Itonididæ with breast-plate was found in the galls.

Fig. 11, left, shows a normal head and a galled one; right, section of affected head.

Grindelia.

Cecidomyia sp. Cecidium nov. Fig. 12.

12. On *Grindelia squarrosa* (Pursh) Dunal, bud gall; kataplasma; sub-globose with attenuate tip or tips representing aborted leaf elements, 5-8 mm. dia., green, very prominent in axils of normal leaves, 1-4 chambers, each elliptical in outline, walls thick of firm, fleshy texture; not common, Manhattan, Kan. Types in the collection of writer.

Hedeoma.

Cecidomyia sp. (?) Cecidium nov. Fig. 13.

13. On *Hedeoma pulegioides* (L) Pers. (Pennyroyal), a simple

inflated calyx; kataplasma, organoid type; calyx slightly inflated to sub-spherical form, 2 mm. dia., segments but slightly differentiated if at all, yellowish, normal nutlets undeveloped. Rather abundant on specimens of pennyroyal seen. Jeffersonville, Ind. 1-4 larvæ present in galls.

Collected by Mr. Chas. C. Deam.

Fig. 13, upper, normal calyx; lower, affected calyx.

Heterotheca.

Lepidopteron. Cecidium nov. Fig. 14.

14. On *Heterotheca subaxillaris* (Lam.) Britton and Rusby, stem gall; kataplasma; simple fusiform enlargement of stem, 3.5–5 cm. long, about 1 cm. wide, epidermis split into elongate diamond-shaped areas concolorous with stem, chamber relatively large, shape of gall. Not uncommon, Arlington, Texas. Types in collection of writer.

Ilex.

Cecidomyia sp. Cecidium nov. Fig. 15.

15. On *Ilex vomitoria* Ait., leaf; kataplasma, leaf-fold type; a simple fold of leaf along midvein with accompanying thickening of part involved, commonly affecting the terminal leaves in which the largest part of the blade is involved, 3-5 mm. long, 2-3 mm. wide, surface same as normal leaf except color is lighter or where exposed to sun, red tinged; Carolina Beach, N. C. (Fort Fisher) occurring on shrubs exposed to ocean; rather common. Types in collection of writer.

Lepidium.

Cecidozoon undetermined. Cecidium nov. Fig. 16.

16. On *Lepidium virginicum* L., stem or root surface; kataplasma; simple, sub-globular, sessile, at stem base or crown of root. .5–1 mm. dia., yellow, smooth; in each gall a yellow-ovoid egg was found (.2 x .15 mm.) enclosed by the homogenous, pith-like tissues of the gall; Arkansas. Types in collection of writer.

The fact that this gall has developed in the presence of the unhatched egg indicates the stimulus to have originated with the adult cecidozoon at the time of oviposition. I was unable to rear the adults and am unable to assign the gall to any group.

I am indebted to Mr. M. R. Ensign for this material.

Fig. 16, left, galls on stem base; right, included egg.

Liatris.

Cecidomyia sp. Cecidium nov. Fig. 17.

17. On *Liatris punctata* Hook., bud gall; kataplasma; subglobular, consisting of a mass of swollen and fused leaves, the ends of some of them projecting distally from the gall, 5-10 mm. dia., 3-5 elongate larval chambers; not common, Manhattan, Kan. Types in collection of writer.

Lobelia.

Cecidomyia sp. Cecidium nov. Fig. 18.

18. On *Lobelia puberula* Michx., stem swelling; kataplasma; simple rather inconspicuous enlargement of stem, variable in length, the maximum being about 10 cm., width varying from 4-5 mm., surface same as normal stem except for presence of a few longitudinal fissures in the epidermis exposing the cortical layer; internally the pith tissue contains a more or less broken, narrow cavity occupied by the larvae which are distributed in a linear series; all tissues of the stem are about equally involved in the hyperplasia. Not uncommon, Raleigh, N. C. Types in collection of the writer.

I am indebted to Mr. I. V. Shunk for the original collection of this material.

Parthenium.

Eriophyes sp. Cecidium nov. Fig. 19.

19. On *Parthenium integrifolium* L.; leaf-blade gall; kataplasma, diverticulum type with trichomes (erineum); extremely variable evaginations projecting either side of the leaf, the smaller ones covered internally and exteriorly with a heavy layer of tomentum made up of slender, twisted, multicellular trichomes, larger pouches often nearly smooth on exterior. Rather infrequent, West Raleigh, N. C. Types in author's collection.

Fig. 19, left, affected leaf; right, two trichomes.

Persea.

Aphid sp. Cecidium nov. Fig. 20.

20. On *Persea Borbonia* (L) Spreng., leaf; kataplasma, leaf

edge-roll type; rather definite local inrollings (upper side) of leaf edge, wall markedly thicker than ordinary leaf, forming definite cavity, galls variable in size, .4–2 cm. long, 3–10 mm. wide, surface smooth, often glaucous, lighter in color than leaf when young, changing to red and finally black when old; abundant, Wrightsville, N. C. Types in author's collection.

Pinus.

Eriophyes sp. Cecidium nov. Fig. 21.

21. On *Pinus echinata* Mill., bud; kataplasma; rosette type; excessive proliferation of stem buds, the leaves either remain massed in the bud condition or develop in a semi-aborted fashion, forming a dense cluster or rosette; intermediate states are of course found; not uncommon, S. E. Ohio, North Carolina. Types in author's collection.

For the first observed material of this form I am indebted to Mr. J. S. Houser of the Ohio Ex. Station. I have repeatedly collected it in North Carolina. In all collections the mites were demonstrated.

Polygonum.

Coleopteron sp. (?) Cecidium nov. Fig. 22.

22. On *Polygonum aviculare* L. (Bird's Knot Weed), internodal swelling; ovoid enlargement of internode (sometimes involving two internodes), 8-13 mm. long, 3-7 mm. wide, green to reddish brown, surface more coarsely striate than normal stem; chamber large, same shape as gall, walls firm; few on plant; Mt. Vernon, Ind. Types in collection of writer.

This gall was collected by Mr. Chas. C. Deam of Bluffton, Ind. Larvæ taken from the galls were tentatively determined as coleopterous by Professor Z. P. Metcalf of N. C. State College. It is to be hoped this insect may soon be successfully reared, for, if it is coleopterous, it will be an interesting addition to the very limited group of gall-making beetles known in America.

Polygonum.

Cecidozoon undetermined. Cecidium nov. Fig. 23.

23. On *Polygonum lapathifolium L.*, leaf edge-roll gall; kataplasma; variable in size and shape, often involving leaf to midrib,

roll very tight, yellow in color, contrasting strongly with normal part of leaf. Common locally, Raleigh, N. C. Types in collection of writer.

In the central region of these galls there constantly occurred a white larva without breast-plate. Whether or not these were merely secondary forms in a possible aphid gall was not determined.

Quercus.

Cynips sp. (?) Cecidium nov. Fig. 24.

24. On *Quercus Muhlenbergii* Engelm., leaf; prosoplasma; broadly crescentic or banana-shaped, attached laterally and sessile on under side of leaf, tips attenuate, 2.5 mm. long, 1 mm. wide, smooth, light green, cavity large ovoid not extending into tips, wall thin; not common, Manhattan, Kan. One specimen, type in collection of writer.

Houard describes a similar gall formed on *Q. toza* of Europe by *Trigonospis bruneicornis* Tav. This form differs, however, in bearing long, straggling hairs.

Cynips sp. Cecidium nov. Fig. 25.

25. On *Quercus stellata* Wang., terminal twig swelling; kataprosoplasma; broadly clavate to ovate, 1-2 cm. long, surface similar to normal twig, bud-bearing, monothalamous with false chamber occurring distal to larval cell and opening exteriorly by constricted orifice, false chamber widest near proximal end, lined with thin layer of hard tissue, larval cell ovoid embedded in woody tissue which consitutes the bulk of the gall; not common, Arlington, Tex. Types in the collection of writer.

Amphibolips sp. (?) Cecidium nov. Fig. 26.

26. On *Quercus marylandica* Muench. at node (originates from bud meristem); prosoplasma, radiate-fiber type; balloon-shaped, 1.5–2.25 cm., long axis, green at first, turning yellow when old, not spotted, smooth; larval chamber connected to peripheral zone by relatively few coarse fibers, outer zone or wall very thick (2-3 mm.) and of pith-like consistency, not shrinking when old; fairly common, Arlington, Tex. Types in collection of writer.

The above is comewhat similar to Amphibolips cooki Gillette. It differs in the absence of the red spots, has a thicker wall, is

never distally nippled and does not shrivel upon drying. The galls remain on the trees for some time after the leaves have fallen and thus are readily observed in the winter.

Cynips sp. Cecidium nov. Fig. 27.

27. On *Quercus stellata* Wang., leaf petiole; prosoplasma; clustered, appendicular; single galls broadly fusiform, angular below through mutual compression, distally round-conic, 4-7 mm. long, 3-5 mm. wide, reddish brown, puberulent; larval chamber in fall minute, .25 mm. dia., walls correspondingly thick, firm, fleshy, outer half more deeply colored (tannin bearing) than inner half; not uncommon, Arlington, Tex. Types in collection of writer.

These galls are most commonly found on the petiole bases of the terminal leaves, where they occur in such masses as to give a striking aspect to the branch end. They dehisce from the trees in late fall, the larva completing its development through the winter and spring.

Rhus.

Eriophyes sp. Cecidium nov. Fig. 28.

28. On *Rhus canadensis* Marsh, leaf; kata-prosoplasma, diverticulum type; irregularly rounded pocket gall, appendicular, under side, 4-6 mm. dia., green to red, on upper side marked by conic depression filled with trichomes; chamber highly branched, opening into depression, trichomes not abundant within; not uncommon, Manhattan, Kans. Types in writer's collection.

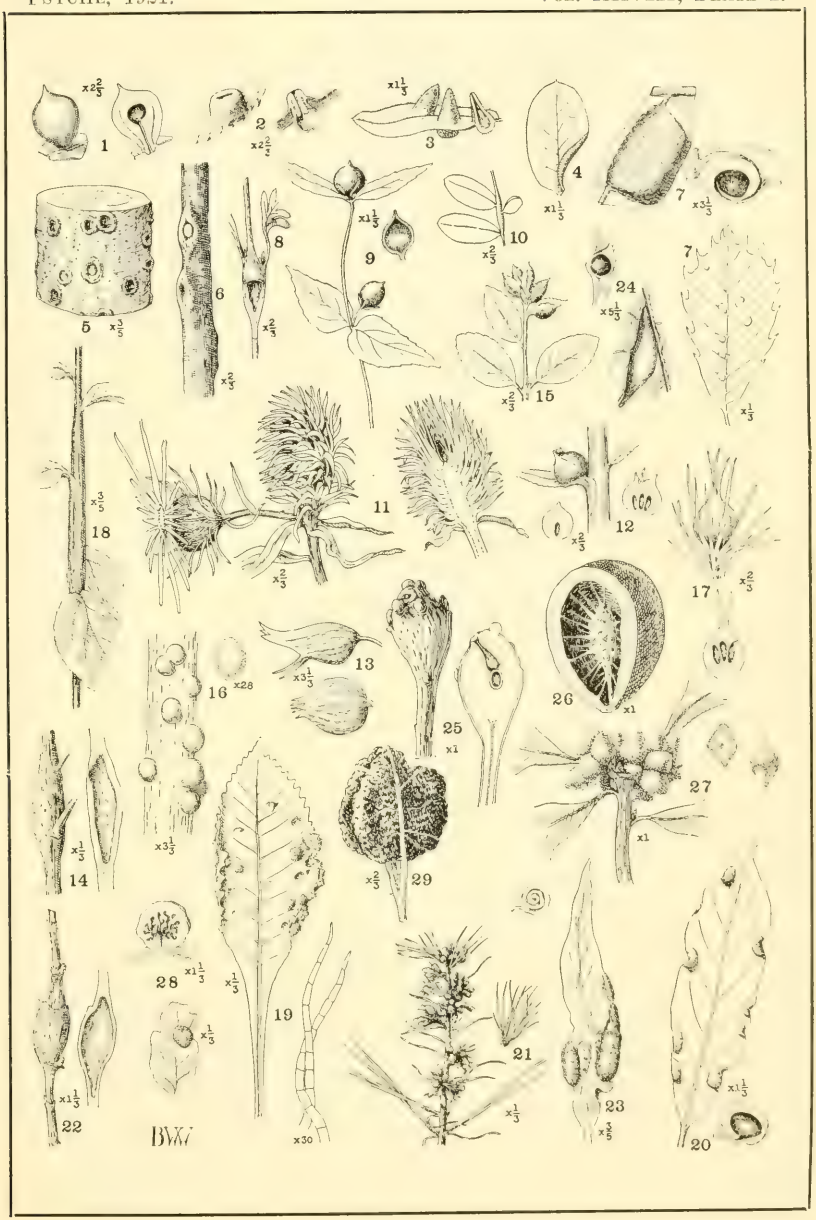
Felt[1] mentions a "cylindric pouch gall" on *R. trilobata* (*canadensis*) from Utah. I have collected this narrow, fusiform type in Kansas. It is sharply and constantly different from the above.

[1] Felt, E. P. Key to Am. Insect Galls. N. Y. State Mus. Bull. 200. 1918.

Solanum.

Cecidozoon undetermined. Cecidium nov. Fig. 29.

29. On *Solanum nigrum* (L.) bud gall; kataplasma, gall consists merely of two highly distorted leaves with their incurled edges tightly appressed, forming a large cavity within. The principal veins are not contorted, this condition being confined to the smaller veins and intervenal tissues which have through slight hyperplasia and hypertrophy grown beyond the normal limits of the principal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19
x1/3
21
x1/3
23
x3/5
20
x1 1/3
22
x1 1/3
x30
BWW

veins. Infrequent; Fayetteville, Ark. Types in collection of writer.

This curious, primitive gall is evidently formed as follows: The larvæ get into the apical region of the developing stem where they are able to interfere with the normal growth of two very young but definitely formed leaves; the embryonic leaves associated with the apical growing point are suppressed and may be observed in the gall as a compact mass of tissue filling the space between the petioles of the leaves involved in the gall proper.

One or two empty pupa cases of the web type were found in the galls.

Tilia.

Cecidozoon undetermined. Cecidium nov.

30. On *Tilia americana* L., leaf; kataplasma; highly irregular wrinkle and distortion of leaf brought about through inhibition of growth of intervenal tissue; the veins become greatly looped and twisted; not common, Cedar Point, O. Types in the collection of writer.

Within the folds of the distorted leaves were found numerous small white larvæ which apparently were the cause of the galled condition; no evidence whatever of the previous presence of aphids was found.

A NEW ABERRANT FORM OF *VANESSA VIRGINIENSIS* DRURY (HUNTERA FABR.).

By Chas. L. Fox.

The museum of the California Academy of Sciences contains an apparently undescribed variety of *Vanessa virginiensis*, which Mr. E. P. Van Duzee, the curator, has turned over to the writer for description.

Vanessa virginiensis var. *ahwashtee* var. nov.

Upper side. Expanse 43 mm. Primaries: Colors as in typical specimens; fulvous, costal margin, apex and broad outer margin

of posterior half blackish; base shaded with olive-brown; apical area marked nearly as in the typical form except that the submarginal line is broader and more suffused; posterior half showing an absence of the black bars found in typical *virginiensis* except for a slight trace in the cubitus$_2$ cell near a submarginal white spot usually found in the typical form. Secondaries: Ground color as in primaries; submarginal row of blue eyelike spots represented by a row of small indistinct white blotches which run into a suffusion of white toward the anterior margin; exteriorly without the submarginal black line found in typical *virginiensis;* fringes as in typical form.

Under side. Primaries: ground color whitish with the olive-brown markings of *virginiensis* much reduced; disk pale apricot-orange, pink in typical form, showing a white spot exteriorly and wanting the black bars of the typical form; base with a double black mark; costa with two black bars, as in *virginiensis.* Secondaries: ground color nearly white; a basal band and two bars on the cell approximate anteriorly, one medial, the other apical, blackish, veined with white; anal area delicately shaded with blackish scales; submarginal eyelike spots characteristic of *virginiensis* much reduced, the anterior almost obliterated; subapical black line heavier than in typical forms; other markings found in *virginiensis* absent.

Described from one male taken by Mr. J. A. Kusche in Golden Gate Park, San Francisco, California, November 11, 1911. Type in collection of the California Academy of Sciences. Named for the Ahwashtee tribe of Indians formerly inhabiting the peninsula of San Francisco.

This variation of *V. virginiensis* corresponds with the form *muelleri* of *Vanessa caryæ* in the markings of the upper surface, while beneath, by its white color, it approaches *Vanessa cardui elymi* Ramb.[1] In the type specimen there is a slight folding of the primaries making the outer margin appear to be too deeply notched below the apex.

[1] This form is quite distinct from var. fulva Dodge and from the aberration mentioned by Mr. H. M. Simms in Entomological News, XXV, p. 33, 1914.

Explanation of Plate II.

Fig. 1. Vanessa virginiensis ahwashtee n. var. Upper side.
Fig. 2. Vanessa virginiensis ahwashtee n. var. Under side.
Fig. 3. Vanessa cardui elymi Ramb.

FOX—*Vanessa.*

NOTES ON THE SOUTH AMERICAN LACTICAS.

By F. C. Bowditch,
Boston, Mass.

In Psyche, volume xx page 127, is given a list of the Lacticas of the Stanford Expedition to Brazil. One of the chief characteristics of the genus as originally laid out, is the transverse groove of the thorax, abruptly terminated by a longitudinal cut; soon, however, forms turned up where this transverse groove was much modified, then were added forms like *thoracica* Jac. where it was almost wanting, and the longitudinal cut only indicated; then *calcarata* Ill. has a well developed spur on the hind tibia (♂ only), then a species appeared with anterior oblique depressions on the thorax (*impressicollis* Jac.), so that the genus as originally planned has been a good deal modified. Among the species undetermined in the above list are:

rubricata Illig., 1 pair, Para.

debilis Har., 1 Madeira Mamore, No. 2219 Thaxter.

trapezophorus Schf., 1 Porto Velho Rio Madeira, No. 2239 Thaxter.

This last species has two foveae on the front and seems rare in collections—though it may be that what seems a fovea is merely the rear of the not uncommon ocular sulcus, covered somewhat by the withdrawal of the head into the thorax.

Lactica brunneipennis sp. nov.

Oblong, medium sized, head, legs and antennæ black; thorax, body below and elytra bright shining reddish-yellow, the latter on either side, with a wide black longitudinal median stripe, starting from the base and extending nearly to the apex, the dark color especially on the disk, being beautifully shaded into the red ground color.

1 (♂) Rio Madeira, Brazil, Mann and Baker, length 4 mm.

Head impunctate on the vertex, and coarsely punctate in the deep ocular sulcus at the rear of the eye, antennæ reaching a little beyond the middle of the elytra, the basal two or three joints more or less red, second joint short, half the length of the third, that

and the fourth about equal, thorax with nearly straight sides and finely punctuate surface, the usual sulci both deep, straight and well defined, elytra very finely and inconspicuously punctulate, and a very obsolete basal depression; the extreme bases of the femora somewhat rufous.

Lactica limbatus sp. nov.

Ovate, small, pale straw yellow, labrum, antennæ (except the base), vertex and neck, and all the edges of the elytra (including the basal and sutural), very dark reddish, piceous black.

♂ and ♀ Porto Velho Rio Madeira, Brabil (Mann and Baker), length 2½–3 mm.

Head finely punctured on the face, very sparsely on vertex, thickly in the ocular sulcus, antennæ 2/3 as long as body, dilute rufous at base, joints 2, 3, 4, increasingly long, thorax with nearly straight sides, surface very finely punctulate, transverse sulcus fairly well marked, the cut-off at the ends as usual better defined and deeper, scutellum pitchy, elytra thickly and finely punctuate, without basal depression, the disk of each elytron of a pale straw color forming a regular oblong spot from base to apex, but not in any place attaining the edges, body below and legs uniformly pale. The elytral markings easily distinguish this form.

Lactica bakeri sp. nov.

Small, elongate parallel, anterior face, antennæ, thorax and legs pale flavous, tinged (especially the latter) with rufous, rear of head, neck and elytra dark violet, body below greenish-black.

5 examples, Porto Velho, Rio Madeira, Brazil (Mann and Beker), length 2¾–3½ mm.

Mouth parts, and antennæ exteriorly, darkened with rufous, vertex with scattered punctures, sulcus of eye more thickly punctate; antennæ reaching a little below the middle of elytra, joints rather stout and flattened, the apex of each joint with stiff hairs, thorax with slightly rounded sides, a few fine punctures on the disk, usual sulci, prominent, deep and straight, elytra parallel, without basal depression sparsely punctulate. The Mexican species *hidalgoensis* Jac. has the same coloration of the elytra but has the head and body below flavous.

Lactica spinifer sp. nov.

Stout, like *calcarata* Ill. or *thoracica* Jac. entirely flavous with black eyes (antennæ except first joint missing), hind tibia with a stout spur-like process (like *calcarata*) placed a trifle behind the middle on the inside.

1 example Chancomayo Thamm (first Jac. coll.), length 4 mm.

Head with a small median fovea, and a few punctures on the front and vertex, thorax sparsely, finely punctulate, sides nearly straight, basal sulcus only moderately deep, the lateral deeply foveate; elytra smooth, polished, sparsely, finely punctulate and with a slight basal depression.

The tibial spur easily distinguishes this form.

In Ann. de Belg. 1893, Mr. Jacoby describes *Lactica thoracica,* a Bolivian form, as having the thorax "without any basal sulcus, the lateral grooves just indicated." My specimen came from Cachabe; it is the best example of the absence of the basal sulcus. Another form with the same characteristic is

Lactica plagiata sp. nov.

Ovate, convex, flavous, palpi, antennæ, legs and breast pitchy black, elytra with a large common blue-black spot from the base to below the middle, leaving a narrow strip of the margin flavous, the rear edge of the spot straight.

3 examples, 2 ♂ 1 ♀, Cachabè l. c. (Rosenberg), length 4-5 mm.

Head with well marked carina between the antennæ, front smooth, except for a few punctures, antennæ reaching below the middle of the elytra, second joint small, the first two joints somewhat testaceous below, thorax with straight sides, smooth and shining above, with a few minute punctures, the basal sulcus barely indicated (it might be called absent), the lateral grooves slightly indented; elytra smooth, convex, lightly punctulate, thickly on the yellow area at the tip. In what I consider the ♀ the hind legs are much more strongly developed than in the ♂ and the apex of the hind tibia is broadened and flattened on the inside. The thoracic structure is almost identical with that of *thoracica* Jac.

Sellata Baly is a well known form, widely distributed in Brazil. A species much resembling it superficially I separate as

Lactica dilatipes sp. nov.

Small, oblong, light straw- yellow, antennæ, except the base, most of the tibæ and tarsi and a common triangular spot on the base of the elytra, dark piceous, hind tibia of ♂ abruptly dilated, inside, near the tip (like some species of Colaspis).

5 ♂ 2 ♀, Salinas Beni R. (Stuart), length 3½–4 mm.

Head with a broad, smooth front, with a few fine punctures, antennæ relatively stout, reaching the middle of the elytra, second joint nearly equal to the third, thorax with nearly straight sides very finely punctulate, sulci well marked, especially the lateral; elytra, smooth, shining, very minutely punctulate, basal depression slight, the dark spot does not cover the scutel, but touches the base in either side, running round under the shoulder, and a straight line across the middle; distinguished from *sellata* by the light legs and dilated ♂ tibia; the punctuation of the ♀ is stronger than the ♂.

Lactica seminigra Jac. P. Z. S. p. 176, is a preoccupied name and should be changed to Rosenbergi. The ♂ hind tibia is distinctly curved and has a large spur-like process on the inside middle, like *calcarata* Ill. In *thoracica* Jac. what I take to be the ♂ has a well marked dilation of the hind tibia close to the tip.

The general shape of the body and the absence or otherwise of the ocular sulcus may be hereafter an aid in the future arrangement or division of the species of this perplexing group.

ON *PARAPERIPATUS LORENTZI* HORST AND OTHER SPECIES OF THE GENUS FROM NEW GUINEA AND CERAM.[1]

By Charles T. Brues.

Mr. Frederick Muir forwarded to me some time ago three specimens of Peripatus collected by Mr. A. F. Pratt in the Arfak Mountains, Dutch New Guinea.

[1] Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 182.

Up to the present time, six species of Onycophora, all belonging to Paraperipatus have been found in New Guinea and the adjacent islands of Ceram and New Britain. In order of their discovery, they are the following:

P. novæ-britanniæ Willey. 1898. New Britain.

P. ceramensis Muir & Kershaw. 1909. Western Ceram.

P. papuensis A. Sedgwick. 1910. Arfak Mts., Dutch North New Guinea.

P. lorentzi Horst. 1910. Wichmann Mts., South Dutch New Guinea.

P. schultzei Heymous. 1912. German New Guinea.

P. stresemanni Bouvier. 1914. Ceram.

With the exception of *P. schultzei* and its variety *ferrugineus,* these have been considered by Bouvier ('14) in an admirable paper which includes a key to species based on type material of *novæ-britanniæ, papuensis, ceramensis* and *stresemanni. P. lorentzi* is included in his table from Horst's descriptions ('10 and '11), but *P. schultzei* is not mentioned.

An examination of the specimens send by Muir shows that they are not *P. papuensis,* the type locality of which is the Arfak Mountains, from whence the examples before me also have come. They agree rather closely with *P. lorentzi,* originally discovered in the Wichmann Mountains which lie to the south of the region occupied by the Arfak range. In spite of the several differences detailed below, I have been forced to conclude that two species, *papuensis* and *lorentzi* occur in the Arfak Mountains. Whether the two species occupy a different level, cannot be stated, as there is no indication of altitude on the label attached to the present specimens. However, *papuensis* occurs at an altitude of 3,500 feet, and *lorentzi* was originally found at 9,000 feet, so that it is very probable that the two do not overlap in their distribution.

The types of *P. lorentzi* were females with 22 pairs of legs. All three of the present species are also females, each provided with 23 pairs of legs. In the types the transverse body folds are of two types, consisting of broad folds bearing mainly large papillæ, alternating with narrow folds, which are supplied mainly with accessory

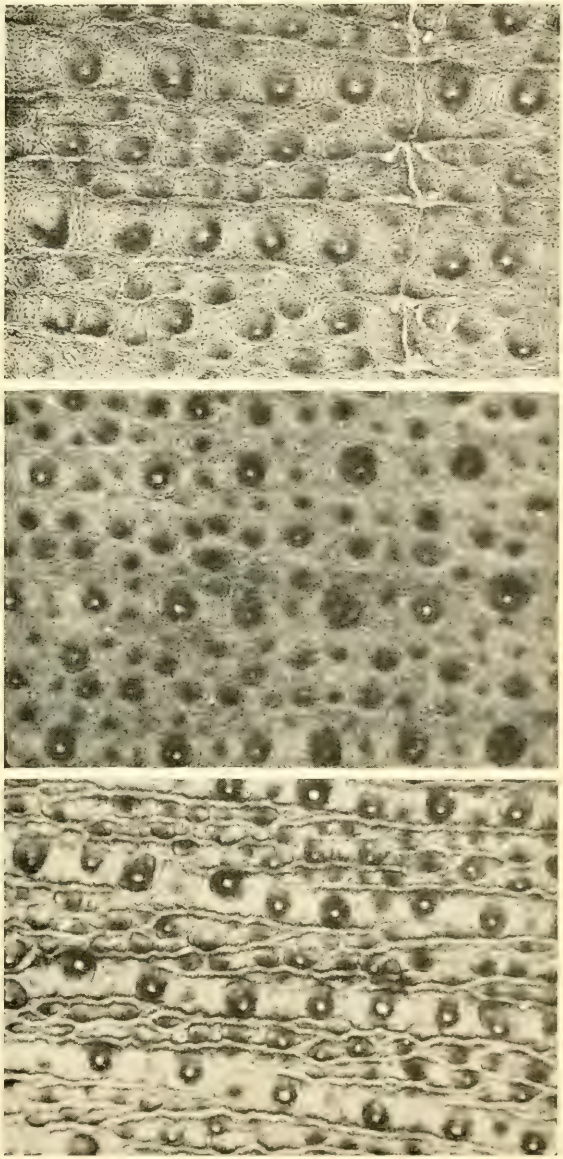
papillæ. There are five or six folds of each kind to a segment, and the narrow ones sometimes divide or may anastomose with the broad ones. In one of the present specimens such an alternation of broad and narrow folds can be seen, but in the others, and particularly in pieces of integument removed from the body and mounted in balsam under a cover-slip, it is seen that the secondary folds are frequently as broad as the primary ones and that they show much irregularity, division and anastomosis. The middle creeping pad of the legs in the types is twice as broad as the first or the third pad, and in the present examples it varies from one and one-half times the width of the first or third. The nephridial tubercle of the fourth and fifth pairs of legs divides the third creeping pad completely in the type and also in the present specimens, although in one individual these tubercles are abnormally small and do not divide the pad.

Aside from these differences, there seem to be no distinguishing features, and it would seem that two distinct forms cannot be distinguished. It is interesting to note that the specimens at hand approach *P. stresemanni* Bouvier from Ceram in having 23 pairs of legs (23-24 in *stresemanni* and 22 in the typical *lorentzi*) and that the width of the second creeping pad on the leg varies from the size given for *lorentzi* to that given for *stresemanni.*

In the case of the Papuan species, as more are being made known, it is evident that the same difficulties are to be encountered in differentiating species as have already become apparent among the American Onycophora.

While it is apparent that *P. lorentzi* in the Arfak Mountain region approaches the Ceramese *P. stresemanni* in the characters mentioned, it seems improbable that the two species are not distinct, although it is evident that they approach one another very closely.

As no photographs of the integument of *P. lorentzi* have been published, I have prepared some from the finely preserved specimens forwarded by Mr. Muir.



BRUES—*Paraperipatus lorentzi.*

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A NEW GENUS OF TERMITE GUEST FROM FIJI.

By Wm. M. Mann,

Bureau of Entomology, Washington, D. C.

The beetle described below, was collected by the writer on several different islands in Fiji, where individuals occur, one or two to a colony, with a termite (Nasutitermes sp.) common throughout the group and found in dead wood. They were running among the host where the latter were gathered thickest, in a manner common to many species of termitophiles, and similar in habits and behavior to our southern species, *Trichopsenius depressus* Lec.

Coleoptera, Staphylinidæ, Aleocharini.

Lauella gen nov.

Male. (Near Perinthus Casey.) Small, moderately slender. Head, small, not constricted at base, broader than long, sides and occiput convex, vertex flattened. Eyes occupying less than half sides of head, glabrous. Antennæ inserted in rather large and shallow foveæ near interior margin of eye; 11-jointed; first joint three times as long as the third, remaining joints sub-equal in length; joints 3-7 cylindrical, 8-11 compressed, the apical more strongly so than the others. Clypeus submembranous, anterior margin straight. Gula subcampanulate. Labrum twice as long as broad, the anterior border strongly, broadly and triangularly excised at the middle. Mandibles acute at the apex. Submentum and mentum not distinctly divided, together large and sub-quadrangular, with the outer angles rounded. Ligula small, strongly excised apically; paraglossæ not visible. Labial palp thick basally; second joint half as broad as the basal; apical joint less than half as broad as the second. Maxillary palp 4-jointed, basal joint short, second and third joints subequal, the apical slender and much shorter than the third. Pronotum broader than long and a little broader behind than in front, sides strongly convex, anterior and posterior angles evenly rounded and not at all projecting. Elytra strongly transverse, nearly as broad and about two-thirds as long as pronotum, sides inflexed as in pronotum. Metasternum broad, episterna narrow; coxæ contiguous. Abdomen narrower at base

than elytra, rather slender and tapering; with six segments visible from above, the first four strongly margined. Legs short and broad; femora and tibiæ rather strongly compressed; femora with short tibial grooves; tibiæ rather broad, tarsi long and slender, 4-jointed on all the legs; claws small.

Fig. 1. Head of *Lauella vitiensis* sp. nov.

ant, antennæ; c, cardo; g, galea; gu, gula; l, lacinia; li, ligula; m, anterior part of mentum (fulcrum); oc, eye; plb, labial palpus; pmx, maxillary palpus; pr, prostheca; sl, labial stipes; sm, posterior part of mentum (sub-mentum).

This genus is near *Perinthus* Casey, of which several species, all of termitophilous habit, are known from tropical America. *Lauella* is distinct in having the antennæ more robust, cylindrical at base, and with only the last four joints flattened (much less strongly than in any species of Perinthus), the eyes are not setose and the anterior border of the labrum is very strongly excised at middle. The legs of Perinthus are much less compressed.

In the male of Lauella the last dorsal segment is broadly and triangularly impressed. In the female seven abdominal segments are visible from above.

Genotype.—*Lauella vitiensis* sp. nov.

Lauella vitiensis sp. nov.

Length 2.50–2.75 mm. (Fig. 1.)

Dark brown, border of abdomen and appendages paler. Head, pronotum and elytra strongly shining, abdomen moderately so. Head, thorax and elytra sparsely and finely punctate; hairs widely separated, long and erect. Abdomen above densely, though superficially punctate; with a covering of fine, short and silky recumbent hairs, most sparse on the dorsum, and a series of long hairs which are suberect on the margins and nearly recumbent on the middle of dorsum.

Head less than half as broad as pronotum. Pronotum about one and one-half times as broad as long, broadest behind, sides little convex. Elytra together twice as broad as long, broadest in front, sides nearly straight, posterior border straight. Abdomen gradually tapering, a little longer than the anterior part of the body.

Described from several specimens taken at Vunisea, Kadavu (type locality); Waquava and Tuvuca, in the Fiji Islands.

The accompanying drawing of the under side of the head and the terminology of the same were kindly prepared by Dr. A. Böving.

NEW DIPTERA FROM TEXAS AND MEXICO.

By Charles W. Johnson,
Boston Society of Natural History.

Lepidostola perpolita sp. nov.

Male. Black, face shining, nearly perpendicular, with a slight middle convexity, sides of the face depressed, the depressions and orbits yellowish pruinose, inferior orbit yellow, frontal triangle shining, the upper angle yellow, in a certain light, a narrow orbital line is seen, expanding and forming a spot on each side, narrowly

separated from the facial depression, vertical triangle prominent, projecting far above the eyes, occiput shining, antennæ yellow, longer than the face, the first joint longer than the first and second together. Thorax black, with a wide band of bright yellow scale-like tomentum between the shining humeri, a wide arcuate band of the same yellow tomentum in front of the scutellum, between the two bands some scattering yellow scales, pleura and scutellum shining, the latter very prominent, conical and slightly pubescent. Abdomen shining, the first and second segments thinly covered with yellowish hairs. Legs black, shining, bases of all the femora and the tarsi (except the last three joints of the front and the last two on the middle and hind tarsi), yellow. Halteres yellow. Wings yellowish hyaline, the veins, stigma and outer third of the wing slightly darker. Squamæ margined with brown, the lower one fringed with long yellow hairs and the upper one with shorter brown hairs. Length 6 mm.

One specimen, Mexico.

Spilomyia texana sp. nov.

Female. Front and face light yellow with a slight brownish facial stripe and a spot on the inferior orbits; vertex and occiput black, and densely pruinose; antennæ yellow. Thorax black, marked with yellow. The humeri fused with large quadrate spots, occupying about two-thirds of the pronotum, leaving a wide black dorsal and transverse band of equal width, the presutural and post-alar callosities yellow, from the latter extend arcuate markings, the ends of which are separated at the suture by the width of the dorsal line of black, a large triangle in front of the scutellum, pleura with spots above the front and middle coxæ, and a large median spot in front of the wing, a large spot is also present on each side of the metanotum, scutellum entirely yellow. Abdomen yellow, the extreme bases of the first to fourth segments black, the median interrupted bands on the second to fourth segments and occupying slightly oblique depressions, are brown, not black. Ventral segments brownish black, margined with yellow. Legs, including the coxæ, yellow, except the outer half of the front tibiæ and all the front tarsi, which are black. Halteres yellow. Anterior of the wing, as far as the fourth vein, clouded with brown, fifth vein widely margined with brown. Length 18 mm.

Round Mountain, Blanco Co., Texas. Allied to *S. hamifera* Loew, and previously looked upon as a variation, but having so many distinguishing characters that it seems worthy of a specific name.

Xylota nebulosa sp. nov.

Male. Face yellow, front brownish, covered with a yellowish pubescence, cheeks brown, vertical triangle and occiput black, shining, antennæ and aristæ black, the third joint round. Thorax bronze black, the humeri whitish pollinose, pleura and scutellum black, somewhat shining. Abdomen black, the first segment shining, the second with two large yellow spots narrowly divided by dorsal line, expanding posteriorly into a large triangle, base margined with black which does not reach the lateral margin, third segment opaque, the side shining, fourth segment metallic green, covered with a yellow tomentum that is longer towards the posterior margin, fifth segment shining black. Venter brownish black, the second segment entirely yellow. Femora and coxæ black, tibiæ and tarsi yellow, the last two joints of the front and middle, and the last three joints of the hind tarsi, blackish, middle of the tibia brown. Halteres yellow. The outer half of the wing clouded with dark brown, base hyaline. Length 9 mm.

One specimen, Texas.

This resembles somewhat the figure and description of *X. paurilla* Will., but the rounded, not elongated, third antennal joint, the less coarctate abdomen and the more heavily clouded wings, readily distinguish this species.

Epiplatea dohaniani sp. nov.

Male. Front brown, opaque, sparsely covered with short black hairs, the entire orbital margins whitish, face yellow, cheeks brown and about two-thirds the height of the eye, occiput brown, covered with short black hairs and whitish pruinose, sharply defined at the cheeks, antennæ yellow, arista dark brown, base yellow. Thorax dark brown with short black hair, macrochætæ as in the genotype

(*E. erosa* Loew), pleura whitish pruinose, scutellum and abdomen dark brown, the fourth and fifth segments blackish. Halteres white. Legs light brown. Wings grayish hyaline with the tip beyond the outer cross-band whitish, the inner edge of this band poorly defined, the middle band extending from the costa (between the ends of the first and second veins), across the posterior cross-vein to the tip of the fifth vein, the inner band extending from the end of the auxiliary across the base of the discal cell to the tip of the anal vein, base of the wing yellow. Length 5 mm.

One specimen, collected by Mr. S. M. Dohanian, at Kelley Field, near San Antonio, Texas, April 27, 1918.

Stegana barretti sp. nov.

Female. Face whitish, cheeks brown, shining, front brownish black, opaque, antennæ brown. Thorax, scutellum and abdomen bluish black, shining, sparsely covered with fine black hairs, humeri and a large spot on the pleura below the base of the wing, snow white. Femora and tibiæ black, tarsi yellow. Halteres yellow. Wings hyaline, with a slight yellow tinge. Length 3.5 mm.

Collected at Amecameca, Mexico, Sept., 1900, by Mr. O. W. Barrett.

A SYMBIOTIC ORGANISM IN FULGORIDS.

By F. Muir,

Hawaiian Sugar Planters' Experiment Station, Honolulu, T. H.

When working on the natural enemies of the delphacid, *Perkinsiella saccharicida*, in Australia, in the latter part of 1919, I found that about eighty per cent of the eggs of this insect in the field were destroyed, and a fungus always present. At first I took the fungus to be the cause of the destruction of the eggs, but upon further investigation, I found that this was not so, and that these eggs were all punctured and their contents sucked up by a Miridi, *Cyrtorhinus mundulus* (Bred.).

Further observations revealed the fact that the young, adults

and eggs of all Delphacidæ contained yeast-like cells very similar to the cells described by Speare in cutworms.* In the adult female *Perkinsiella* these organisms clustered around certain parts of the ovarian tubes and evidently penetrated the walls and entered the eggs where they could always be found congregated in a round mass at the posterior end of the egg. They appear to be held together by a viscid substance, for under a little pressure they flatten out and return to a sphere when the pressure is released. With greater pressure the ball bursts and the cells are dispersed. After the eggs are laid, this mass becomes reddish, due to minute red bodies; during development it works up to the anterior end of the egg and breaks up. Most of the cells appear to be thrown out of the embryo and lie under the egg cap, but a number remain within the embryo and multiply by end-building. After the young leave the egg-shell, the cells remaining within the shell germinate, develop hyphæ, and, if the conditions be favorable, fructify in a similar manner to *Sorosporella uvella* described by Speare.

All the species of Delphacidæ that I examined in Australia contained this organism, but in no species of Ciccadellidæ could I find any. All species of Hawaiian Delphacidæ so far examined contain them, and also *Siphanta acuta,* an introduced Australian fulgorid.

It appears that this organism is in no way inimical to its host. Perhaps it is beneficial, helping it to digest the starches and sugars which form a large percentage of its food.

This note is published in the hope that some student of mycology will make further investigations, work out the life history and identify the fungus.

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* Jour. Agri. Research XVIII. 8, 1920, pp. 399-440.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

The annual meeting was held January 11th. The Secretary reported 11 meetings during the year, with average attendance of 22. Eleven members were elected and the present members number 81. The Treasurer's report showed that $923.28 had been paid for the publication of Psyche, and $943.06 received from subscribers. $58.00 had been received from assessments and $56.42 paid for general expenses. The editor of Psyche reported that the magazine had been reduced in size and 161 pages published, with a small number of illustrations which had been paid for by contributors.

The following officers were elected for 1921:

President .....Nathan Banks.
Vice-President .....L. R. Reynolds.
Secretary .....J. H. Emerton.
Treasurer .....F. H. Walker.
Executive Committee.....C. A. Frost, A. P. Morse, P. G. Bolster.

Prof. Brues, who had attended the entomological meetings of the American Association for the Advancement of Science at Chicago, gave an account of the proceedings. Prof. Wheeler gave an account of a visit to the entomologists at the University of Illinois.

Mr. A. P. Morse showed several grasshoppers and froghoppers especially abundant on the grass, *Andropogon scoparius,* widely distributed along the sea coast.

Mr. R. H. Howe, Jr., showed a diagram of the elevations of land in New England used for plotting the vertical distribution of insects.

Mr. Varás who had attended club meetings for the past three years and was about to return to his home in Chile, asked for correspondence and exchange of specimens.

CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p. m. at the Bussey Institution, Forest Hills, Boston. The Bussey Institution is one block from the Forest Hills station of both the elevated street cars and the N. Y., N. H. & H. R. R. Entomologists visiting Boston are cordially invited to attend.

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CONTENTS

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PSYCHE

VOL. XXVIII JUNE, 1921 No. 3

MUSCULATURE AND MECHANISM OF MOVEMENT OF THE TARSI IN APHIDS.[1]

By Leopoldo B. Uichanco,
College of Agriculture, University of the Philippines,
Los Baños, P. I.

The present work is an attempt to determine the muscles responsible for the movement of the tarsi in aphids. The manner of articulation of the first tarsal segment on the tibia and the mechanism of movement of the tarsi are discussed in some detail.

Material and Methods.

The form used was *Myzus persicæ* Sulzer. Like many other aphids, this species is a very favorable subject for anatomical study of the appendages on account of the semi-transparent condition of the integument, which renders the interior more or less visible, even in the living specimen. Two series were studied: (1) living material and (2) balsam preparations *in toto*. For the study of the living insects, both nymphs and adults, mounted in aqueous or saline media, were used. In these it was possible to follow the movements of the tarsi under both the 16-millimeter and the 4-millimeter objectives of an ordinary Bausch and Lomb microscope fitted with a No. 10 ocular. The muscle responsible for the movement and its tendons also showed a fairly sharp definition in the fresh, unstained preparations. Amputated legs were likewise studied, although not used as a basis for the investigation of tarsal movements for the reason that the operation might have brought about conditions which would tend to produce abnormal reflexes. A more careful preliminary anatomical study was made of fresh specimens with the aid of Schneider's acid carmine. This reagent was found to stain the nuclei of the hypodermal cells and the muscle bodies deeply, differentiating them fairly well from the

[1] Contributions from the Entomological Laboratories of the Bussey Institution for Research in Applied Biology, Harvard University. No. 187.

adjoining tissues, which do not take the stain so readily. Balsam mounts were prepared from legs excised above the bases of the coxæ, fixed in Gilson's mercuro-nitric mixture and stained in either Ehrlich's acid hæmatoxylin (12 hours; then differentiated in 70 per cent. alcohol which had been slightly acidulated with hydrochloric acid, and dehydrated) or in alum-cochineal prepared according to Guyer's formula[2] (36 hours; then washed 20 minutes in several changes of water and dehydrated). Alum-cochineal was found to produce more delicate differentiation. Ehrlich's hæmatoxylin also gave good results, but its tendency to stain the material too deeply makes it inferior to the alum-cochineal for preparations *in toto*.

Anatomical Considerations.

Except in size and in some other minor differences, the three pairs of legs are apparently uniformly similar in their anatomical characters. In the absence therefore of any important structural modifications in any of the legs, no attempt is made in the present discussion to treat each of the three pairs separately.

The legs of aphids have two tarsal segments. In the case of *Myzus persicæ* the first segment (Plate IV, figures 1 and 3. *C*) is nearly one-fourth the length of the second (Plate IV, figures 1 and 3. *c*). The former is subtriangular from the lateral aspect, and is produced at the entoproximal[3] margin into two subconical projections, as follows: (1) A longer one, which is subconfluent with the ental wall of the first tarsal segment (Plate IV, figures 3 and 5. *H*). This serves as the base for the insertion of a muscle which by its analogy in function to certain vertebrate muscles will be termed the *extensor tarsi*.[4] (2) A smaller projection which branches from the former at the base and is directed entally with respect to the median line of the insect's body at an angle of about 90 degrees

[2] Guyer, M. F. 1917. Animal Micrology: 9. Chicago.

[3] In this and the paragraphs which follow, such terms as **ental, ectal,** etc., refer to the normal position of the leg with respect to the median line of the insect's body.

[4] In vertebrates, muscles are usually "arranged in antagonistic groups, the action of one being the opposite of its antagonist. Thus there are **flexors** to bend a limb, **extensors** to straighten it. . . ." Kingsley, J. S. 1917. Outlines of Comparative Anatomy of Vertebrates, second edition, revised: 134. Philadelphia.

from the ental wall of the first tarsal segment (Plate IV, figures 3 and 5. *I*). This projection is connected at the apex and sides with the articular membrane (Plate IV, figures 3 and 5. *J*), and will be described presently. The ectal wall of the first tarsal segment is very short, and is broadly and deeply cleft at the proximal margin, forming an outer, round-top, subconical process, which fits rather snugly into a groove at the ectodistal margin of the tibia. This arrangement (Plate IV, figures 3 and 4. *G*) serves as the single hinge on which the tarsus moves, a condition contrasting with that of the adjoining segment, the tibia, since the latter, as pointed out by Woodworth (1908), moves on two hinges, situated on either side at its junction with the femur. At its ento- and lateroproximal sides, the first tarsal segment fits telescopically into the thickly chitinized distal wall of the tibia (Plate IV, figures 3 and 5). When the tarsus is extended, the intervening space is widest between the ental walls of the two segments and narrows down ectolaterally into the hinge. The proximal margin of the first tarsal segment apparently first snugly into the distal rim of the tibia when the former is flexed outward. The cuticular membrane connecting the proximal margin of the first tarsal segment with the distal margin of the tibia (Plate IV, figures 3 and 5. *J*) is a continuation of the cuticula of the leg and is very flexible owing to its being only thinly chitinized. It is widest entally and narrows ectolaterally into the hinge, remotely assuming when stretched a semilunar shape. The darker appearance of a small area immediately adjoining the tarsal projection, which has been referred to above, indicates a marked reinforcement in this region.

As has been mentioned in the foregoing paragraphs, a subconical projection at the entoproximal margin of the first tarsal segment serves as the base for the insertion of the extensor tarsi. This muscle, as far as I could make out, both in the fresh preparations and in balsam mounts, has its origin within the ectal wall of the tibia, near the proximal end of the latter (Plate IV, figures 1 and 2. *E*). The body of the muscle is at the subdistal portion. This is a short, spindle-shaped mass, which is readily distinguishable through the tibial wall in whole mounts (Plate IV, figure 3. *E*).

A short tendon[5] connects it with the projection of the tarsus. The tendon which connects this muscle with the subproximal end of the tibia is relatively much longer and narrowly subfusiform, abruptly expanding subconically toward the point of origin.

It is of considerable interest in connection with the musculature of the tarsi in aphids that the flexor is absent, its function having been taken over by another arrangement which will be described presently. In the more primitive types of insects, as in the Blattidæ, two antagonistic sets of tarsal muscles are present. Miall and Denny (1886) found a flexor and a retractor moving the tarsi of *Blatta orientalis* Linn. The disappearance of the flexor tarsi in aphids must have been the result of degeneration consequent upon the more highly specialized habits of this insect.

The junction between the first and the second tarsal segments has not been satisfactorily studied in connection with the present work. It appears, however, that the two segments are more or less firmly connected by a narrow strip of articular membrane in such a way as to give the second tarsal segment only a very restricted amount of independent movement.

Mechanism of Tarsal Movement.

From an examination of the anatomical structure of the legs, as well as from direct study of their movements under the microscope, it is evident that movement in the tarsal region centers around the first tarsal segment. Apparently, the tension of the highly chitinized wall of the tibia has the tendency to stretch the articular membrane outward, and, since the single hinge is located at the ectal part of the articulation of the first tarsal segment with the tibia, where it offers resistance to the tension of the tibial wall, the tarsus is bent on this hinge at an angle of about 90 degrees. As the extensor tarsi contracts, an upward pull is applied on the entoproximal margin of the first tarsal segment. Pivoted on the

[5] The term **tendon**, as used in the present paper, is applied to the more or less subcylindrical strand of tissue which connects the main body of the muscle with the inner wall of the insect's legs. As used by Woodworth (1908), the word apparently has a different significance. So far as I was able to make out from both his discussion and his figures, it is apparently meant by him to apply to the projection or elongation of the chitinous wall which serves as the muscular insertion.

hinge, the tarsus is stretched medially and becomes extended so as to bring it at an approximately straight line with the tibia. Relaxation of the extensor removes the force which pulls the first tarsal segment at the place indicated, and the tension of the wall of the tibia brings the former back to its original position. It appears, therefore, that the wall of the tibia performs the function of the lost antagonistic muscle of the tarsi in aphids. The movement of the tarsi in either direction is limited by the articular membrane.

As has already been noted, the movement of the second tarsal segment is apparently very restricted, probably to the extent of merely giving the tarsus a certain amount of resiliency when the insect is walking. It has not been observed in the present work to flex to any marked extent either ectally or entally with respect to the first tarsal segment.

Summary.

In certain more primitive insects, two antagonistic muscles move the tarsus. In the aphids, one of these is lost through degeneration or atrophy, only the extensor remaining.

The function of the lost antagonistic muscle is taken over by the walls of the tibia, which, by its tension, has the tendency to flex the tarsus outward at an angle with the tibia.

The tarsus moves on a single hinge, located at the ectal portion of the articulation of the first tarsal segment with the tibia.

The articular membrane limits the movements of the tarsus in either direction.

The second tarsal segment is apparently very restricted in its movement, perhaps to the extent of only giving the tarsus a certain amount of resiliency when the insect is in motion.

Literature Cited.

Miall, L. C., and Denny, A. 1886. The Structure and Life History of the Cockroach (*Periplaneta orientalis*): 77. Fig. 37. London and Leeds.

Woodworth, C. W. 1908. The Leg Tendons of Insects. The American Naturalist, **42**: 452-456.

Explanation of Plate IV.

Details of Legs of *Myzus persicæ* Sulzer.

A. Femur.

B. Tibia.

C. First tarsal segment.

c. Second tarsal segment.

D. Ungues.

E. Extensor tarsi.

F. Hypodermis of tibia.

G. Hinge at articulation of first tarsal segment with tibia.

H. Subconical projection of entoproximal margin of first tarsal segment, serving as base for insertion of extensor tarsi.

I. Another projection of first tarsal segment, connecting with articular membrane.

J. Articular membrane connecting proximal margin of first tarsal segment with distal margin of tibia.

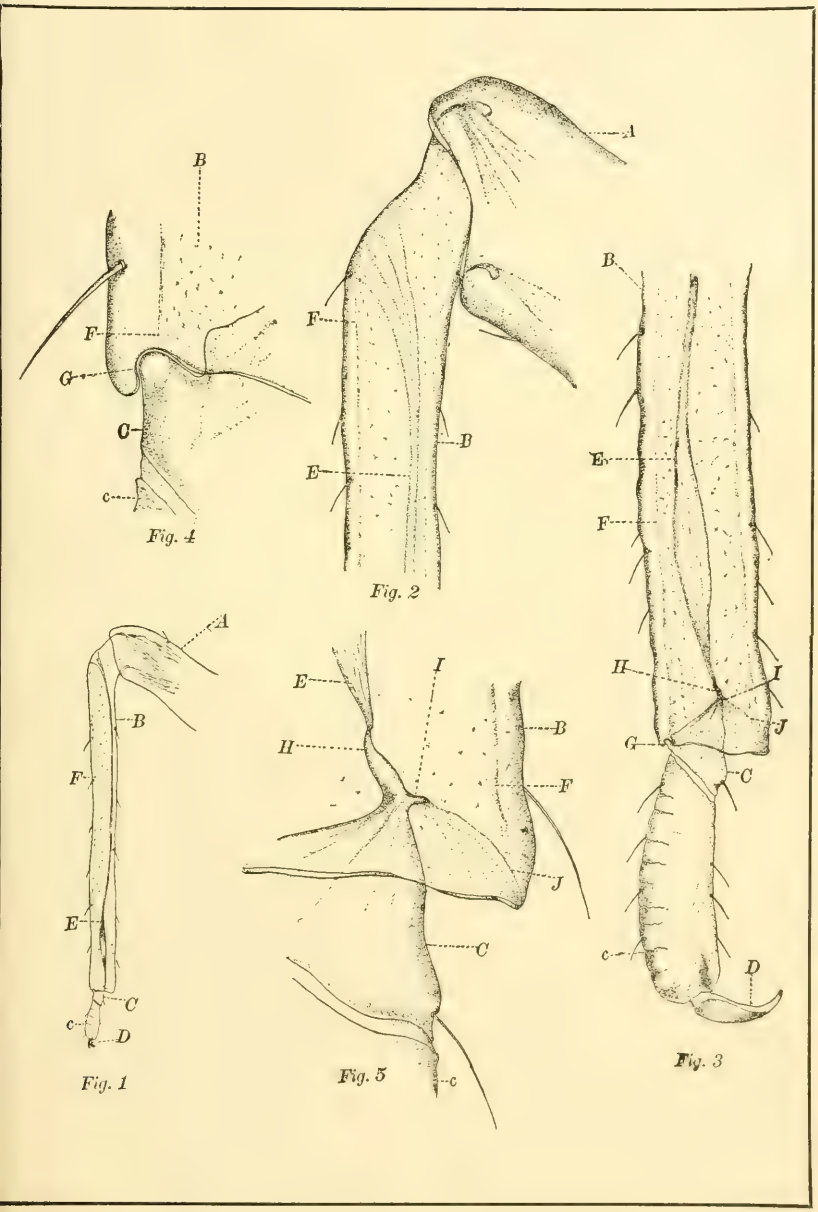
Figure 1. Lateral view of leg, showing relative positions of femur and more distal adjoining segments; muscle and hypodermis. × 85.

Figure 2. Articulation and adjoining portions of femur and tibia, showing origin of extensor tarsi. Lateral aspect. × 350.

Figure 3. Distal portion of tibia and adjoining segments, showing insertion of extensor tarsi; articulation of first and second tarsal segments; hinge of first tarsal segment; and articular membrane. Lateral aspect. × 350.

Figure 4. Ectolateral portion of leg adjoining articulation of first tarsal segment with tibia, showing hinge. Lateral aspect. × 675.

Figure 5. Entolateral portion of leg adjoining articulation of first tarsal segment with tibia, showing articular membrane and the subconical projections at entoproximal margin of the first tarsal segment. Lateral aspect. × 675.



UICHANCO—*Musculature of Tarsi in Aphids.*

DESCRIPTIONS OF NEW ICHNEUMONIDÆ IN THE COLLECTION OF THE MUSEUM OF COMPARATIVE ZOOLOGY, CAMBRIDGE, MASS.

By Henry L. Viereck,
Washington, D. C.

With one exception the following new species are all from localities in Virginia near the District of Columbia.

Ameloctonus xanthocerus sp. nov.

Type.—No. 11182, M. C. Z.

Type-locality.—Great Falls, Virginia, June 5 (N. Banks).

Female.—Length, 7 mm.; ovipositor 1.25 mm.; related to *A. clisiocampæ* Weed, from which it is readily known by the color of the antennæ, the less completely areolated propodeum, etc. Head black, dullish, finely densely sculptured, sericeous with silvery pubescence, temples and occiput between occipital carina and top of head shining and less densely sculptured than the face, facial line : transfacial line :: 25 : 34, axial line : temporal line :: 10 : 6, greatest diameter of lateral ocelli apparently a trifle longer than the ocellocular line, which latter is shorter than the lateral ocellar line which in turn is shorter than the postocellar line which in turn is distinctly shorter than the ocelloccipital line, clypeus truncate, finely granular and indistinctly punctured, mandibles mostly yellow, with brownish teeth, palpi mostly pale, antennæ mostly yellowish stramineous, blackish or black beyond the 10th joint, scape nearly as thick as long, pedicel apparently less than half as long as scape, joint 3 distinctly longer than 4 but shorter than 4+5 and at least three times as long as thick at apex, following joints subequal, joint 27 apparently thicker than long; thorax colored, sculptured and pubescent much like the head, mesonotum sculptured much like the clypeus except where the notauli ought to be where the sculpture is not so fine, pronotum reticulated, laterally striate, mesopleuræ mostly densely reticulated and punctured, the upper half with a striate depressed area and an almost sculptureless streak, scutel sculptured much like the clypeus, metanotum with indefinite sculpture, metapleuræ sculptured and pubescent much like the

lower half of the mesopleura, wings almost colorless with a uniformly distributed brownish tinge, costa blackish, stigma yellowish stramineous, rest of veins brownish stramineous, bullæ whitish, cubitus beyond second transverse cubitus mostly paler than the other veins, areolet petiolate, receiving recurrent vein beyond its middle, the petiole shorter than the shortest side of areolet, wing base yellowish-stramineous, tegulæ mostly yellowish with a pale-stramineous margin, fore and mid coxæ and trochanters pale-stramineous, hind coxæ brownish stramineous, hind trochanters pale-stramineous, rest of fore and mid legs mostly brownish-stramineous except claws and empodia which are more or less brownish to blackish, hind femora reddish-brown, hind tibiæ and tarsi brownish-stramineous with the former darker near the base and at apex than elsewhere, hind claws and empodia concolorous with those of fore and midlegs, claws pectinate; propodeum black, finely sculptured and pubescent with silvery pubescence, exareolate beyond the basal transverse carina, the latter obtusely angulate in the middle, basalarea triangular, apical transverse carina incomplete, propodeum apparently shorter from base to apex, than wide at base, rather rugulose beyond the basal transverse carina, not at all depressed down the middle; abdomen shining, covered with pale pubescence and rather fusiform, truncate at apex, first segment with its basal two-thirds subcylindrical, its apical third convex but broader than thick dorso-ventrally, black throughout, petiole with a fossa on each side, spiracles distinctly nearer to each other than to the apex, second and third sternites yellowish stramineous, second tergite black except for the apical third which is mostly reddish, rest of tergites reddish except the sixth which has a black stain on its basal half above, thyridia rather oval, brownish much nearer the base than to the spiracles and as near the lateral edge as to the base, spiracles of second tergite apparently nearer the base than the apex and not much more than their own width from the lateral edge, sheaths of ovipositor blackish and hardly longer than the apical truncature of abdomen.

Angitia æstivalis sp. nov.

Type.—No. 11183, M. C. Z.

Type-locality.—Falls Church, Virginia, July 4, Aug. 27 (N. Banks).

Other localities.—Glencarlyn, June 30, Great Falls, June 21, Virginia (N. Banks).

Female.—Length 9 mm.; ovipostor 1 mm.; compared with the original description of (*Amorphota*) *Angitia? lawrencei* (Viereck).

This species differs as follows: Very like (*Amorphota*) *Angitia? augusta* (Viereck) in color. Head.—Face indistinctly punctured, clypeus more distinctly punctured, antennæ 36-jointed. Thorax.—Hind coxæ black, hind proximal trochanters mostly black, other trochanters yellowish-stramineous, claws brownish to blackish and pectinate, all of fore tarsi reddish brown, mid onychii blackish, hind tibiæ reddish brown except for a blackish apex and a yellowish base, mid tarsi brownish stramineous, hind tarsi mostly blackish brown, the joints yellowish at base. Propodeum.—Basal area circumscribed, nearly quadrate and nearly as large as the areolet, areola and petiolarea confluent, slightly concave, covered with decussating, conspicuous silvery hairs, costulæ wanting, lateral and median logitudinal carinæ present. Abdomen.—Compressed like a knife blade, black throughout, exserted portion of ovipostor apparently as long as the first tergite. Compared with the original description of *Angitia? augusta* (Viereck). This species differs in its wider cheeks, in its antennæ having more joints, stigma blackish brown. Areolet distinctly petiolate, fore and mid coxæ brownish stamineous, etc.

Campoplex banksi sp. nov.

Type.—No. 11184 M. C. Z.

Type-locality.—Falls Church, Virginia, July 12, at honey dew on tulip tree (N. Banks).

Female.—Length 10 mm.; ovipositor 1.5 mm.; black and sericeous with silvery pubescence; agrees with *C. nigricincta* (Ashmead) in the greatest diameter of lateral ocelli being longer than the ocellocular line, in the quadrate head with outside line of eyes and temples nearly in the same plane, etc., but differs in size, in the mandibles and palpi which are almost entirely black or blackish, in the antennæ which are black except for a brownish edge at apex

of scape and pedicel, in the tegulæ which are stramineous, in the legs which are black or blackish except for the fore tibiæ and tarsi, basal half of mid tibiæ, part of mid tarsi, base of hind tibiæ and hind metatarsi, all of which are pale stramineous or yellowish white, in the propodeum which is rather indistinctly areolated, rugulose and longitudinally channeled, longitudinal carinæ virtually wanting, and the apical transverse carina confused with the sculpture down the middle of the propodeum, in the abdomen which has a yellowish band at apex of first and second tergites, the basal third of the second tergite mostly brownish, second sternite yellowish and brownish stramineous, and in the wings which are broadly margined with a blackish brown stain the lower edge of which is parallel or nearly parallel to the terminal or pale abscissa of the cubitus, stigma and costa blackish, rest of veins blackish-brown, areolet sessile, five-sided.

It gives me much pleasure to dedicate this beautiful species to its well-known collector.

Cryptohelcostizus Cushman.

Judging from the following species this is an atypical member of the Osprhynchotinæ with the spiracles of the first tergite in or before the middle and nearer to each other than to the apex of the tergite. According to Ashmead's classification this genus is related to *Callicryptus* Ashmead, it also has characters in common with *Spilocryptus* as exemplified by *S. extrematis* Cresson.

Cryptohelcostizus dichrous sp. nov.

Type.—No. 11189, M. C. Z.

Type-locality.—Southern Pines, North Carolina, November 3, 1908. (A. H. Manee).

Female.—Length 12 mm.; shiny, black except an almost continuous yellowish line along the eye margin of the head, the reddish abdomen and the deeply infumated wings; axial line : temporal line :: 25 : 10, malar space : width of mandiles at base as 8 : 8 or malar space or width of mandibles at base, each 336 u, anterior third of clypeus in the form of a broad facet, antennæ twenty-five jointed, the terminal joint truncate at apex, face with

distinct punctures that are mostly either adjoining or one or two puncture width apart, non-facetted portion of clypeus punctured much like face, almost impunctate down the middle, shiny and finely sculptured, facetted portion polished or nearly so, pronotum mostly, deeply punctured, striate in and along the deepest portion of the sclerite, dorsulum punctured much like the face, but polished, its notauli deep and ribbed, mesopleuræ sculptured much like the dorsulum, sternauli wanting except for a difference in sculpture evidenced by short vertical striæ, metapleuræ rugoso-punctate, scutel planate or nearly so, rather truncate at apex, areolet pentangular, its inner side formed by the first transverse cubitus, distinctly longer than the next longest side that is formed by the second transverse cubitus, its upper side or second abscissa of radius a little shorter than the outer side, but a little longer than the lower inner side, the latter a little longer than the lower outer side which is the smallest side, nervulus received by the median cell before the basal vein, nervellus broken distinctly below the middle and forming an obtuse angle, fore tibiæ almost club-shaped, as if pinched near base; propodeum shiny, the upper aspect separated from the posterior aspect by the apical transverse carina, upper aspect polished, transversely striate down the middle, punctured laterally, its punctures adjoining or nearly, posterior aspect polished, coarsely reticulate except the upper half of the posterior aspect down the middle; abdomen punctured, its first tergite polished and with its punctures mostly from one to three puncture widths apart, the succeeding tergites a little more closely punctured, shiny and finely reticulated, fifth, sixth and seventh tergites with more or less shallow and indistinct punctures, ovipostor apparently a little more than 3.5 mm. long, its apex with a rather coarse structure.

Allotype.—No. 11189, M. C. Z. Southern Pines, North Carolina, Feb. 5, 1909 (A. H. Manee).

Compared with the description of the type given above this differs as follows: Length, 10 mm.; axial line : temporal line :: 19 : 8, malar space : width of mandibles at base :: 4 : 5, or malar space 168 u, width of mandibles at base 210 u, antennæ 26-jointed, the terminal joint not truncated, but nearly pointed, lower half of

clypeus forming a broad, polished facet, the remainder of the clypeus dullish and sparsely indistinctly punctured; pronotum with faint striæ in the furrow, elsewhere more or less sparsely punctured, first transverse cubitus a little longer than the lower inner side of the areolet or the next longest side, second transverse cubitus a little shorter than the lower inner side, second abscissa of radius : lower outer side of areolet :: 5 : 4, fore tibiæ normal as in *Spilocryptus extrematis* Cress., posterior aspect of propodeum coarsely reticulate throughout; abdomen sculptured much as in the type but not so distinctly.

Holocremnus flaviclypeus sp. nov.

Type.—No. 11185, M. C. Z.

Type-locality.—Chain Bridge, Virginia, June 14 (N. Banks).

Male.—Length 8 mm.; compared with the original description of *H. virginiensis* Viereck this species differs as follows:—Head, black except the face below antennæ, which, including the clypeus is mostly yellow, lower edge of temples yellowish, transfacial line : facial line :: 36 : 33, interocellar space finely sculptured, though not so finely as along the ocellocular line, lateral ocellar line slightly shorter than the ocellocular line, clypeus apparently punctured and granular, scape almost entirely yellow, pedicel yellow beneath (antennæ broken), pedicel nearly one-half the length of scape; thorax, black except for appendages and yellowish tubercles, costa stramineous, stigma and other veins, except bullæ, brownish stramineous, stigma palest, terminal abscissa of cubitus mostly nearly as pale as center of stigma, fore coxæ yellow throughout as are the mid coxæ, hind coxæ black at base and laterally on basal half, elsewhere more or less reddish or yellowish, fore and mid femora yellowish, appendages of fore and mid onychii dark brown or blackish, basal half of their claws pectinate, hind trochanters concolorous yellowish, hind femora reddish, hind tibiæ brownish stramineous except for a yellowish base, hind tarsi yellowish, with darkened tips and darkened onychii, appendages of latter similar to those of fore and mid legs; propodeum, basal area triangular, petiolate, petiolarea transversely rugosostriate, areola mostly indefinitely sculptured; abdomen, distance between first pair of spiracles more

than two-thirds the length of the post petiole, thyridia oval, spiracles of second tergite as near to the apex as to the base, abdomen mostly reddish above, post petiole partly reddish, second tergite with its basal half mostly black, its apex also black, third tergite blackish at base, remaining tergites reddish throughout, plica stramineous, rest of visible sternites reddish though not so dark as the tergites.

Holocremnus virginiensis sp. nov.

Type.—No. 11186, M. C. Z.

Type-locality.—Falls Church, Virginia, June 28 (N. Banks).

Other locality.—Glencarlyn, Virginia, June 24 (N. Banks).

Female.—Length 9.5 mm.; head dullish, covered with silvery pubescence, black and densely sculptured, temples and occiput shining and rather indistinctly punctured, transfacial line : facial line :: 41 : 34, lateral ocellar line distinctly shorter than the postocellar line, interocellar space coarsely reticulately sculptured, contrasting sharply with the fine reticulation along the ocellocular line, lateral ocellar line distinctly shorter than the ocellocular line and apparently as long as the greatest diameter of the lateral ocelli, postocellar line apparently half as long as the ocelloccipital line, eyes slightly concave along the inner margin, malar line distinctly shorter than the mandibles are wide at base but distinctly longer than half the width of the mandibles at base, axial line : temporal line :: 20 : 10, clypeus punctured and partly indistinctly striate, finely sculptured between the punctures, clypeus truncate, mandibles yellow with stramineous lower edge and blackish-castaneous teeth, antennæ black or blackish excepting the scape which is mostly yellowish in front, 37-jointed, scape apparently twice as long as thick, pedicel hardly one-third the length of the scape, joint 3 distinctly longer than 4 but shorter than 4+5 and at least 4 times as long as its greatest thickness, following joints subequal in length except the ultimate joint which is distinctly longer than the penultimate joint, latter joint apparently two and one-half times as long as thick; thorax, colored, sculptured and pubescent much like the head, mesonotum densely reticulated and punctured, in part almost striate-punctate, notauli represented by a more coarsely

sculptured area than elsewhere on the anterior half of mesonotum, pronotum more or less striate all over, mesopleuræ and mesosternum mostly punctured and finely reticulated, the upper half of the former partly striate, partly sculptureless or nearly so, scutel sculptured much like the center of the mesonotum, metanotum coarsely indefinitely sculptured, wings transparent with a uniformly distributed brownish tinge, subcosta blackish, stigma and other veins dark brown excepting bullæ and most of the terminal abscissa of cubutus which latter is brownish-stramineous, areolet petiolate, recurrent vein received distinctly beyond the middle, wing base yellowish, tegulæ yellowish and pale stramineous, fore coxæ blackish brown at base, mostly yellowish, mid and hind coxæ blackish, concolorous, fore and mid trochanters and their tibiæ and tarsi mostly yellowish, fore and mid femora reddish stramineous except for yellowish tips, fore and mid onychiæ brownish, their claws pectinate and blackish, proximal trochanters of hind legs mostly blackish, their distal trochanters yellowish, their femora, tibiæ and tarsi reddish, their claws pectinate and blackish, metapleuræ sculptured like lower half of mesopleuræ; propodeum, mostly punctured and shining, basal area wider at base than at apex and distinctly longer than wide at base, not as distinctly separated from the areola as from the pleural areas, areola and petiolarea confluent and rugosopunctate, costulæ wanting, abdomen reddish, shining except the petiole which is mostly black and almost polished, plica brownish, petiole almost cylindrical, somewhat depressed above, with a fossa on each side, post petiole minutely reticulated and convex, distance between spiracles nearly two-thirds as great as the distance from spiracles to apex, second tergite finely reticulated and punctured, thyridia almost reniform, somewhat nearer to the lateral margin than to the base, spiracle with its diameter equal to the distance between it and the lateral edge of the second tergite, a little nearer to the base than to the apex, rest of abdomen more or less compressed, ovipositor a little longer than the apical truncature. In the paratype the areolet is neither petiolate nor sessile.

Idechthis nigriscapus sp. nov.

Type.—No. 11187, M. C. Z.

Type-locality.—Glencarlyn, Virginia, June 8, 17, 30, July 2, on flowers of *Ceanothus americana* (Nathan Banks).

Other localities.—Great Falls, June 25 and Sept. 24, and Falls Church, Va., June 11, 27 (N. Banks), Plummer Island, Maryland, Aug. 25, 1907 (A. K. Fisher).

Female.—Length 11 mm.; head dullish, covered with silvery pubescence, black and densely sculptured, temples and occiput shining and rather distinctly punctured, transfacial line : facial line :: 44 : 37, lateral ocellar line hardly more than half as long as the postocellar line and apparently a little shorter than the ocellocular line and as long as the greatest diameter of the lateral ocelli, postocellar line apparently a little longer than the ocelloccipital line, eyes slightly concave, along the inner margin, malar line more than half as long as the mandibles are wide at base, occiput extending distinctly behind a vertical plane tangent to the hind ocelli, axial line : temporal line :: 22 : 10, clypeus almost rugoso punctate, with adjoining punctures, truncate, mandibles yellow with brownish stramineous lower edge and castaneous teeth with blackish tips, palpi pale, antennæ black except for the apical edge of scape and pedicel which is stramineous, 44-jointed, scape nearly as thick as long, pedicel apparently less than half the length of the scape, joint 3 distinctly longer than 4 but shorter than 4+5 and at least three times as long as thick, following joints subequal in length except the ultimate joint which is distinctly longer than the penultimate joint, the latter joint apparently one and one-half times as long as thick, thorax colored, sculptured and pubescent much like the head, mesonotum densely reticulated and punctured, in part striato-punctate, notauli present on the anterior third and transversely striate, pronotum more or less striate all over, mesopleuræ and mesoternum mostly punctured and finely reticulated, the upper half of the former partly striate, partly sculptureless, scutel and metanotum more densely sculptured than mesonotum though apparently not more densely covered with pubescence, wings almost colorless, with a uniformly distributed brownish tinge, subcosta and stigma blackish, rest of veins dark brownish stramineous except bullæ which are whitish and the cubitus beyond the second transverse cubitus which is paler beyond its first ninth than its

first ninth, areolet petiolate, the recurrent vein interstitial with the second transverse cubitus, wing base yellowish, tegulæ yellow and pale stramineous, fore coxæ mostly yellow brownish at base, mid coxæ with the basal half mostly black, the apical half mostly yellowish, hind coxæ black except for yellowish tips, all trochanters, fore and mid femora and most of fore and mid tibiæ more or less yellow or yellowish, fore tarsi except onychii, the latter and all of mid tarsi dark brown, hind femora reddish brown, hind tibiæ and tarsi blackish, their spurs stramineous, metapleuræ more closely and finely punctured than the mesopleuræ; propodeum, black, mostly shallowly punctured, shining and covered with silvery pubescence, basal apical and longitudinal carinæ present, the median longitudinal carinæ rather poorly developed, petiolareæ and third lateral area transversely ribbed, abdomen mostly reddish and shining, first segment black, petiole polished and cylindrical, post petiole minutely reticulated and bulbous, the distance from the spiracles to the apex nearly three times as great as the distance between the spiracles, second tergite black except for reddish brown apical margin and subtly sculptured, finely reticulated, thyridia oval, brownish, nearer to the lateral edge than to the middle of the tergite, spiracles of the second tergite distinctly beyond the middle and not as near to the lateral edge as are the thyridia, third tergite with its uper aspect, black and sculptured much like the second tergite, the sides of the third tergite, finely reticulated ,punctured, shining and reddish like the rest of the tergum except for a blackish longitudinal tinge down the middle of the compressed tergum, visible sternites, excepting the first, yellowish, abdomen obliquely truncate, ovipositor at least half as long as the abdomen. The recurrent vein is not always interstitial.

Labrorychus æstivalis sp. nov.

Type.—No. 11188, M. C. Z.

Type-locality.—Chain Bridge, Virginia, June 23 (N. Banks).

Other localities.—Falls Church, June 22, at flowers of *Ceanothus*, Glencarlyn, July 2, Virginia (N. Banks).

Type ♀; length 13 mm.; reddish maculated with black and yellow; head, transfacial line : facial line :: 42 : 35, axial line :

temporal line :: 26 : 12, narrowest space between eyes on front : narrowest space between eyes on face :: 23 : 14, occiput polished and punctured, black with a reddish border, vertex reddish with the interocellar region black, apparently as sparsely punctured and polished as the reddish edge of occiput except for the interocellar area where the punctures are deep and almost adjoining on each side of a median longitudinal fovea, front partly striate, partly nearly as closely punctured as the interocellar area and black except a border along the eye margin which is reddish and not so closely punctured as down the middle of the front, temples mostly reddish and punctured like the sides of the vertex, lower fourth mostly yellowish, malar space almost crowded out, finely sculptured, malar line apparently less than one-fourth the width of mandibles at base, face below antennal line, including clypeus and mandibles mostly yellow, face most densely punctured, clypeus polished, with a few scattered punctures, acutely pointed with its anterior edge stramineous, teeth of mandibles blackish, palpi yellow, antennæ mostly brownish, 10.5 mm. long, 51-jointed, scape almost as thick as long yellowish beneath, blackish above, pedicel mostly blackish nearly as long as scape, third antennal joint curved, blackish beneath and also on its basal half above, elsewhere brownish, joint 3 longer than 4+5 but shorter than 4+5+6, flagel with its apical half mostly blackish like the basal half above; thorax colored, sculptured and pubescent much like the head, prescutum mostly black, more densely punctured than the reddish scapulæ, notauli represented by punctures and rugosities, pronotum reddish with a black stain along the anterior margin, punctured and striate, upper half of mesopleuræ reddish, partly striate, mostly almost impunctate and polished, rest of mesopleuræ and all of mesosternum black and closely punctured, scutel rugoso-punctate, brownish stramineous and distinctly bounded anteriorly and laterally by a distinct carina, metanotum indefinitely sculptured, wings transparent, with a brownish tinge, subcosta and most veins blackish, stigma stramineous, transverse cubitus distinctly longer than the second abscissa of the cubitus, wing base yellowish, tegulæ brownish stramineous and concave, fore and mid coxæ mostly yellow, brownish stramineous at base, hind coxæ reddish except for a black spot on

the inner aspect near the base, fore and mid trochanters yellow, hind trochanters mostly reddish with a blackish stain above, rest of legs mostly reddish or yellowish stramineous, empodia black, claws brownish stramineous, fore and mid tibiæ yellowish-stramineous above, reddish-stramineous beneath, fore tarsi yellowish, mid tarsi with the basal joint yellowish, the remaining joints brownish, hind tibiæ dark brown, hind tarsi pale brown, metapleuræ reticulated, black and reddish; propodeum reticulated, with a black band at base, elsewhere reddish, the neck of the propodeum extending nearly to the apex of the hind coxæ; abdomen mostly reddish and shining, first segment reddish throughout, almost cylindrical and polished, post-petiole planate above, the distance between the spiracles and the apex nearly twice the distance between the spiracles, second tergite blackish above, reddish laterally, subtly sculptured except at base and apex where it is nearly polished, spiracles of second tergite removed from the lateral margin at least as much as three times their diameter, the distance between the spiracles and apex nearly twice the distance between the spiracles, third tergite sculptured much like the second, a little more than half as long as the second tergite with somewhat more than the apical half blackish above, succeeding tergites successively shorter and blacker until the seventh which is hardly exserted, ovipositor distinctly longer than the apical truncature of the abdomen.

Zastenomorpha gen. nov.

According to the latest classification of the Ophioninæ* this genus appears to be related to *Nothanomalon* Szépligeti, from which it may be distinguished by the convex non-carinate scutel and in the second abdominal segment being shorter than the first. Propodeum extending to apex of hind coxæ.

Zastenomorpha lamina sp. nov.

Type.—No. 11190, M. C. Z.

Type-locality.—Great Falls, Virginia, June 16, Oct. 21 (N. Banks).

*Szépligeti, Gen. Ins., fasc. 34, 1905.

Transfacial line or greatest width of head : facial line or greatest distance from top of head to apex of clypeus :: 42 : 32.

Female.—Length 12.5 mm.; head dullish black and densely sculptured, except on the temples and occiput, where it is rather indefinitely pitted and shining, head covered with silvery pubescence, lateral ocellar line shorter than the postocellar line and apparently as long as the ocellocular line and the greatest diameter of the lateral ocelli, eyes distinctly emarginate, malar line apparently not more than half as long as the mandibles are wide at base, ocelloccipital line apparently more than twice as long as the ocellocular line, occiput hardly extending behind a vertical plane tangent to the hind ocelli, axial line or greatest axial diameter of head : the temporal line or greatest diameter of temples :: 21 : 6, clypeus finely granular and punctured, truncate, mandibles black with blackish castaneous tips, palpi mostly pale, antennæ black, 41-jointed, scape nearly as thick as long, pedicel apparently less than half the length of the scape, joint 3 distinctly longer than 4 but shorter than 4+5 and nearly four times as long as thick at apex, following joints subequal in length, except the ultimate joint, which is distinctly longer than the penultimate joint, the latter joint almost exactly as thick as long; thorax, colored, sculptured and pubescent much like the head, mesonotum densely reticulated and punctured, notauli completely wanting, pronotum dorsally rather smooth, laterally striate, mesopleuræ with the upper half mostly almost sculptureless and polished partly punctured and striate, the lower half and the mesosternum granular and punctured much like the mesonotum, scutel and metanotum more densely sculptured than the mesonotum and densely covered with silvery pubescence, metapleuræ sculptured and pubescent much like the mesonotum, wings almost colorless with a brownish tinge that is intensified along the margin of the apical fourth, veins and stigma blackish except bullæ which are whitish and the cubitus beyond the second transverse cubitus which is mostly brownish stramineous, areolet petiolate receiving the recurrent vein beyond its middle, wing base pale stramineous, tegulæ black, coxæ, trochanters and femora mostly black, femora yellowish at apex, fore femora brownish stramineous

above, fore and mid tibiæ and tarsi mostly whitish yellow, fourth, and fifth joints of fore tarsi and third, fourth and fifth joints of mid tarsi brownish to blackish, hind tibiæ black beneath, brownish above, yellowish at base, hind tarsi blackish except at base of hind metatarsi where they are yellowish, claws pectinate and with reddish brown tips; propodeum, black, rugulose, dullish and covered with silvery pubescence, nearly twice as long as broad at base, with a median, shallow, narrow, longitudinal furrow that is transversely striate, with a poorly circumscribed basal area and areola, the latter open at apex, apical transverse carina represented on each side by a short carina, abdomen shining, covered with pale pubescence and compressed like a thin knife blade, truncate at apex, first segment cylindrical with the apical third bulbous, black except the postpetiole which is reddish apically and laterally, spiracles distinctly nearer to each other than to the apex, venter beyond the first segment brownish stramineous, second tergite black except for the basal half which is brownish stramineous on the lateral fourths, thyridia stramineous, cuneiform, nearly one-sixth the length of the tergite, nearly adjoining the lateral edge of the tergite and the apical end of the basal half of the tergite, apical half of second tergite reddish along the lateral edge and with subapical reddish band, spiracles apparently nearer to the apical edge than to each other and almost adjoining the lateral edge, third tergite reddish except a longitudinal black streak above on the basal two-thirds, which streak broadens out toward the base of the tergite, the following tergites reddish except for a blackish tinge along the upper edge of the fifth and sixth tergites, sheaths of the ovipositor blackish and hardly longer than the apical truncature of the abdomen.

THE ORIGIN AND HOMOLOGIES OF THE SO-CALLED "SUPERLINGUÆ" OR "PARAGLOSSÆ" (PARAGNATHS) OF INSECTS AND RELATED ARTHROPODS.

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In several recent papers published in the Fiftieth Report of the Entomological Society of Ontario, the Transactions of the Entomological Society of London, and the Annals of the Entomological Society of America, I have called attention to many current misinterpretations of the homologies of various structures in insects; but since no figures were there given, in which the parts of insects were compared with those of Crustacea and allied arthropods, I would present the following brief consideration of the comparative anatomy of the paragnaths (or "superlinguæ") in insects, Crustacea, etc., as the second of a series of papers dealing with the comparative morphology of insects and their arthropodan relatives, from the standpoint of evolution (the first paper of the series, which deals with the evolution of the mandibles, has recently been published in the Journal of the New York Entomological Society).

During the course of these investigations, it has been a source of continual amazement to me that such patently impossible, and obviously untenable views concerning the interpretation of the mouthparts of insects, as are now current among entomologists, could have gained such universal acceptance in these days of scientific progress, when abundant, and easily-examined material, illustrating the true interpretation of the parts so clearly that the veriest tyro could not mistake them, is available to anyone with enterprise enough to capture a common mayfly naiad (nymph) from the nearest stony brook, and compare it with any common *Asellus* from the nearest pond! That this statement is not exaggerated may be seen, for example, when one compares the much-misunderstood "superlinguæ," "paraglossæ," or "maxillulæ" of an insect, such as the common mayfly naiad shown in Fig. 2 (Plate V), with the corresponding parts in one of the common *Ligyda exotica* (Fig. 1) from the Carolina coast. The ubiquitous *Asellus*

communis, found in almost any pond, would have served equally well for the purpose of comparing the "superlinguæ" (paragnaths) in the two groups of arthropods, but *Ligyda* has a large median lobe, or lingua, which is not developed in *Asellus,* thus making it somewhat easier to compare all of the parts under consideration, in the two groups of arthropods (insects and Crustacea), and on this account, *Ligyda,* rather than *Asellus* is here used for the purpose of comparison.

If the underlip and maxillæ of the mayfly naiad are removed, as in Fig. 2, one may readily observe immediately behind, and between, the mandibles "md", a structure called the *hypopharynx,* which is composed of a median, tongue-like lobe, the *lingua,* "li", and a pair of lateral lobes, "pg", which the entomologists call "superlinguæ", or "paraglossæ" (a term which should be restricted to the outer lobes on either side of the glossæ of the labium). Similarly, in the crustacean shown in Fig. 1, if the underlip and the two pairs of maxillæ are removed, one may observe immediately behind, and between, the mandibles, "md", a hypopharynx (exactly like that of the mayfly shown in Fig. 2) composed of a median, tongue-like lingua, "li", and a pair of lateral lobes, "pg", which the carcinologists call *paragnaths.* In the following discussion, I have applied the carcinologists' term paragnaths, to the corresponding structures in insects, and I have applied the entomologists' terms lingua and hypopharynx to the corresponding structures in Crustacea, and allied arthropods.

The absolutely patent correspondence between the parts of the hypopharynx of an insect (Fig. 2), and a crustacean (Fig. 1), which is so simple and utterly obvious, that it should be evident to anyone possessed of even the rudiments of a knowledge of comparative anatomy, has apparently suffered through its very obviousness and simplicity, for the human mind is apt to regard the obvious with suspicion, as though it were a snare to entrap the careless or undiscriminating observer, and to seek for subtler analogies which appeal more strongly to the imagination, and stimulate the speculative faculties. The unmistakeable resemblance between the hypopharynx of an insect (Fig. 2) and that of a crustacean (Fig. 1), however, is not merely a superficial re-

semblance calculated to deceive the unwary, since the hypopharynx in the two groups not only occupies the same position, and has the same form and structure in both insects and Crustacea, but it also has exactly the same embryological development, and serves the same function (i. e., that of a secondary underlip, provided with taste organs, etc.) in both groups—and what more could one ask, to establish complete homology? I would therefore maintain that the so-called "superlinguæ" of insects do *not* represent the maxillulæ or first maxillæ of Crustacea, since they do not occupy exactly the same position, they do not exhibit the same form and structure, they do not have exactly the same embryological development, and they do not have exactly the same function in the two groups; and I would claim that the so-called "superlinguæ" of insects most emphatically do represent the paragnaths of Crustacea, since they agree with these in all of the features mentioned above.

Since the "superlinguæ" of insects represent the paragnaths of Crustacea, by comparing the higher Crustacea, which are near insects, with the lower Crustacea, which approach the trilobites and other primitive arthropods, we are able to trace the evolution of these structures, and to determine their morphological significance. In *Ligyda* (Fig. 1) the paragnaths, "pg", are rather closely associated with the median lingua, "li", which appears to be formed as a projection of the pharyngeal ridge, "pc", behind it, which apparently includes in its composition a portion of the sterna of certain of the mouthpart segments. In *Talorchestia* (Fig. 3) the lingua, "li", is represented by a double ridge, or lobe-like projection of the median pharyngeal ridge, "pc"; and it would appear that the median, basal portions of the paragnaths, "pg", likewise take part in the formation of the lingua, "li", so that the lingua of higher Crustacea and insects may be formed in part by the paragnaths, although the greater part of the lingua is probably formed by portions of the sterna of certain of the mouthpart segments, as is indicated by embryology. On either side of the median pharyngeal ridge, "pc", of Figs. 1 and 3, are rib-like structures, "tc", which are located at the base of the trophi or mouthparts. It is possible that the lingual loræ, "ll", of Figs. 2 and 8, represent

modifications of these rib-like or ridge-like structures in insects, and it is also possible that certain of these structures may be the precursors of portions of the tentorium of insects, although I have not been able to determine this point as yet.

The pharyngeal ridge, "pc", of Fig. 3, etc., appears to represent a portion of the sterna of the mouthpart segments, which are quite broad in Fig. 4; and the lingua is not developed in the lower Crustacea. In *Mysis* (Fig. 4) the paragnaths, "pg", are borne at the anterior margin of the sternite, "mxs", of the first maxillary segment; and in the lower Crustacea, the paragnaths appear to be more closely associated with the maxillulæ or first maxillæ, than they are with the mandibles, thus indicating that the paragnaths may represent detached lobes of the first maxillæ.

In *Squilla* (Fig. 6), the paragnaths, "pg", are attached to the basal portions of the maxillulæ or first maxillæ, "mx", and in the very primitive crustacean *Apus* (Fig. 7) both paragnaths, "pg", and maxillulæ, "mx", arise from the same basal lamina, "bl", which projects internally beneath the body wall. The paragnaths and maxillulæ in Fig. 7 are bent over backward (instead of being represented in their normal upright position, as in Fig. 6), in order to show that both paragnaths and maxillulæ are borne on the same basal lamina. The fact that both paragnaths and maxillulæ arise from the same basal lamina in such primitive forms as *Apus*, would indicate that the paragnaths of higher Crustacea are merely detached lobes of the maxillulæ, possibly corresponding to the endites or gnathobase-like structures of the trunk limbs of *Apus;* and in the higher Crustacea, these paragnathal lobes become more or less separated from the remainder of the first maxillæ (maxillulæ), and become somewhat more closely associated with the mandibles, as a secondary modification.

I do not know of any instance in which the paragnaths are situated in front of the mandibles, so that the metastoma, "mts", of the trilobite *Triarthrus* (Fig. 10), which is situated in front of the bases of the so-called mandibular appendages, "md", (only the tips of the basal segments of these are shown in the figure) and occupies a position between the bases of the so-called second antennæ, "at", is situated too far forward in the head region, to

occupy a position strictly comparable to that of the paragnaths, unless it be true that the so-called second antennæ of trilobites, are in reality the representatives of the mandibular appendages of other arthropods. In certain trilobites there is a rather deep median incision, or emargination in the metastoma, thus suggesting that this organ may have been formed by the union of two lobes like the paragnaths; but this cannot be demonstrated from the material at present available. The suggestion that the metastoma of trilobites may represent the united paragnathal lobes of Crustacea, is thus merely a speculation, and has no particular bearing upon the subject of the origin and development of the paragnaths in Crustacea and insects.

I imagine that there are still some individuals who will vigorously maintain that the "superlinguæ" of insects must represent the maxillulæ (first maxillæ) of Crustacea, on the ground that Folsom, 1900, has described in a collembolan embryo a supposed "superlingual" segment, or neuromere, which he claims is the representative of the first maxillary segment of Crustacea; and he further claims that since the "superlinguæ" are supposedly the appendages of this alleged "superlingual" segment, they must therefore represent the maxillulæ, or appendages of the corresponding first maxillary segment, in Crustacea.

In reply to this argument, it is sufficient merely to call attention to the fact that Philiptschenko, 1912 (Zeitschr. Wiss. Zoologie, Bd. CIII), who has made an exceptionally careful and thorough study of collembolan embryology, and has attempted to verify Folsom's work on these insects (Bull. Harvard Mus. Comp. Zoology, 1900, Vol. 36, No. 5), has demonstrated that the supposed "superlingual" neuromere, or embryonic segment, described by Folsom, exists only in its author's imagination; and recent writers who quote Folsom's mistaken observations as though they were established facts, are apparently wholly ignorant of Philiptschenko's work, and know even less of the anatomy and embryological development of the structures of Crustacea with which they seek to compare the structure of insects. If there were no other reasons for discrediting the statement that the "superlinguæ' represent the maxillulæ of Crustacea, the fact that the *paragnaths* (*not* the

maxillulæ) of Crustacea develop embryologically in exactly the same position and in the same way as the "superlinguæ" do in the embryos of insects, would be sufficient to completely disprove this unfounded and misleading statement, and it is hardly in keeping with the modern scientific spirit to continue to promulgate such misinformation, when a little time spent in the reading of the literature of the subject, or in easily conducted research, would readily convince anyone of its falsity.

Carpenter, 1903 (Proc. Royal Irish Academy, Vol. 24, Section "B", Part 4), interprets the structures labeled "a", "b", and "c", in Fig. 9, of the paragnath of *Machilis maritima,* as the representatives of the lacinia, galea, and palpus of the first maxilla (or "maxillula") of a crustacean, in an effort to prove that the "superlinguæ" (paragnaths) of insects represent the maxillulæ of Crustacea. The structures which he figures in the "superlingua" of *Machilis,* however, are nothing like the true lacinia, galea, and palpus of the maxillulæ themselves, in Crustacea, but are exactly like similar structures found in the paragnaths of Crustacea, as one would expect to be the case if the "superlinguæ" of *Machilis* represent the paragnaths, not the maxillulæ, of Crustacea. Literally hundreds of Crustacea exhibit in their paragnaths small projections like those labeled "a" and "b" in Fig. 9; and these projections of the paragnaths of Crustacea not only have the same appearance as these structures in the "superlingua" of *Machilis,* but they also bear the same type of hairs, taste organs, etc., as in *Machilis.* Furthermore (as I have pointed out in several papers), the palpus of a maxilla of an insect, or crustacean, represents the terminal segments of a mouthpart limb (the endopodite) in which the basal segments form the body of the maxilla, the galea and lacinia being appendages (endites, or gnathobase-like structures) of the basal segments of the maxillary limb. Since the palpus represents the terminal segments of such a modified limb, and since the "superlinguæ" (paragnaths) do not represent modified limbs, they cannot possibly have a palpus; and the small outgrowth labeled "c" in Fig. 9 of the paragnath ("superlingua") of *Machilis,* is merely a small, secondarily formed appendage, similar in nature to the articulated appendage "c", borne on the paragnath of the

crustacean shown in Fig. 5. In Fig. 14, Plate II, of a paper on *Anurida* (L.M. B. C. Memoir No. XIII), an appendage of this kind, borne near the tip of the paragnaths as in *Apseudes* (Fig. 5), is figured in the "maxillulæ" (i. e. the true paragnaths) of the insect *Anurida,* by Imms, 1906; and in both insects and Crustacea, these appendages of the paragnaths cannot possibly be homologized with the palpus, or terminal segments of the endopodite of the limb forming the maxillula, or first maxilla.

The principal points brought out in the foregoing discussion may be briefly summarized as follows. The great similarity between the hypopharynx of insects and Crustacea lends additional weight to the evidence of a very close relationship between these two groups of arthropods, furnished by a study of numerous other structures of the body as well; and since no such close correspondence in the details of the parts of insects and chilopods exists, it is infinitely more probable that insects were descended from crustacean-like (instead of chilopod-like) ancestors. The "superlinguæ" of insects are completely homologous with the paragnaths of Crustacea, because they occupy exactly the same position, and have the same form, structure, and function in the adult condition, and arise in the same location, and in the same fashion, during embryonic development *in both* groups of arthropods, thus fulfilling *all* the requirements for establishing complete homology between the corresponding parts in insects and Crustacea. Since the paragnaths of Crustacea are not the maxillulæ of Crustacea, it is folly to state that the "superlinguæ" of insects correspond to the maxillulæ of Crustacea, if they represent the paragnaths of Crustacea instead; and it is to be hoped that if anyone is unwilling or unable to inform himself as to the truth in this matter, that he will at least refrain from deceiving others by promulgating the misinformation that the "superlinguæ" of insects represent the maxillulæ of Crustacea, as though it were a demonstrated fact!

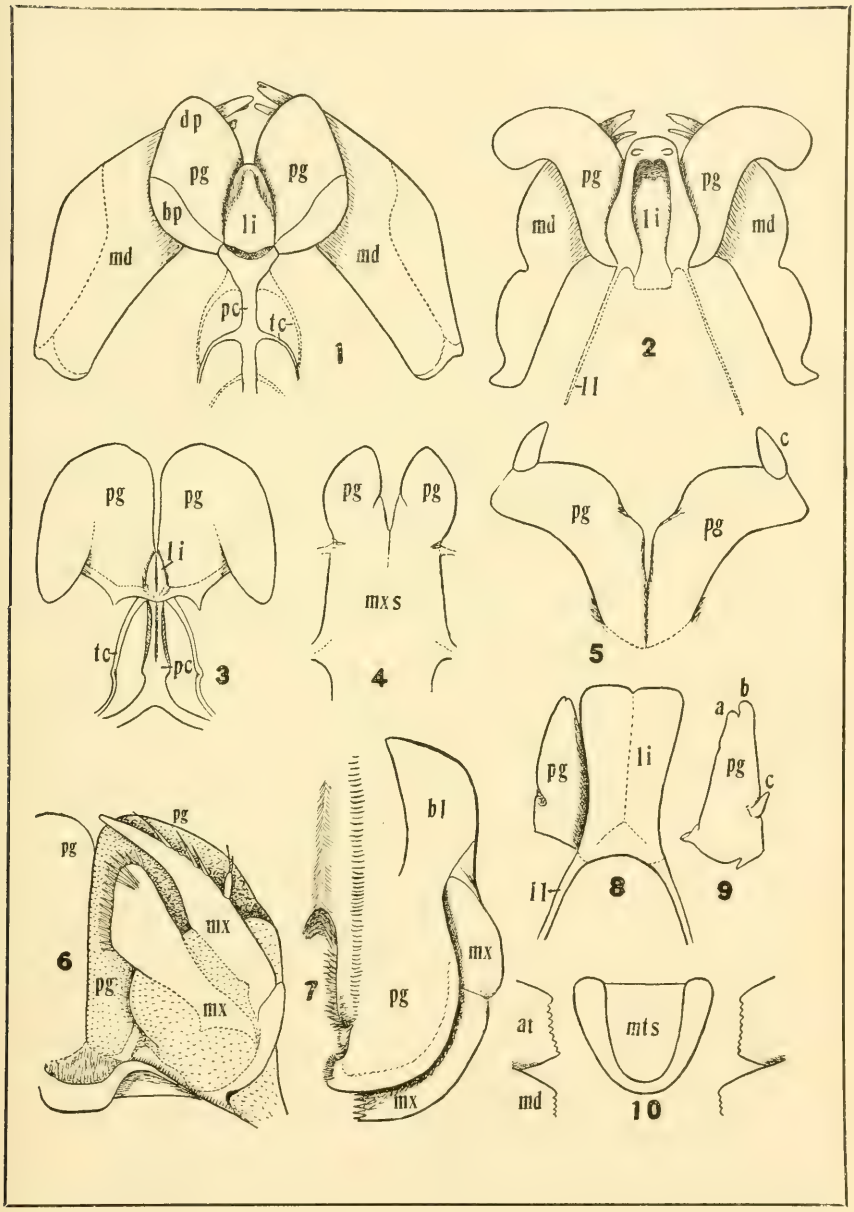
EXPLANATION OF PLATE V.

Fig. 1. Posterior (ventral) view of mandibles and hypopharynx of the crustacean **Ligyda.**

Fig. 2. Same of a nymph of the mayfly **Heptagenia.** The hypoporus, or salivary pore beneath the hypopharynx is not shown.

Fig. 3. Posterior (ventral) view of the hypopharynx of the crustacean **Talorchestia.**

Fig. 4. Ventral (posterior) view of the sternum of the first maxillary segment, and the paragnaths of the crustacean **Mysis.**



CRAMPTON—*Superlinguæ or Paraglossæ of Insects.*

Fig. 5. Posterior (ventral) view of the paragnaths of the crustacean **Apseudes.**

Fig. 6. Posterior (ventral) view of a paragnath and maxillula of the crustacean **Squilla.**

Fig. 7. Anterior (dorsal) view of a paragnath and maxillula of the crustacean **Apus,** bent over backward to show attachment to the basal lamina.

Fig. 8. Ventral (posterior) view of a paragnath and the lingua of the insect **Machilis.**

Fig. 9. Same view of a paragnath of **Machilis** taken from a drawing by Carpenter.

Fig. 10. Anterior view of metastoma of the trilobite **Triarthrus** from a drawing by Raymond.

Abbreviations.

a, Lobule of paragnath; **at,** Portion of basal segment of trilobitan limb homologized with second antenna; **b,** Lobule of paragnath; **bl,** basilamina, or basal lamina which bears the paragnath and maxillula; **bp,** Basiparagnath, or basal portion of paragnath; **c,** Epiparagnath, or appendage of paragnath; **dp,** Distiparagnath, or distal portion of paragnath; **li,** Lingua; **ll,** Lingua-lora, or lora of lingua; **md,** Mandibles; **mts,** Metastoma of trilobite; **mx,** First maxilla, or maxillula; **mxs,** Sternum of first maxillary segment; **pg,** Paragnaths, "superlinguæ", or "paragossæ"; **pc,** Pharyngocrista, or median pharyngeal ridge; **tc, Trophicostæ,** or rib-like structure at bases of trophi.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

At the meeting of February 8, Prof. W. M. Wheeler described the nesting habits of some ants of the genus *Carebara,* found in South America. These live in nests of Termites, making their own burrows between those of their hosts and feeding on the young of the latter. The various forms of these ants had been obtained from the stomachs of Anteaters killed near their nests. The males and females were of large size and the workers extremely small. When the males and females leave the nest for the mating flights some of these minute workers cling to their hairs, and when the females start new colonies these workers bring in food and feed the first-hatched young, which the female herself is unable to do.

Another genus of ants of small size, *Allomerus,* lives partly in the swoollen branches of certain plants, going up and down between the plant and the underground nest in earth-covered galleries attached to the hairs of the plant.

Prof. C. T. Brues described some guests of Ants and Termites from South America. Wingless flies of the family *Phoridæ* live in the nests of some ants and even travel with them in their raids outside the nest. In some termite nests are minute hymenopter-

ous parasites with wings reduced to thread-like appendages. Specimens and enlarged drawings were shown.

Mr. C. W. Johnson spoke of the female of the rare fly *Glutops singularis*, and made some additions and corrections to his notice of this species in the December Psyche.

Mr. L. R. Reynolds and several other members discussed the recently published list of American Coleoptera by C. W. Leng.

At the meeting of March 8, Mr. L. R. Reynolds read a paper on zoological nomenclature, which was discussed by Messrs. Banks, Frost, Howe and Johnson. The discussion dealt mainly with the difficulties of the subject and led to no practical plans for improvement.

At the meeting of April 12, several designs for a club seal were shown.

Mr. Roland Hussey read a paper on "Hibernation of Aquatic Hemiptera." After a review of hibernation in general, Mr. Hussey told about his observations at a pond near Minneapolis, where he watched large numbers of Corixidæ which, as the cold weather came on, collected in the part of the pond where there was most vegetation, in some places on October 29, as closely as 150 to a square foot under two inches of ice. In January, under ice eight inches thick, there were but few in motion, and in February none, all being torpid at the bottom.

January 15, under ice two feet thick, a species of *Cymata* was found hibernating, entirely torpid, in air bubbles in the ice, without the insects themselves being frozen. Mr. Hussey started to investigate this curious method of hibernation, but was taken sick and obliged to give it up for the season, and the next winter conditions were unfavorable for continuing the study.

Mr. Gove showed a table which he had prepared of the elevations at which he had collected butterflies, showing that each species habitually flies at certain heights above the general level of the country.

Mr. C. A. Frost spoke of the recent collections of Coleoptera by Mrs. Hippisley, at Terrace, B. C., Canada, a newly settled country within a hundred miles of the Pacific Coast.

Mr. R. H. Howe, Jr., showed a metal tray of triangular section for holding insects wrapped in papers.

Mr. Howe spoke of the discoverey of insects in the peat at Eastham, Cape Cod.

CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p. m. at the Bussey Institution, Forest Hills, Boston. The Bussey Institution is one block from the Forest Hills station of both the elevated street cars and the N. Y., N. H. & H. R. R. Entomologists visiting Boston are cordially invited to attend.

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CONTENTS

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PSYCHE

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REPRODUCTION IN THE APHIDIDÆ WITH A CONSIDERATION OF THE MODIFYING INFLUENCE OF ENVIRONMENTAL FACTORS.[1]

By Leopoldo B. Uichanco
College of Agriculture, University of the Philippines,
Los Baños, P. I.

Literature on aphids abounds in references to the existence of an "asexual" and a "sexual" reproduction. As a matter of fact, however, they reproduce sexually only, the term "sexual reproduction" being generally accepted by zoölogists as meaning reproduction by means of special reproductive cells, and "asexual reproduction" that method which involves a direct division, or budding, of an animal without the intercession of specific germ cells.

Reproduction in aphids may be subdivided into two categories: 1. *Amphigony.* This involves the union of reproductive cells of both sexes, the female gamete, or egg, necessitating fertilization by the male gamete, or spermatozoön, as a prerequisite to development. 2. *Parthenogenesis.* In this mode of reproduction the male gametes are dispensed with, the egg developing without having been previously fertilized. Hertwig and Kingsley (1912, p. 130) characterize parthenogenesis as "a sexual reproduction in which a degeneration of fertilization has taken place." In addition to the two foregoing methods of reproduction, occasional cases of *pædogenesis* (e. g., in *Aphis avenæ* Fabricius, as reported by Ewing, 1916, and in *Toxoptera graminum* Rondani, Webster and Phillips, 1912) have been reported. Pædogenesis is parthenogenesis occurring in the preadult stages of animals.

Amphigonous reproduction is considered as the more primitive method in insects, parthenogenesis being the result of a later specialization. The latter method of reproduction has become of normal occurrence in aphids and has practically supplanted the former, amphigony taking place only under the influence of adverse conditions in the environment. We have thus in aphids a

[1] Contribution from the Entomological Laboratories of the Bussey Institution, Harvard University. No. 191.

very remarkable instance of a highly specialized group of sexually reproducing animals in which fertilization of the female reproductive cells as a prelude to development has been reduced to an apparently unnecessary and unessential physiological process.

General Features of Amphigony in Aphids.

In the amphigonous generation both sexes are, of course, represented. The presence of the male is the only characteristic of the amphigonous generation.

The main external characteristics of an amphigonous female are the general absence of wings (Baker, 1920), and the presence of an ovipositor in certain species (Buckton, 1882, p. 119). Davis (1908) also noted the presence of "sensoria" on the hind tibiæ as a secondary sexual character of the amphigonous female, "at least in the subfamilies Pemphiginæ, Schizoneurinæ, Lachininæ and Aphidinæ."[2] Internally, the most conspicuous features are the presence of a spermatheca and a pair of collaterial glands. The acessory glands, as well as the vagina, of which they are an evagination, and also the oviducts, are easily recognizable on account of their relatively thick walls. The large amphigonous eggs and their nurse cells are also very characteristic and are in evidence in the ovaries early in the embryonic stage of the mother. Cleavage and the formation of the blastoderm do not begin until after the eggs are fertilized and deposited. The amphigonous female is oviparous. The eggs are covered with a vitelline membrane and chorion.

General Features of Parthenogenesis in Aphids.

Among the aphids of temperate countries, aphidologists distinguish between (1) "stem mothers," which are the parthenogenetic individuals hatching from the overwintering amphigonous eggs, and (2) later parthenogenetic generations. The former are typically apterous; the latter, either apterous or alate. In the fall

[2] The typical genus of Schizoneurinæ, which is Schizoneura Hartig, 1837, is considered by Baker (1920) as a synonym of Eriosoma Leach, 1818. He grouped the latter under the tribe Eriosomatini of the subfamily Eriosomatinæ. The subfamily Pemphiginæ has been reduced by the same author to tribe Pemphigini under the subfamily Eriosomatinæ; and Lachninæ, to Lachnini under Aphidinæ.

there is also a third form, the generation of 'sexupara," that is, parthenogenetic individuals which give rise to amphigonous forms. These are, as a rule, alate (Patch, 1920). In all specimens of parthenogenetic aphids which I have dissected neither spermatheca nor colleterial glands were found. The absence of these structures was apparently first reported by von Siebold (1839) and subsequently confirmed by other authors. In contrast with the amphigonous forms, the walls of the ovary are uniformly thin and membraneous, except at the vagina, where they are somewhat thicker.

Parthenogenetic aphids are viviparous, the entire incubation period being passed within the abdomen of the mother. This is a very unique characteristic, in view of the fact that a similar case does not occur in closely related families. The Phylloxeridæ, which is the only other family with the Aphididæ in the superfamily Aphidoidea, also have parthenogenetic generations, but they are always oviparous. In certain other families of the order Homoptera, like the Aleyrodidæ, parthenogenesis and viviparity are not correlated.

In parthenogenetic aphids, the development of the eggs proceeds in the ovaries long before deposition, eggs in the blastoderm stage having been observed within the abdomen of parthenogenetic embryos. There is no formation of a vitelline membrane and chorion.

Modifying Factors in the Production of Amphigonous Individuals.

As has been suggested elsewhere in the present paper, aphids seem to have the tendency indefinitely to reproduce parthenogenetically under favorable environmental conditions. As experimental evidence favoring this view may be cited Ewing's (1916) work on *Aphis avenæ* Fabricius, in which he found that he could maintain continuous and uninterrupted parthenogenetic reproduction through as many as eighty-seven generations in the material he experimented with on the Pacific Coast of the United States. In that region, oviparous forms in any aphid species had not been known, except in very few cases. His experiments, unfortunately, had to be brought to a close through the dying of all the individuals in his eighty-seventh generation from excessive heat; otherwise, he would probably have been able to observe parthogenetic reproduc-

tion for a much longer period, if not indefinitely. Earlier investigators, like Bonnet (1745) and Kyber (1815), had previously observed the maintainence of continuous parthenogenetic reproduction in various species of aphids for long periods of time.

Males and oviparous females are known to be produced only under the prolonged influence of extremes of temperature, such as during the winter in temperate climates, and, as certain investigators claim, in cases of scarcity of food. Observations on this modifying action of climate and food, according to Buckton (1882, p. 109) were reported by Bonnet in 1745, and later confirmed by De Geer in 1773.

From our somewhat fragmentary knowledge of tropical aphids, we may tentatively infer, in the absence of more definite evidence to the contrary, that representatives of this family reproduce exclusively by parthenogenesis in warm countries. The following table gives a partial list of the localities in which a continuous parthenogenetic reproduction throughout the year has been observed. It will be noted that the various localities included in the list are characterized either by the total absence of winter or by a relatively mild climate.

LOCALITY	SPECIES	AUTHORITY
France (Orleans)	*Aphis rumicis* L.	Gaumont (1913)
Germany (Bremen?)	*Hyalopterus trirhodus* Walk.	Börner (1914)
	Rhophalosiphum lactucæ Kalt.	*ditto*
Holland	*Aphis gossypii* Glov.	van der Goot (1915)
	Aphis hederæ Kalt.	*ditto*
	Aphis abietina Walk.	*ditto*
	Aphis rumicis L.	*ditto*
	Eriosoma lanigera Hausm.	*ditto*
	Macrosiphum granarium Kirby	*ditto*
	Myzus persicæ Sulz.	*ditto*
India	*Aphis brassicæ* L.	Maxwell-Lefroy (1907)
	Aphis cardui L. var.	*ditto*
	Aphis gossypii Glov.	*ditto*

South Africa	*Myzus persicæ* Sulz.	Moore (1912)
Sudan	*Aphis sorghi* Theob.	Vuillet (1914)
Sudan, Anglo-Egyptian		
	Aphis sorghi Theob.	Theobald (1904)
United States:—		
California	*Aphis avenæ* Fabr.	Ewing (1916)
	Macrosiphum rosæ Ream.	Russell (1914)
Florida	*Aphis brassicæ* L.	Quaintance (Herrick, 1911)
Indiana[3]	*Macrosiphum granarium* Kirby	Phillips (1916)
Texas	*Aphis pseudobrassicæ* Davis	Paddock (1915)
Virginia[3]	*Macrosiphum granarium* Kirby	Phillips (1916)
South Carolina	*Callipterus trifolii* Monell	Davis (1914)
Southern U. S.[4]	*Toxoptera graminum* Rond.	Webster and Phillips (1912)
Washington	*Pemphigus betæ* Doane	Doane (1900)

Supplementary to the above data may be cited here the other paper of van der Goot (1917, p. 2), who, after three years of biological and taxonomic work on the Aphididæ in Java, reported that he had never found amphigonous individuals in that country—not even at high mountain elevations where the temperature falls to the freezing point at night. Likewise, several years of casual observation and collecting in the Philippine Islands by me failed to disclose the male and oviparous-female forms. So far as I am aware, the occurrence of amphigonous aphid individuals in any other tropical country has not been definitely reported. It should be borne in mind, however, that failure to discover such forms in a given locality does not prove their non-existence there; although, when workers carrying on investigation for years in tropical regions report their inability to find amphigonous forms in any season of the year, there is some ground for suspicion that partheno-

[3] Amphigonous individuals and winter eggs of that species also found in this locality.

[4] South of the 35th parallel.

genetic reproduction is continuous and uninterrupted, at least among the more common species of tropical aphids. If such a condition does obtain, the most reasonable explanation appears to be that in the tropics conditions are relatively more uniformly favorable to the aphids, both with respect to the climate and the nutritive factors in the environment.

Patch (1920), on the other hand, in a very interesting general treatise on the life cycle of aphids, remarks that "in tropical climates experiencing a wet and a dry season gamogenetic [amphigonous] eggs are produced to tide over the period of famine"; but unfortunately she does not cite any specific evidence or authority to support her thesis. It is not improbable, however, that some rare cases of amphigonous forms might occur in those tropical countries where, as she suggests, the year is divided between a wet and a dry season,[5] in view of the fact that in the height of the hot, dry season, when conditions are less favorable for many living organisms, certain species of insects are known to assume a resting state, presumably corresponding to hibernation in temperate climates.

[5] Such a condition obtains in the Philippine Islands, Java, and many other countries of the tropics of both hemispheres.

In temperate countries, as a rule, reproduction of aphids by parthenogenesis is continuous during the milder seasons of the year, and amphigonous forms do not appear until the onset of the fall, when the low temperatures begin to affect the insects unfavorably. Exceptions to this generality are determined by the modification of the climate in a given region through the agency of various factors, such, for instance, as the prevailing winds blowing from the ocean and causing the summers to be "more moderate and the winters milder" on the Pacific Coast of the United States than in regions situated at similar latitudes in the interior and on the Eastern Coast.[6] The aphids in the former locality are thus subjected to comparatively more favorable conditions throughout the year and, consequently, they rarely, if ever, undergo heterogony (Ewing, 1916, and Swain, 1919, p. 8).

[6] R. DeC. Ward. 1918. Climate Considered Especially in Relation to Man, second edition, revised: 44. xvi+380 pp. G. Putnam's Sons, New York and London.

The Nature of Influence of Extremes of Temperature and Lessening of Food Supply in the Determination of Amphigony.

It may be inferred from the foregoing considerations that winter, with its attendant low temperatures and inadequate food supply, plays a very important, if not an exclusive, part in the determination of amphigony. Amphigony correspondingly becomes of less frequent occurrence as winter becomes less severe in a locality, until in tropical regions where the temperature and, incidentally, the food supply also are more equably maintained throughout the year, amphigonous froms occur very rarely, if at all.

In this connection, it is interesting to note that, although heterogony has been brought about evidently as an adaptation to unfavorable environmental factors, the effects of low temperatures do not seem to be a necessary immediate stimulus in the production of amphigonous individuals and that aphid strains normally undergoing heterogony may continue to produce an amphigonous generation and lay eggs at least in the fall following the spring of the same year in which the insects from the open are taken into the greenhouse. The following experimental evidence, which has led me tentatively to arrive at this conclusion, is based on preliminary observations, which will have to be confirmed by further investigations under more adequate control:

In July, 1920, seedlings of *Tanacetum vulgare* Linnæus were transferred to the greenhouse of the Bussey Institution. At about the middle of August, after the plants had been well started, they were inoculated with their common aphid pest, *Macrosiphum tanaceti* Linnæus. The host plants appeared to grow normally and the aphids continually reproduced parthenogenetically until about the end of October, 1920. In October the temperature outdoors began to fall every now and then, especially at night, and at this time the greenhouse was kept heated to an average of about 65°F. This temperature had been observed previously by Ewing (1916) to be the optimum for aphids, in that it is least stimulating to the production of wings in the viviparous forms; and this behavior may be interpreted as an indication that the insects were under more favorable environmental conditions than the individuals which showed greater tendency to produce wings when subjected to other

temperatures. In spite of the precautions observed in the present experiments, at about the end of October and the first week of November, 1920, when the tansy plants were still in apparently good condition, the aphids produced amphigonous individuals and laid winter eggs, in the same manner as the insects of identical species which were exposed to the more adverse weather conditions in their natural environment outdoors.

In the same greenhouse were a number of plants of *Nicotiana alata* Otto et Fink. These had been observed by me since September, 1919, to be infested with *Myzus persicæ* Sulzer. The insects, which are a common greenhouse pest in this part of the country, were probably descendants of parents that had been associated with greenhouse plants for a long period of time, and thus had been continually protected for generations from the drastic effects of winter. These individuals of *Myzus persicæ* in the greenhouse, which were under the influence of the same temprature conditions as the tansy aphids, continuously reproduced parthenogenetically throughout the winter of 1919-1920 and of 1920-1921.

At the time the above experiments were conducted, there was no facility available for a more accurate regulation of temperature and other conditions. The simultaneous presence in the same place of parthenogenetic forms of *Myzus persicæ,* however, tends to eliminate to some extent the possibility of adverse conditions existing in the greenhouse and bringing about amphigony in *Macrosiphum tanaceti.* Another difficulty in the present experiments was that I had no opportunity to work with material of identical species for control. However, under natural conditions outdoors in this locality, both *Myzus persicæ and Macrosiphum tanaceti* begin to produce winter eggs at about the same time of the year, in the fall.

In apparent contradiction to my findings on *Macrosiphum tanaceti* are the results reported by Slingerland (1893) in his work on *Myzus achyrantes* Monell, which species is considered by Gillette and Taylor (1908) as a synonym of *M. persicæ.* On April 2, 1890, Slingerland isolated the nymph of a wingless, parthenogenetic female, and within two years and ten months from that date he succeeded in raising from his material sixty-two successive generations of parthenogenetic individuals. The work was done

at the Cornell Agricultural Experiment Station, at which locality winter is more or less severe, and this species is known, under natural conditions, to undergo an alternation of generations during the year. It should be noted, however, that *Myzus achyrantes* is a common pest of the greenhouses in Ithaca, as Slingerland himself admits in his paper. It is highly probable, although he does not specifically say so, that he obtained his material of this species from stock which had been in existence in the greenhouse for generations, and, as was the case with *Myzus persicæ* in the present experiments, the progenitors of the nymph with which he started his cultures might have come from a strain that had been reproducing exclusively by parthenogenesis as a result of prolonged seclusion from the untoward effects of winter. Under these circumstances then, Slingerland's results would tend to corroborate mine, instead of contradicting them. Nor would Ewing's (1916) eighty-seven continuous parthenogenetic generations of *Aphis avenæ* disprove my results, in view of the fact that the source of his material was the Pacific Coast of the United States, where this aphid has been known to reproduce normally by parthenogenesis for indefinite periods. This author himself states in his paper that he was unable to find amphigonous forms of the species outdoors during the entire time that his experiments were in progress. The results reported by earlier investigators, like Bonnet (1745) in France, on nineteen continuous parthenogenetic generations of *Aphis sambuci* Linnæus, and Kyber (1815) in Germany on parthenogenetic reproduction during a four-year period by *Macrosiphum rosæ* Linnæus (=*Siphonophora rosæ* Koch) and *Myzus persicæ* Sulzer (=*Rhophalosiphum dianthi* Schrank), may have to be classed in the same category as Ewing's or Slingerland's, for the reason that (1) at least one species, *Myzus persicæ,* as I have stated, is a common greenhouse pest, and (2) the material with which they worked might have come from stocks which, in their respective localities, had been reproducing outdoors normally by parthenogenesis throughout the year, cases of which have been reported lately from both countries (Gaumont, 1913, and Börner, 1914). In this event, their results would not tend to contradict mine.

It would not be safe, on the basis of the foregoing evidence, to

formulate definite conclusions. The present observations, however, suggest the following preliminary deductions:

1. Heterogony in certain aphids of temperate climates has probably become a rhythmic process, occurring regularly at definite periods in their yearly cycle of generations and independently, for a period at least, of the immediate stimulus brought about by adverse temperature conditions.

2. Amphigonous reproduction in these aphids, although evidently maintained as an adaptation to, and under the influence of adverse climatic conditions, continues to occur at these definite cyclical intervals for some time after the causative factors have been removed.

The foregoing views find additional support in the fact that in nature in temperate climates amphigonous and parthenogenetic individuals of identical species in the same locality and feeding on the same parts of a host plant live side by side for considerable periods of time, even weeks, on the onset of the fall. I have noticed such a condition in Boston, and other workers have observed it elsewhere. This failure of all the individuals to respond simultaneously in the same manner to a given condition of the environment tends to show that environmental factors do not furnish the immediate or adequate stimulus in the determination of amphigony.

In 1907 Tannreuther (1907), in a paper on *Melanoxanthus salicis* Weed, *M. salicicola* Thomas, and several other species of aphids, announced somewhat similar views. He said in part that "external conditions, whether severe or normal, would not bring about the production of sexual generation before a definite number of parthenogenetic generations had intervened." He further noted, after two seasons of experimentation, that "if a stem mother and offspring were kept in favorable conditions in the greenhouse on the same species of hosts as out of doors, the time and length of period for each succeeding generation was approximately the same as out of doors, and that in both instances the sexual females and males appeared after the intervention of six parthenogenetic generations."

It may be necessary, at this juncture, to call particular attention to the fact that in the foregoing discussion the rôle of temperature in influencing the form of aphid reproduction is by no

means belittled. As has been stated above, adverse temperature conditions evidently play a very important part in the determination of amphigony, and a uniformly mild temperature is apparently conducive to an indefinite maintainance of parthenogenetic reproduction. The point suggested, however, is that the effect of continuous subjection of an aphid strain which normally undergoes heterogony to mild temperature does not immediately become manifest. But this fact does not preclude the possibility that the cumulative effects on more than one yearly cycle of generations might bring about a change in the method of reproduction to one of continuous parthenogenesis. I have no data bearing on the reaction of the greenhouse aphids which reproduce continuously by parthenogenesis to the adverse weather conditions outdoors during the fall and winter months.

I am not prepared to discuss from personal observations the relation between scarcity of food and the determination of amphigony. There is apparently nothing in the literature which touches this subject, except the statement of Tannreuther (1907) that "abundance or scarcity of food is not a factor in determining the sex in the case of the aphids," for which, however, he presents no concrete experimental evidence. Of some possible interest in connection with this problem are the experiments by Gregory (1917), who found that by subjecting parthenogenetic individuals of *Macrosiphum pisi* Kaltenbach (=*M. destructor* Johnson) to varying periods of starvation, in certain cases carrying her experiments to the maximum possible points without killing the insects, she could induce the production from apterous mothers of alate offspring, which, as shown by her check cultures, would otherwise have been apterous. It is, however, apparent from her paper, although she does not state it, that the subsequent offspring of these starved aphids were invariably parthenogenetic and that the production of amphigonous individuals was not artificially induced by the treatment. It is to be regretted that she did not carry her experiments through the succeeding generations after the mother; and the question now arises as to whether the production of amphigonous individuals is induced only by the successive and cumulative effects of starvation on several generations of parthenogenetic individuals. One point is suggested by these experiments, and that is that, as

in the case of temperature conditions, if the quantity of available food has any tendency at all to change the method of reproduction in aphids, the effect does not become apparent immediately. This question, however, needs further investigation before very definite conclusions can be reached.

Summary.

1. The sexual type of reproduction is the only one known to occur in the Aphididæ. This process takes three forms in this family: (a) amphigony; (b) parthenogenesis; and (c) pædogenesis.

2. Amphigony is considered as the more primitive method in insects. Parthenogenesis has practically supplanted it in aphid reproduction.

3. Parthenogenesis in aphids is apparently continuous and uninterrupted under favorable environmental conditions, amphigony occurring only under the influence of low temperatures and, as certain authors claim, inadequate food supply.

4. Aphids in tropical and other warm climates appear to have the tendency to reproduce exclusively by parthenogenesis. The same condition apparently obtains among greenhouse aphids in temperate climates.

5. Aphids in colder climates undergo heterogony as an adaptation to adverse environmental conditions. In certain species, the appearance of the amphigonous generation seems to be a rhythmic process, which continues to occur at definite cyclical intervals for some time after the influence of low temperature has been eliminated.

6. Nothing very definite is known about the relation of food and heterogony. If the quantity of food has any influence at all on the determination of amphigony in a parthenogenetic mother, the effect does not become manifest in the immediate offspring.

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CHINESE ANTS COLLECTED BY PROF. C. W. HOWARD.[1]

By William Morton Wheeler.

Since the publication of my paper on Chinese ants[2] Professor C. W. Howard has sent me a small collection made in Canton and the immediate vicinity. The collection comprises two very interesting undescribed species and several others which have not been previously recorded from China.

Ponerinæ.

1. *Stictoponera menadensis* Mayr subsp. *bicolor* Emery ☿—Two specimens from Leng-oo, near Canton.

2. *Diacamma rugosum* Guill. subsp. *geometricum* Sm. var. *anceps* Emery. ☿—Numerous specimens from Canton.

3. *Odontoponera transversa* Sm. ☿—Several specimens from Canton and Honan Island, on which Canton College is situated.

4. *Ectomomyrmex astutus* Sm. ☿—A single specimen from Leng-oo.

5. *Leptogenys* (*Lobopelta*) *diminuta* Sm. ☿—Five specimens from Leng-oo.

Pseudomyrminæ.

6. *Tetraponera allaborans* Walk. ♀—A single deälated specimen from Honan Island.

Myrmicinæ.

7. *Monomorium pharaonis* L. ☿ ♀—Many specimens from Canton.

8. *Monomorium carbonarium* Sm. ☿—Eleven specimens from Canton.

9. *Cardiocondyla nuda* Mayr. ☿—Three specimens from Canton.

10. *Crematogaster rogenhoferi* Mayr. ☿ ♀—Several specimens from Canton.

11. *Crematogaster biroi* Mayr. ☿—Two specimens from Canton.

12. *Pheidologeton diversus* Jerd. ☿ ☿—Many workers and a single soldier from Canton. One lot of workers attending scale-insects.

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 194.

[2] Bull. Mus. Comp. Zool. 64, 1921, pp. 529-547.

DOLICHODERINÆ.

13. *Dolichoderus* (*Hypoclinea*) *taprobanæ* Sm. var. *gracilipes* Mayr. ☿ ♀ ♂—Numerous specimens from Canton.

14. *Dolichoderus* (*Hypoclinea*) *affinis* Emery var. *nigricans* Emery. ☿—Numerous specimens from Tei-loi and Loh-Kong, Canton.

15. *Dolichoderus* (*Hypoclinea*) *sinensis* sp. nov. (Fig. 1).

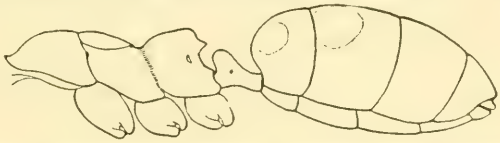

Fig.1 ***Dolichoderus (Hypoclin a) sinensis, sp. nov., worker.***

Worker. Length 3.4 mm.

Closely related to the Palearctic *D. quadripunctatus* L. but differing in the following particulars: Joints 3-7 of funiculi shorter, not longer than broad; mesonotum slightly longer, more nearly parallel-sided; base of epinotum much more elevated and convex and broader in proportion to its length; its posterior corners depressed and developed as small, rather acute teeth, not as tubercles. Petiolar node distinctly lower and more evenly rounded above in profile, the cylindrical portion behind the node longer.

Surface of head, thorax and petiole much more opaque; the foveolæ on the head and thorax more regular and more distinct. Mandibles, clypeus and pleuræ slightly shining, or lustrous, finely shagreened. Gaster very smooth and shining.

Pilosity and pubescence quite as feebly developed as in *quadripunctatus.*

Head, thorax, petiole and legs deep red, the tibiæ slightly darker; tarsi, mandibles and antennæ slightly paler, the tips of the scapes and funiculi infuscated. Gaster black; first and second segments as in *quadripunctatus,* each anteriorly with a pair of ivory yellow but somewhat larger spots.

Described from a single specimen from Canton.

16. *Technomyrmex albipes* Sm. ☿—Numerous specimens from Canton; attending mealy bugs.

17. *Iridomyrmex anceps* Roger ☿—Nine specimens from Canton.

18. *Tapinoma indicum* Forel ☿—Six specimens from Leng-oo.

FORMICINÆ.

19. *Plagiolepis longipes* Jerd. ☿—Several specimens from Canton.

20. *Plagiolepis rothneyi* Forel ☿—Numerous specimens from Canton.

21. *Paratrechina longicornis* Fabr. ☿—Numerous specimens from Canton.

22. *Paratrechina* (*Nylanderia*) *yerburyi* Forel ☿—Numerous specimens from Canton.

23. *Gesomyrmex howardi* sp. nov. (Fig. 2).

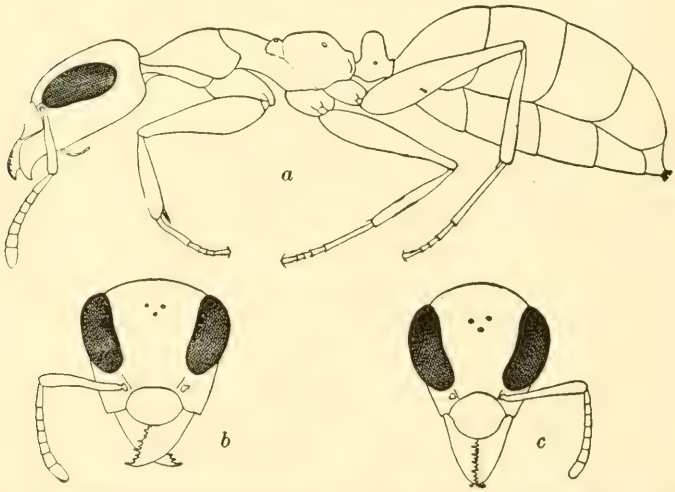

Fig. 2. ***Gesmoyrmex howardi*** **sp. nov. a, worker major; b, head of same, c, head of worker minor.**

Worker major. Length 3 mm.

Head, without the mandibles, a little longer than broad, broader behind than in front, with straight, anteriorly angular cheeks, convex and broadly rounded posterior border and corners, broadly and arcuately excised occipital border and rather flat dorsal and gular surfaces. Eyes very large, prominent, elliptical, fully 2½ times as long as broad, situated at the middle of the sides of the head. Ocelli minute but distinct. Mandibles rather flat, their external borders straight at the base, convex towards the tips, their apical borders straight with acute, crowded teeth, alternately long and short. Clypeus broader than long, convex but not carinate in the middle, flattened and depressed anteriorly where it projects as a broad, arcuate lobe over the bases of the mandibles. Frontal

carinæ very short, twice as far apart as their distance from the lateral borders of the head, running back towards the anterior orbits. Frontal area and groove obsolete. Antennæ short, 8-jointed, scapes somewhat thickened apically, not reaching to the posterior orbits; funiculi gradually thickened to their tips, all their joints longer than broad. Thorax long and slender; broadest through the pronotum, much narrowed at the mesonotum; pronotum seen from above elliptical, a little longer than broad, its dorsal outline evenly rounded, continued back into that of the sloping mesonotum to the constriction, which is sellate and bears on each side a swelling with one of the metanotal spiracles. Base of epinotum rising somewhat above the constriction, slightly but distinctly convex, longer than the feebly concave, sloping declivity. From above the epinotum is a little longer than broad and slightly narrower than the pronotum, the mesonotum less than half as broad as the latter. Petiolar node nearly as high as the epinotum, transverse, erect, as thick above as below, its anterior and dorsal surface rounded, its posterior surface more flattened; seen from behind it is broader above than below, with broadly rounded superior corners. Gaster moderately large, elliptical, its first segment not longer than the second. Legs moderately long, femora all distinctly incrassated at the base, tibiæ subcylindrical, their bases slightly constricted. Tarsal claws slender and rather straight.

Shining; finely but sharply shagreened; thorax and petiole, except the pronotum, subopaque, finely and densely punctate. Mandibles, clypeus and front of head with fine, dense, superficial, longitudinal striæ.

Hairs and pubescence whitish; the former absent except on the clypeus, palpi and tip of the gaster; the pubescence extremely short and dilute, distinct only on the antennal funculi.

Dull honey yellow; legs scarcely paler; mandibles, clypeus and antennæ more whitish; eyes black; mandibular teeth reddish brown.

Worker minor. Length 2. 3mm.

Differing from the major in its smaller size, narrower head, proportionally larger, more prominent and slightly more reniform eyes, even more minute ocelli, shorter, less angular and anteriorly more convergent cheeks; longer and more anteriorly produced clypeus and more slender mandibles.

Described from two specimens from Canton, both from the same vial in which they were mingled with several other ants.

This is the fourth species of *Gesomyrmex* to come to light. The genus was established by Mayr in 1868[3] for a species, *hoernesi*, from the Baltic Amber. Emery, in 1891, referred a peculiar form, *corniger*, from the Sicilian Amber to the same genus,[4] but I have recently made it the type of a distinct though allied genus, *Sicelomyrmex*.[5] In the same paper I described a second species of *Gesomyrmex*, *annectens*, from the Baltic Amber. In 1892 Ernest Andre[6] described and figured an extant species, *capperi* from the Kapouas Basin of Borneo. This insect has not been seen since. It is therefore of considerable interest to find on the Asiatic continent a second living *Gesomyrmex*. It is evident that the Bornean and Chinese species are very rare and probably vanishing relicts of a group of Formicinæ with huge eyes and 8-jointed antennæ, which was represented by numerous species during the Oligocene and Miocene Tertiary. To this group we must also assign the allied genera *Sicelomyrmex* and *Dimorphomyrmex*. The latter is known from two species from the Baltic Amber, *theryi* Emery and *mayri* Wheeler, and three extant species, *andrei* Emery and *janeti* Ern. André from Borneo, and *luzonensis* Wheeler from the Philippines.

Judging from André's figures and description, *Gesomyrmex howardi* differs from *capperi* in its smaller size, less reniform eyes, broader pronotum, more cylindrical mesonotum, more convex epinotum, thicker petiole and more uniform honey-yellow color. André's specimens measured 3.5 to 4 mm. and seem to have been minor workers. Since the major worker measures in all probability not far from 4.5 mm. *capperi* must be considerably larger than the Chinese species. The amber specimens which I described as *annectens* may, perhaps, be major workers of *hoernesi*, but the measurements seem not to favor this supposition, since *annectens* varies from 4 to 6 mm., *hoernesi* from 2.5 to 6 mm. The great similarity of all four described species of *Gesomyrmex* leads me

[3] Die Ameisen des baltischen Bernsteins. Beitr. Naturk. Preussens. Physik. Ökon. Ges. Königsberg 1, 1868, pp. 1-102, 5 pls.

[4] Le Formiche dell'Ambra Siciliana nel Museo Mineralogica dell'Universita di Bologna. Mem. R. Accad. Sc. Ist. Bologna (5) 1, 1891, pp. 141-165, 3 pl.

[5] The Ants of the Baltic Amber. Schrift. physik. ökonom. Ges. Königsberg 55, 1914, pp. 1-142, 66 figs.

[6] Voyage de M. Chaper a Borneo. Catalogue des Fourmis et Description des Espèces Nouvelles. Mém. Soc. Zool. France 5, 1892, pp. 46-55, 5 figs.

to suspect that the amber specimens, which I examined, may represent more than two very closely related forms. The worker major of *G. howardi* shows that the genera *Gesomyrmex* and *Dimorphomyrmex* are more closely related than was supposed. Nevertheless, the gizzard of *D. andei* figured by Emery[7] is quite different from the gizzard of *G. capperi* figured by André. In the former insect the organ is short and broad with short, terminally reflected calyx-lobes, in the latter long and slender and more as in *Camponotus* and *Oecophylla.*

The thickened bases of the femora of *G. howardi* indicate that this ant can jump like the large-eyed *Gigantiops destructor* Fabr. of the Neotropical Region, and the rather feeble tarsal claws would seem to indicate that it is not arboreal but nests in the ground.

24. *Camponotus* (*Myrmoturba*) *nicobarensis* Mayr ☿ ♀—Many specimens from Honan Island, Canton.

25. *Camponotus* (*Myrmoturba*) *mitis* Sm. ☿—Many specimens from Canton.

26. *Camponotus* (*Myrmoturba*) *barbatus* Roger var *albosparsus* Forel ☿—Eight specimens from Canton.

27. *Camponotus* (*Myrmosericus*) *rufoglaucus* Jerd. subsp. *paria* Emery ☿—Numerous specimens from Tei-loi, Canton.

28. *Polyrhachis* (*Myrma*) *mayri* Roger ☿—Three specimens from Canton.

29. *Polyrhacis* (*Myrmhopla*) *dives* Sm. ☿ ♂—Numerous specimens from Canton.

30. *Polyrhachis* (*Cyrtomyrma*) *rastellata* Sm. subsp. *laevior* Roger var. *debilis* Emery ☿—Three specimens from Canton.

[7] Descriptions de deux fourmis nouvelles. Ann. Soc. Ent. France 63, 1894, pp. 72-74, 2 figs.

ON SOME RECENT REMARKS ON THE PHYLOGENY OF HOMOPTERA.

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In a recent publication Dr. G. C. Crampton[1] remarks: "In any phylogenetic study we must consider the lowest representatives rather than the highly specialized members of a group."

Unfortunately Dr. Crampton, on more than one occasion when discussing the phylogeny of Homoptera, has not followed this good advice. In a recent paper[2] he has compared the wing of a Psyllid and a wing of a Psocid and concluded that their similarity is due to their common ancestry. The Psocid wing he figures is a specialized one and not the lowest representative of the group, and Psyllidæ are highly specialized Homoptera. Any similarity between the venation of the wings of these two insects is therefore of no phylogenetic significance, but due to convergence.

As I am not an authority upon the Psocidæ I can only support my contention by a comparison of the Psocid wing figured by Dr. Crampton with such genera as *Amphientomum* and *Cymatopsocus,* where the venation is more generalized but still too specialized to be ancestral to the Homoptera.

My contention that the Psyllidæ do not represent the primitive type of Homoptera is based upon a detailed study of the suborder. The evidence is too lengthy to give in detail in this paper, but the following is a brief summary of some of the points.

The Hemiptera form a homogeneous and monophyletic order characterized by a unique shape and arrangement of the mouth parts found in no other order of insects. Although the order is of great size and the forms found within it are very diverse, yet the mouthparts are always of the same type and far more uniform than is found in any other of the large orders. That such a type of mouth organs should have arisen independently in two or more groups seems highly improbable.

The nearest approach to the Hemipterous mouthparts is found

[1] Proc. Ent. Soc. Washington 23, 2, p. 37 (1921).
[2] Ent. News XXII, No. 4, p. 97-105 (1921).

in the Thysanoptera. But here we find two distinct types of mouth organs and both are so dissimilar to the Hemiptera that it is not likely that one arose from the other. The Psocidæ possess a semi-free maxillary style which may represent a condition found in the ancestors of the Hemiptera, but no Psocids that we know today could have been that ancestor because they are far too specialized in certain directions.

The most generalized head in the Hemiptera is found among the Heteroptera where the gula is well developed or very large, the head capsule of more normal shape and position, the labium is four-jointed and consists of a submentum, mentum, subgalea with amalgamated paraglossa and lacinia. In some few species the labial palpi are also present. In the Homoptera the gula has disappeared or is represented only by a membrane, and the labium is in close association with the pronotum. The reduction of the gula has drawn the head downward and under, bringing the top of the head to the front and altering the whole shape of the head capsule. In this respect the Cicadoidea are more primitive than the Fulgoroidea.

In the Sternorhynchi this line of evolution of head set up in the Auchenorhynchi is carried to a still greater extent. In the Psyllidæ the clypeus, frons (bearing the phrayngeal muscles), tentorial structure and the labium have separated themselves from the head capsule and become still more closely connected with prosternum. To accommodate the long mandibular and maxillary setæ an invagination at the base of the labium penetrates the prothorax. In the Coccidæ the reduction of the head capsule is carried to the extreme, so that the frons, clypeus, tentorial structure, labium and the styles are isolated in a membraneous area and appear to be thoracic structures. The line of evolution of the head of the Hemiptera is so well defined that any student of comparative morphology, except an extreme mutationist, will agree that the Psyllidæ are highly specialized and do not represent the ancestral form.

The Hemiptera can be divided into two groups on the condition of the alimentary canal. In the Heteroptera, Fulgoroidea and Cicadellidæ this is simple. In the Cicadadæ, Cercopidæ, Membracidæ and the Sternorhynchi the posterior portion of the midgut is in intimate contact with the anterior portion and forms a filter

chamber. This is of a simple nature in the Psyllidæ. The fact that this division separates the Cicadellidæ and the Membracidæ raises difficulties, as they are otherwise so closely related. It seems improbable that such a condition arose in two or more groups independently. It seems more probable that it has been lost in two or more groups independently. Kershaw has shown that the connection is fully developed in nymphs when hatched, so that it is an embryonic character and not a later development to meet special conditions.

Judging by venation the Hemiptera must have divided into two groups, the Homoptera and Heteroptera, early in the history of the order, but not early enough, in my opinion, to justify making it into two orders. A very slight study of the venation of the Homoptera shows that the nearest approach to the hypothetical ancestral type is not found among the Psyllidæ but among the Auchenorhynchi.

A study of the hind legs also indicate a state of high specialization in the Psyllidæ.

Again, in discussing the male genitalia of Homoptera, Dr. Crampton has offended against his own advice. Although there are several distinct types of both male and female genitalia among the Auchenorhynchi he has selected Ormenis as the type to homologize with other orders. But unless it can be shown that this genus possesses a generalized type, any homologies drawn from it are of little phylogenetic value.

Among the Cicadoidea we have two distinct types of male genitalia and a third in the Fulgoroidea. Cicadadæ have no genital styles or these are only rudimentary and are articulated and the aedeagus comparatively simple. This is most likely specialization by reduction. In the other Cicadoidea there are two pairs of appendages, the outer pair or plates and the inner pair. In some forms the outer pair are amalgamated together and appear to be part of the pygofer. In the Membracidæ the aedeagus is generally simple; in the Cercopidæ it is often complex; in the Cicadellidæ it is of various forms, some of which are highly complex and others greatly reduced. In the Fulgoroidea there is only one pair of styles, which in certain cases are amalgamated into a single organ.

Both the inner styles of the Cicadoidea and the styles of the

Fulgoroidea are in connection with the base of the ædeagus. They are probably homologous.

In the Fulgoroidea there is great diversity of structure and it is very difficult to decide which is the most generalized. In certain forms (i. e., certain Delphacidæ) it is of a simple tubular nature with a small ring round its base. In other forms this ring is greatly enlarged and forms an outer tube around the inner tube. In some forms there are even three tubes and one may be exceedingly complex.

Until we understand the homologies of the various types within the order Hemiptera any homologizing with other orders is but guesswork and not scientific evidence, although the guesses may be correct.

Dr. Crampton has so often associated the Psocidæ and Psyllidæ together, as if the latter were descended from the former and all else followed naturally, that there is a possibility of readers not acquainted with the Homoptera accepting that conclusion as well founded. For that reason I raise the above objections.

Certain remarks in Dr. Crampton's papers leads one to believe that he holds views on evolution considerably different to those of the majority of biologists; or his metaphors are so anthropomorphic that they are misleading. As an example of this I quote from a recent work:[3]

"Taking their anatomy as a whole, the Hymenoptera show undoubted affinities with the Neuropteroid insects (i. e., the Neuroptera, Mecoptera, Tricoptera, etc.), but they also present certain points of similarity to the Psocoid insects, such as the Homoptera, Thysanoptera, Psocida, etc. The lines of development of all of these forms apparently arose from ancestors intermediate between the Zoraptera (with the Isoptera) on the one side, and the Coleoptera (with the Dermaptera) on the other—much as a family of children inherit traits from the father's side—and I am inclined to consider that the Hymenoptera inherited their social tendencies from the side of the Zoraptera (with the Isoptera) while their type of genitalia apparently comes from the side of the Coleoptera (with the Dermaptera)."

Does Dr. Crampton believe that new orders arise as hybrids from the crossing of individuals belonging to different orders, or are things not what they seem in the quoted paragraph?

[3] Ent. News XXXII 5, (1921) p. 137.

NOTES AND DESCRIPTIONS OF A FEW NORTH AMERICAN DOLICHOPODIDÆ (DIPTERA).

By M. C. Van Duzee
Buffalo, N. Y.

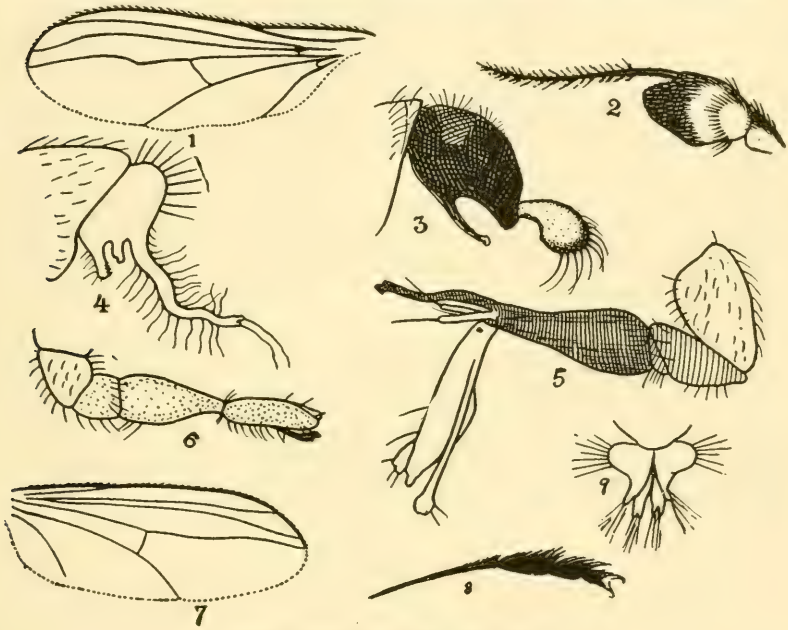
Diaphorus hirsutus sp. nov.

Male: Length 4–4.5 mm.; of wing 4 mm. Face narrow, silvery white. Palpi yellow, proboscis brownish. Front nearly opaque with grey pollen, the ocular tubercul more blackish; ocullar bristles long, a bristle close to the orbit on each side curves forward. Antennæ black; first joint long, hairy above; second joint large with rather long bristles at tip; third small, not as large as second, rounded at tip; arista basal, long, pubescent. Lateral and inferior orbital cilia whitish, five or six of the upper cilia on each side black.

Thorax nearly opaque with brown pollen, the median line on the dorsum and the scutellum green, quite shining; acrostichal bristles small, in a single row; six large dorsocentral bristles on each side; scutellum with four large bristles on its margin; pleuræ more blackish with gray pollen, its posterior edge yellow. Abdomen yellow with the posterior edge of first segment, large triangles on the dorsum of second, third and fourth, which nearly reach the preceding segment on the median line and the sides on the posterior margin of the segments, and nearly the whole of fifth and sixth segments, shining green or bronze; hairs on the dorsum rather long, especially near the base of the abdomen, those on the sides of the abdomen yellowish. Hypopygium rather conspicuous, blackish, still more or less yellow towards the ventral point; its appendages small brownish lamellæ, it has about four rather long and conspicuous, although not very stout bristles at tip.

Coxæ yellow; middle pair with a blackish streak on outer side; fore and middle pairs with black bristles on the apical half of their anterior surface. Femora and tibiæ yellow, very hairy; fore femora with a few slender bristles on the apical part of the lower posterior edge, which are as long as the width of the femora; posterior femora infuscated on apical half of upper surface, and the slender hairs of their lower surface as long as the width of the femora; bristles on upper surface of the tibiæ small and incon-

spicuous. Tarsi hairy, more or less blackish from the tip of the first joint; fore and middle tarsi nearly as long as their tibiæ, the former with fourth and fifth joints of about equal length. All fifth tarsal joints with bristle-like hairs at tip; their pulvilli much enlarged and with the empodium also elongated and hairy, appear-



EXPLANATION OF FIGURES.

Fig 1, **Diaphorus hirsutus** sp. nov., wing.; Fig. 2, **Proarchus violaceus** sp. nov., antenna; Fig. 3, **Proarchus violaceus** sp. nov., Hypopygium; Fig. 4, **Leucostola terminalis** VanDuzee, hypopygium of male; Fig. 5, **Thripiticus longicauda** sp. nov., hypopygium of male; Fig. 6, **Thripticus nigripes** sp. nov., hypopygium of male; Fig. 7, **Paraclius ornatus** sp. nov., wing; Fig. 8, **Paraclius ornatus** sp. nov., last four joints of fore tarsus; Fig. 9, **Paraclius ornatus** sp. nov., outer appendages of the hypopygium of male.

ing like claws when seen with a low-power lense; hind tarsi scarcely as long as their tibiæ, the first and second joints of nearly equal length. Calypters and halteres pale yellow, the former with a brown tip and yellowish cilia.

Wings (Fig. 1) grayish; first vein reaching a little more than one-third the distance from the root of the wing to tip of second vein; third vein bent backward at tip; last section of fourth vein with a quite abrupt bend at a point opposite the tip of fifth vein,

from which point it is parallel with third vein and ends in the apex of the wing; sixth vein reaching the wing margin; anal angle rounded but rather full, the wing being of somewhat parallel width.

Female: Two females which seem to belong here have the face wide, still rather narrow for a female, white. They have only the second and third abdominal segments yellow on the dorsum, these have the same metallic triangles as are found in the male; the legs and feet have only short hairs; the scutellum has one pair of bristles; the second vein reaches only half the distance to the tip of second; last section of fourth vein is nearly straight and parallel with third.

Described from three males and two females from California; the males were taken at Berkeley, Calif., May 10, 20 and 28, 1915; the females at Alpine, San Diego County, April 8 and 11, 1915. Type in the author's collection.

Diaphorus fuscus nom. nov.

D. adustus Van Duzee, Bulletin of the Buffalo Society of Natural Sciences, Vol. XI, p. 173, 1915, as the name *Diaphorus adustus* Wied. of Europe has precedence. I would change the name of my species to *Diaphorus fuscus.*

Leucostola terminalis Van Duzee.

In the Entomological News, Vol. XXV, p. 405, I described a female under this name. Since then I have seen several male specimens, one of which is in my collection. It agrees with the female described in having the first antennal joint wholly yellow, it also has the reddish coppery stripes above the root of the wing, although they are not as conspicuous and are divided into two spots, one at the suture and one above the root of the wing. It has the last two joints of the middle tarsi, a little flattened, of about equal length, each nearly as wide as long, the two taken together about as long as the third joint; hind tibiæ black at tip for nearly one-fourth their length; hind tarsi wholly black, the second joint a little longer than the first; last section of fourth vein only a little bent at its middle; hypopygium (Fig. 4) with its lamellæ developed into long hairy filaments, and with two bristles at tip, which are slender and hair-like.

Proarchus (*Phylarchus*) Aldrich.

Dr. Aldrich described this genus from two females taken in Mexico, and has placed the genus in the Thinophilinæ. I have a species found in New York and Virgina which I am placing in that genus. It has the antennæ and plumose arista as in his species, the face of the female is as he described it (about as in Pelastonerus). My specimens have distinct acrostichal bristles, while his species was destitute of these bristles. The hypypygium of this new species is large, extending forward under the venter, as in Dolichopus and its lamellæ are as in that genus (fig. 3). If the male of his species proves to have the hypopygium as in my species, it would place the genus in Dolichopodinæ, I should say after Polymedon, or perhaps after Sarcionus and next to Pelastoneurus, from which it is separated by its nearly parallel third and fourth veins.

This would place the genus near the European genus Poecilobthrus Mik. The female of the only species of that genus that I have seen, *P. nobilitans,* has the face formed very much as in Pelastoneurus and has a plumose arista. I should place our species in that genus, only the second and third veins are not approximated nor the wing of the male ornamented with black as in all species of Poecilobothrus known to me.

Proarchus violaceus sp. nov.

Male: Length 4–4.5 mm.; of wing 4 mm. Face wide, covered with grayish-white pollen, sometimes almost silvery, upper portion a little concave and with a slightly depressed median line, the lower part rather short and slightly convex. Front dark violet, sometimes almost black, a little dulled with brown pollen. Palpi yellow with black hairs and a little white pollen. Antennæ (fig. 2) yellow; third joint sometimes mostly brown, short, somewhat oval in outline; arista dorsal, distinctly plumose, although the hairs are not long. Orbital cilia wholly black.

Dorsum of the thorax violet with the lateral and anterior margins quite broadly greenish; acrostichal bristles rather large, in two rows; scutellum violet with two large and two very small bristles on its margin; pleuræ more black with gray pollen. Abdomen green with white pollen; incisures black; hind margins of segments with stiff black bristles. Hypopygium (fig. 3) formed

about as in Dolichopus, black, greenish on basal half; its lamellæ large, somewhat oval but tapering into the stem, yellowish with a wide black border on the apical margin, which is jagged and fringed with long black bristles.

Coxæ, femora and tibiæ yellow; middle coxæ blackened on outer surface, hind ones a little infuscated at base; fore coxæ covered with black hairs on their anterior surface, hind ones with one large and one small bristle on outer surface. Middle and hind tobiæ each with four blackish spots on upper surface where the bristles are inserted. Fore tarsi a little longer than their tibiæ, a little blackened from the tip of the first joint; middle and hind tarsi black from the tip of the first joint, the latter with the first joint distinctly shorter than the second. Calypers and halteres pale yellow, the former with black cilia.

Wings grayish, tinged with brown in front of the third vein; broad, distinctly expanded at tip of fifth vein; anal angle prominent, although the hind margin of the wing is slightly excavated at tip of sixth vein; costa slightly thicker from the tip of the first vein; last section of fourth vein nearly straight, ending a little before the apex of the wing, nearly parallel with third vein, which is a little bent backward so as to approach fourth vein a very little at tip; cross-vein a little more than its length from the wing margin, measured on fifth vein.

Female: Face a little wider than in the male; color of head, thorax, abdomen and legs as in the male; wings as in the male, but not quite as wide at tip of fifth vein.

Described from three males and three females; I took the holotype and allotype at Dayton, Erie County, N. Y., July 5, 1920; two males were taken by Mr. Banks at Falls Church, Va., May 30; one female was taken by Mr. Hine at Kent, Ohio, June 18; and one female was taken at Bridgewater, Mass., July 11.

Table of North American Species of Thripticus. Males.

1. Femora black, or green 2
   Femora yellow 4
2. Hypopygium with yellow lamellæ (Calif.), *longicauda* sp. nov.
   Hypopygineal lamellæ brown 3
3. Hypopygium somewhat oval in outline, rather thick (Calif., Mex., N. Y.) ..... *fraterculus* Wh.

Hypopygium rather slender, tapering towards its apex, more conical than oval (Nev.) ..... *nigripes* sp. nov.

4. Venter and part of the dorsum of the abdomen yellow 5
Abdomen without yellow, except sometimes on the venter .. 6

5. Whole of sixth abdominal segment and base of the hypopygium yellow (W. I.) ..... *cupuliferous* Ald.
First abdominal segment and more or less of the base of the hypopygium yellow (Ind., Mo., N. C., Ga., D. C., N. Y.) ..... *abdominalis* Say

6. Hypopygium ovipositor-like, bent under the abdomen (W. I.) ..... *singularis* Ald.
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Fourth vein only gently bent at the cross-vein 8

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Capsule pointed at tip (N. Y., Md.) ... *muhlenbergiæ* J. & C.

10. Hypopyginal lamellæ sessil, rounded at tip (N. Y.) *tectus V. D.*
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Lamellæ decidedly longer than wide 12

12. Thorax with violet reflections and with a golden spot on the posterior slope before the scutellum (Ga.) *aurinotatus* V. D.
Thorax green or purple with the posterior slope green 13

13. Thoracic dorsum purple; hypopygium rather pointed, its lamellæ pointed at tip (Mex.) ..... *pusillus* Ald.
Dorsum of thorax green; hypopygium rounded at apex, its lamellæ rounded at tip (N. Y., Ont.) ..... *comosus* V. D.

Thrypticus nigripes sp. nov.

Male: Length 1.75 mm. Face, front, thorax and abdomen dark shining blue-green. Face very narrow below. Antennæ and mouth parts black. Bristles of the thorax and the conspicuous hairs on the abdomen yellow. Hypopygium blue-green, its hairs yellow;

the lamellæ brown, large, about as long as the main portion of the hypopygium, rather bare (fig. 6).

Coxæ, legs and feet black, except the extreme tips of the coxæ and the trochanters, which are yellowish. Calypters, their cilia and the halteres yellow.

Wings nearly hyaline; third and fourth veins nearly parallel.

Female: Face a little wider; otherwise about as in the male.

Described from one male and two females which I took at Wells, Nev., June 6, 1915. Type in the author's collection.

The wings in all my specimens are in poor condition. This is very much like *T. fraterculus* Wh., it differs in having the capsule of the hypopygium conical, not oval as in Wheeler's species, and the lamellæ much longer and less hairy.

Thrypticus longicauda sp. nov.

Male: Length 3 mm. Face green, narrow below, the lower edge and the palpi covered with white pollen. Front blackish. Antennæ black, small. Lateral and inferior orbital cilia white. Frontal bristles black.

Thorax green with bronze reflections; there is but one bristle left on the thorax and that is black with the tip more whitish, the minute hairs on the anterior portion are yellow. Abdomen long and slender, green, its hairs and the bristles on the hind margins of the segments are yellow, but they are small and inconspicuous. Hypopygium long and slender, green, its hair yellow (fig. 5); its lamellæ very long, yellow, with a few yellow hairs.

Fore coxæ yellow with white hairs, its basal half on the anterior surface green. Middle and hind coxæ and all the femora green, with the tips of coxæ, extreme base of middle and hind femora, apical third of fore, and apical two-thirds of middle femora, tips of hind femora, and all tibiæ and tarsi yellow. Fore and middle tarsi nearly twice as long as their tibiæ. Second joint of hind tarsi longer than the first. Calypters, their cilia and the halteres yellow.

Wings grayish; costa black; veins brown; third and fourth veins parallel, the fourth ending in the apex of the wing; last section of fifth vein nearly three times as long as the cross-vein.

Female: Face wider; thorax with black and yellow bristles mixed; coxæ and femora mostly black; tibiæ and tarsi yellowish

brown; fore tarsi scarcely one and a half times as long as their tibiæ. Wings as in the male.

Described from one pair which I took at San Francisco, California, May 12, 1915. Type in the author's collection.

Paraclius minutus sp. nov.

Male: Length 2.5 mm.; of wing 2 mm. Face rather narrow, covered with white pollen, the suture near apical third, lower portion flat. Palpi blackish with a little white pollen and black hairs. Front almost opaque with brown pollen. First two antennal joints yellow; third mostly brown, small, rounded at tip. Arista long with long pubescence, but scarcely plumose. Inferior orbital cilia whitish.

Thorax greenish, dorsum more brown with coppery reflections, which form a median vitta extending to the hind margin of the scutellum. The ante-alar black spots distinct but nearly divided by the green of the dorsum; when viewed from behind there are four silvery-white spots visible, a large one at the lower edge of the front end of the black spot, and a very small one above the root of the wing; pleauræ and coxæ covered with white pollen. Abdomen green; the spots of white pollen on its sides not very conspicuous. Hypopygium rather small, entirely sessel, black; its lamellæ quite small, black, they appear to be nearly bare on their edges.

Coxæ yellow, middle ones blackened on basal half, hind ones a little blackened at base; anterior pair with black hairs on their front surface. Femora and tibiæ yellow. All tarsi black from the tip of the first joint. Calypters and halteres yellow, the former with black cilia.

Wings tinged with brownish gray; first section of costa not thickened, last section of fourth vein rather abruptly bent beyond its middle, beyond which it curves forward so the tip is near the tip of the third vein; last section of fifth vein a little longer than the cross-vein.

Female: About like the male in the width of the face, color and venation, except that the last section of the fifth vein is a little longer.

Described from two males and three females which I took in

Florida, four at Bradentown and one pair at Anna Maria Key, all in March. Type in the author's collection.

This is much like *P. quadrinotatus* Ald., but does not have the anta-alar spots divided as in that species, and these spots are not as large.

Paraclius ornatus sp. nov.

Male: Length 3–3.5 mm.; of wing, the same. Face narrow, silvery-white. Palpi small, yellow, with a black bristle at tip. Proboscis yellow, with a fringe of little yellow hairs on its edge. Front silvery-white, widened above. Antennæ wholly black or with the lower edge of the first joint slightly yellowish; third joint small, about as long as wide, scarcely pointed at tip. Arista dorsal, pubescent. Lower orbital cilia yellowish, slender.

Thorax green with bronze reflections, a little dulled with white pollen; there are no ante-alar black spots. Abdomen green with quite abundant white pollen. Hypopygium small, but little longer than thick, extending forward under the venter, black with green reflections; its outer appendages look like small yellow lamellæ (fig. 9) with black bristles, but they seem to be united at base as in the figure; the inner appendages are darker and rather small, they are deeply slit into three parts at tip.

Coxæ, femora and tibiæ yellow. Fore coxæ with black hairs on the inner edge of their anterior surface; middle and hind coxæ each with a long black bristle on outer side, the former darkened on the outside. Hind femora scarcely darker at tip above, their tibiæ more distinctly brown at tip. Middle and hind femora each with a slender preapical bristle, the former also has smaller ones below near the tip. Fore tarsi (Fig. 8) more than one and a half times as long as their tibiæ, first two joints yellow with their extreme tips blackish, second slightly longer than the first and very thin, it is about as long as the last three joints taken together; third and fourth joints black, compressed and widened, fringed above with little black hairs; fifth yellow with the base narrowly black. Middle tarsi longer than their tibiæ, black from the tip of the first joint. Hind tarsi equal to their tibiæ in length, wholly black, still sometimes the first joint is yellowish at base, first joint shorter than the second. Calypters and halteres yellow, the former with yellow cilia, which appears nearly black in certain lights.

Wings (fig. 7) grayish; third vein bent backward at tip; last section of fourth vein bent at its basal third, approaching third, but bending back a little toward its tip so as to be parallel with third vein for its apical third and ending in the apex of the wing; last section of fifth vein twice as long as the cross-vein; anal angle of wing rounded but rather prominent.

Female: Like the male in general color and the form of the wings. The face is not very wide and is hollowed out almost to its lower edge; face and front wholly silvery-white, proboscis narrowly blackish on the edge, which is fringed with quite conspicuous black hairs. Ovipostor yellowish with a circlet of short, blunt spines at tip. Fore tarsi blackened from the tip of the first joint; their second joint about three-fourths as long as the first.

This female is easily recognized by its venation, together with the silvery front and yellow proboscis and ovipostor.

Described from many males and females. I took them in Williamsville, Erie County, N. Y., August 8 and 29, 1920. Mr. Burns took many at the Palisades, N. J., July 5, 1920.

Holotype and Allotype in the author's collection and taken at Williamsville, N. Y.

Those I took were flying around the surface of the water which was running over the rocks, and resting on the moss and rocks in the little falls, very much as does *Liancalus*. The very short hypopygium would almost separate this species from *Paraclius,* but it is entirely disengaged although sessil and extends a little under the venter.

Paraclius ovatus Van Duzee.

This is the same as *Paraclius venustus* Aldrich, and is therefore a synonym of that species. Dr. Aldrich reports it as abundant in the West Indies and Mexico. I have seen specimens from Georgia and Costa Rica.

CICADELLA GOTHICA SIGN.—A CORRECTION.

By Geo. W. Barber,
U. S. Bureau of Entomology, Arlington, Mass.

In Vol. XXVII, page 147, 1920, of this journal, I have recorded the occurrence of *Cicadella hieroglyphica* (Say) from Massachusetts. The record was an error and was based on a determination submitted to me which, at the time, I had no reason for questioning. The insects recorded under this name are all *Cicadella gothica* Sign., as are all of a large number of specimens from New England at hand.

The confusing of these two species, which has so often happened, is further made possible by the discovery of a dark variety of *gothica* which resembles *Cicadella hieroglyphica,* var. *dolobrata* Ball very closely indeed. This variety seems to be undescribed, and as to its future collection may again lead to a confusion of these species, it may be well to characterize it at this time.

Cicadella gothica, var. *atra* var nov.

General structure and size of *gothica:* Shining black, markings on anterior half of vertex nearly as in *gothica,* except that the yellow area surrounding the black apex is narrowly produced posteriorly for a third the length of the vertex. The black markings on the posterior half of the vertex confused, so that this portion appears solidly black with some light points indicating the yellow markings of *gothica;* eyes irregularly margined with yellow; margins of clavus light. Beneath, black; tips of femora, tibiæ and tarsæ lighter; front, dark brown, median stripe tawny.

One male taken at Lexington, Mass.. September 8, 1920.

This variety is distinct from any dark forms of the typical insect that I have seen, although dark individuals are not uncommon.

SPIDERS FEEDING ON SMALL CYPRINODONTS.

By T. Barbour,
Museum of Comparative Zoology, Harvard University.

This spring was unusually dry in Southern Florida, especially during March and early April. Ponds were low and even the large lakes were considerably reduced in area. This condition may have influenced the habit which I observed and which Mr. Banks and Mr. Emerton have kindly suggested my recording.

While fishing for bass in the upper St. John River, above Lake Washington, where the river is a narrow, sluggish stream, I have always camped to cook my midday meal on a willow tussock in a shallow slough, which offers about the only chance to build a fire in this very boggy country. This year the water in the little bayou was low and the water hyacinths and lettuce plants usually afloat were resting with their roots on the mud in the shallows. The vegetation swarmed with Dolomedes, but then these spiders always seem to have a predilection for creeping about on the floating lettuce, especially. The water, both beneath the plants and in the little open spaces between them, teemed with several species of cyprinodont fishes, of which a Gambusia, beyond doubt affinis, was the most abundant.

After eating, I rested quietly awhile in the stern of my boat, which was partly hauled up on the tussock, hence quite motionless. A tiny flash of silver caught my eye, and I looked again, to see a spider carrying a small dead fish, perhaps an inch long, across a wide leaf to the dark interior of a large lettuce cluster. I thought that probably the spider had found a dead fish by chance, and I relit my pipe, when about six feet away in another direction the episode was repeated. This time the little fish was still struggling feebly in the spider's cheliceræ. Later I saw a third fish being carried off which was dead and quite dry. At the time I presumed that the habit of catching fish was probably well known and I thought no more about the happening until I spoke to my friends and searched the literature with small results.

McCook, in his "American Spiders and their Spinning Work," (Vol. 1, 1889, p. 236, fig. 219), pictures an enormous spider riding on the back of a moribund and gigantic carp, if the relation of

the size of the fish to that of the surrounding lily leaves is normal. The accompanying story of the unique event is too flamboyant to be very convincing. Comstock (Spider Book, 1912, p. 186), offers no original observations but adds, "Several apparently well-authenticated instances of the destruction of small vertebrated animals, including birds, a mouse, a fish and a snake, by spiders that are much smaller than the Avicularia are given by McCook. But, of course, all such occurrences are exceptional." I presume that, given conditions such as I have described, small fish may offer an easy and frequent prey for spiders with the habits of Dolomedes. Otherwise the opportunity to secure such prey cannot be very frequent. The species involved I believe to have been *Dolomedes tenebrosus.*

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Prodryas persephone Scudder.

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VESPA ARCTICA ROHWER, A PARASITE OF *VESPA DIABOLICA* DE SAUSSURE.[1]

By W. M. Wheeler and L. H. Taylor.

The summer of 1921, at least in New England, was a "wasp summer," probably on account of the protracted, hot, dry weather during June and July. Certain species of *Vespa,* especially the common yellow-jacket, *V. diabolica,* were unusually abundant. Probably for this reason we were able to make the following observations on a rare wasp, *V. arctica,* which, as shown by Fletcher in a paper read before the Entomological Society of America (1908), is a parasite in the nest of *diabolica.* Unfortunately, Fletcher died before he could publish his paper, and the very brief notice of it in the proceedings of the Society is all that has appeared.

During the summer of 1921 the senior author spent his vacation at Colebrook, in the Litchfield Hills of Connecticut; the junior author at Forest Hills, near Boston. In both places a number of *diabolica* nests were examined, and in three of them *arctica* was taken. The latter species[2] is black and white, and in size and markings may be very readily mistaken for *V. consobrina* De Saussure, but closer examination shows that it has long cheeks and long hairs on the tibiæ. It lacks, moreover, the worker caste, and therefore differs from all known species of *Vespa,* except *austriaca* Panzer, which will be considered more fully in the sequel. This absence of the worker caste at once suggests that *arctica* is a social parasite like the species of *Psithyrus* in the nests of bumble-bees and certain ants (*Anergates, Epoecus, Epipheidole, Sympheidole, Anergatides,* etc.) in the nests of *Tetramorium, Monomorium* and

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 195.

[2] This species was originally described by Lewis (Trans. Amer. Ent. Soc. 24, 1897, p. 173) as **Vespa borealis,** but Rohwer (in Viereck, Hymenoptera, or Wasp-like Insects of Connecticut, 1916, changed the name to **arctica,** as Kirby had previously described a **V. borealis** (Fauna Boreali-Americana, 1837, p. 264).

Pheidole. *V. arctica* belongs to the Canadian and Upper Transition zones. Sladen (1918) records it as ranging from Nova Scotia to British Columbia. It has been recorded from Amherst, Mass., according to Rohwer (Viereck, 1916), and by him included in the list of Connecticut Hymenoptera as probably occurring in that state. The senior author has taken it repeatedly but sparingly at Colebrook (1200-1600 ft.) during the summers of 1918 and 1919, on the flowers of *Spiræa salicifolia*. Until it was taken by the junior author at Forest Hills during the past summer, there was no record of its occurrence near sea-level and in Eastern Massachusetts.

The three observations that go to confirm Fletcher's contention that *arctica* is a social parasite in the nests of *diabolica* are the following:

1. On July 4, the senior author's attention was called to a *diabolica* nest attached to the bottom of the back-net of his tennis-court, at the surface of the ground, in a bunch of grass and sensitive fern. As the wasps were intimidating the players, the colony was asphyxiated after dusk on July 7 by throwing cloths saturated with carbon bisulphide over the nest. On removing the cloths on the following morning, the nest and its occupants were carefully examined. The structure had attained the size and shape of an orange about 12 cm. in diameter, and contained two broadly elliptical combs, a larger, upper, measuring 8 by 6.5 cm., and a smaller, lower, measuring 7 by 5 mm. There were 64 wasps in the colony, 62 workers of *diabolica*, a queen of the same species, and a queen *arctica*. The upper and older comb had two concentric circles of capped cells, enclosing pupating larvæ and pupæ. The open cells contained eggs and young larvæ of different sizes. Undoubtedly all the brood in this comb represented workers of *diabolica*. The lower comb (Fig. 1) had a single circle of 20 pupæ of *diabolica* on half its area, while the center of the other half was occupied by a clearly defined cluster of 11 very large, elongate cells, each containing a conspicuously large larva. These cells are marked with white crosses in the figure. The remaining cells were very small and short and contained eggs and very young larvæ. Evidently all or nearly all the brood, except the 11 large

larvæ belonged to *diabolica*. These large larvæ, which were nearly ready to pupate, must have belonged to *arctica*, and were probably females. That they had been abundantly fed by the *diabolica* workers and their development favored beyond that of the remaining larvæ was evident from a glance at the two combs. Examination of the two queens, which were of the same size, showed that their wings were mutilated. The apical halves of both wings of the *arctica* queen on the right side had been bitten off. As both queens were still fresh when found in the nest on the morning of July 8 (the *diabolica* queen, when stimulated, still moved her tarsi!) we may infer that both were living together in the nest, though probably not on the best of terms, that the *arctica* queen had probably entered the nest just as the workers were beginning to build the second comb and had oviposited in 11 of its cells, and that the resulting larvæ were being actively fed by the *diabolica* workers, because the parasite's wings were too much mutilated to permit her to leave the nest and forage.

2. On June 29, the junior author killed a colony of *diabolica* which had its nest in the hay-scales of the State Antitoxin Laboratory on the grounds of the Bussey Institution. It was younger than the preceding, had one comb and only a few cells of a second, and contained only a small number of *diabolica* workers and an *arctica* queen. Since the colony was captured during the day, most of the *diabolica* workers were probably out foraging, and the absence of the *diabolica* queen may, perhaps, be accounted for on the same supposition.

3. August 4, the junior author took in the Arnold Arboretum a nest of *diabolica* containing three recently emerged males of *arctica*. In the same nest were about a dozen large larvæ and two or three pupæ, evidently queens, though whether of *diabolica* or *arctica* was not determined, as they were unpigmented. In all probability, however, they belonged to *arctica*. The presence of worker larvæ and pupæ indicated that the queens of both species were in the colony at about the same time (that is, if the time for development of *diabolica* workers is about the same as that required for the *arctica* males), and that at least one of the queens had been in the nest very recently was indicated by the numerous eggs, although these might, of course, have been laid by the workers.

During the entire summer we sought carefully for additional nests of *diabolica* infested with *arctica*, but none was found. At Colebrook the males of *arctica* were not uncommon on the flowers of *Spiraea salicifolia* and *Pastinaca sativa*, usually during the morning or late afternoon hours in three different localities where infested colonies of *diabolica* must have been present but could not be located. The first of these males was captured as early as July 16, and a few were taken every few days throughout the remainder of July and the first two weeks of August. Thereafter the species seemed to have disappeared, though in previous years a few males and females were captured as late as September 1. No males of *V. consobrina* were seen on flowers till July 31, and virgin females and males of *diabolica* did not appear till later (August 20 to 22), and soon afterwards disappeared. It would seem, therefore, that the early emergence and long flying period of the *arctica* males is an adaptation to insuring the fecundation of the much less numerous females, an adaptation the more necessary because the species is very rare most summers, when the host species, too, is less abundant.

The foregoing observations have an important bearing on what has been learned concerning *V. austriaca*. This wasp, which also lacks a worker caste, has long been known in Europe, where it ranges from Ireland to Russia, with a marked preference for mountains up to an altitude of 5500 feet. It seems also to occur in Palearctic Asia. Recently Bequaert (1916) took two females of *austriaca* at Fort Lee, New Jersey, opposite New York City, and recorded a specimen taken by Prof. J. S. Hine on the same day (July 16) on Staten Island. More recently (1918) Sladen has taken *austriaca* at Ottawa and Chelsea, Quebec (mid-June), and at Winnipeg and Kaslo, British Columbia (mid-July), and Bequaert (1920), cites specimens from Savonoski, Alaska (July), Mt. Hood, Oregon (G. P. Engelhardt Coll.), and Beaver Mouth, Selkirk Mountains, British Columbia (J. C. Bradley Coll.). In Europe this wasp has been taken in the nests of *V. rufa* and has been regarded as a parasite of the latter by Morawitz (1864), Schmiedeknecht (1881), Robson (1898), Saunders (1903), Sharp (1893), Pérez (1910), and Bequaert. Carpented and Pack-Beresford (1903) have published a careful account of an *austriaca-rufa*

colony taken in Ireland. They show that the two species are very closely related taxonomically, and infer that "the old *austriaca* queen was the foundress of the nest and that both the *rufa* and *austriaca* are her offspring." The evidence with which they endeavor to support this inference seems to us to be very inconclusive. It is indeed surprising that such accomplished entomologists should have failed to take account of the habits of other parasitic Aculeata, such as *Psothyrus* and the workerless ants, which are all so much better known than the wasps they werestudying.

The occurrence of *austriaca* in the vicinity of New York City and in British America and Alaska, at once raises the question as to its American host, since *rufa* is not known to occur on this side of the Atlantic. Bequaert surmises that *consobrina* may be the American host, and maintains that this wasp, "although very different in coloration, is very probably the American rase or subspecies of *Vespa rufa* L." If this proves to be the case, we should have the short-cheeked, black and yellow *austriaca* living with the short-cheeked, blach and white *consobrina,* just as our long-cheeked, black and white *arctica* lives with the long-cheeked, black and yellow *diabolica.*

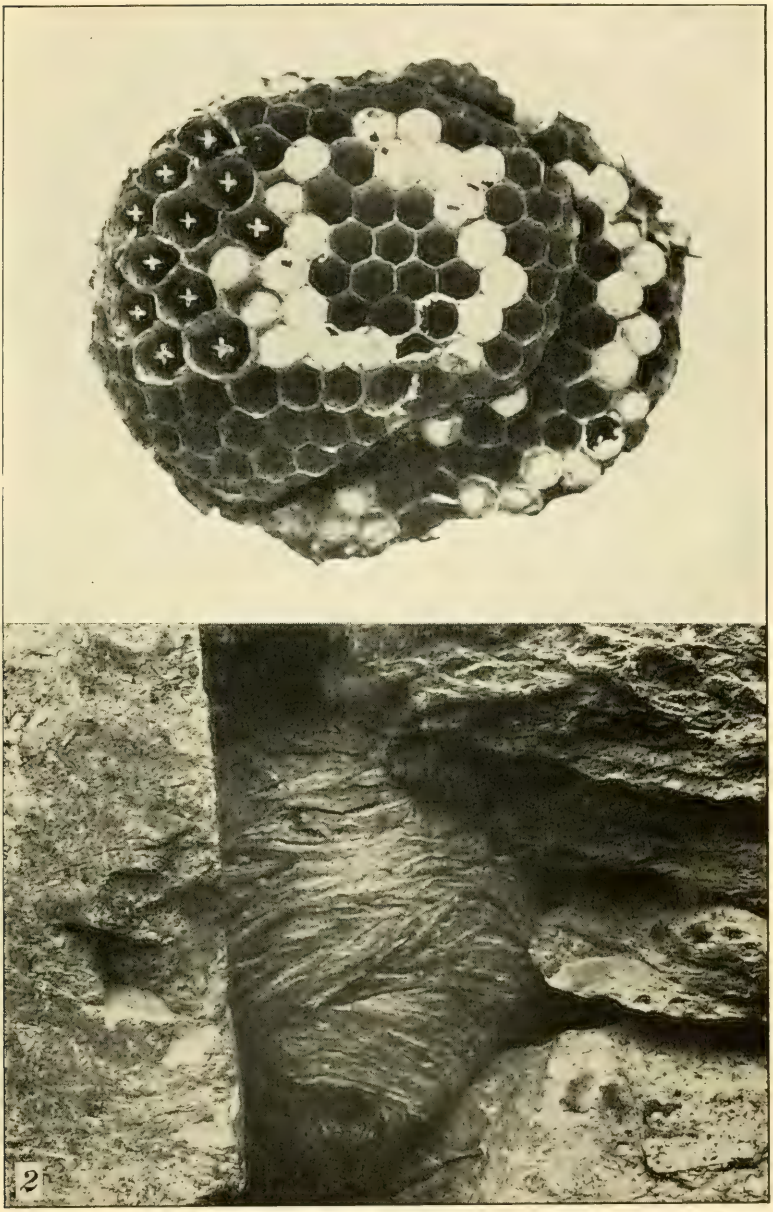
The dates of flight of male and female *austriaca* and *rufa*, carefully recorded by British entomologists (Carpenter and Pack-Beresford and Evans (1903)), indicate that the *austriaca* queens issue from hibernation later in the spring than the nest-founding *rufa* queens. The same is probably also true of *arctica* as compared with *diabolica.* Hence the parasitic queens, when they first appear in the spring, find the host nests already well-established and containing a worker personnel ready to nurse the parasitic brood. The parasitic *Psithyri* show the same tendency to enter the *Bombus* colonies only after their first batch of workers has emerged (Sladen, 1912), and the parasitic ants take a similar advantage of their host species.

The presence of both host and parasitic queens in the *arctica-diabolica* nest examined by the senior author at Colebrook, raises the question as to the probable eventual fate of the host queen in infested nests. In the various cases of the mixed colonies among ants the host queen is soon eliminated, and, according to Sladen (1912), the same rule applies to the *Bombus* queens of colonies

invaded by *Psithyrus* and to the queen of *B. terrestris lucorum* when its nest is invaded by the queen of *B. terrestris virginalis*.[1] Had the Colebrook *arctica-diabolica* colony, which was still young when asphyxiated, been permitted to continue its growth and development, the *diabolica* queen might, of course, have been eliminated. This would, indeed, seem probable, if we may judge from the observations of Robson and Carpenter and Pack-Beresford on *austriaca-rufa* colonies, which were well-developed when examined. The colony observed by Robson had no *rufa* queen, but must have been founded by one, since typical *rufa* males were present. He saw the *rufa* workers dragging out of the nest the decapitated and mutilated carcass of an *austriaca queen,* presumably after her brood had been reared by the *rufa* workers. Thus it would seem that in this colony the host-queen had been killed either by her own workers or by the parasitic queen, and that the latter had been killed by the *rufa* workers or had died a natural death in the nest after completing her life-work. Carpenter and Pack-Beresford give a detailed census of their *austriaca-rufa* colony. It contained an old *austriaca* but no *rufa* queen, besides many males and three pupal queens of *austriaca*. In this case also, the host queen seems to have been eliminated earlier in the season.

The absence of the host-queen from nests infested by the parasitic wasps, as in the nests of *austriaca-rufa* just considered and the two *arctica-diabolica* nests found by the junior author, may be due, nevertheless, to quite other causes. Desertion of the nest by its foundress, even after brood is present, or her destruction while foraging, may leave the colony motherless and open to invasion by parasitic queens. Janet (1903) has even observel the invasion of a motherless *V. crabro* nest by a strange *crabro* queen, and her adoption by the workers. Both Janet and Marchal (1896) have failed to find the queen in several nests of this wasp, and the latter shows that in the case of *V. media* the queen is so short-lived that she completes oviposition by the beginning of August and disappears soon afterwards. The development of *media* colonies is, therefore, considerably accelerated as compared with the colonies

[1] This rule does not seem to apply to some of our American Psithyrus-Bombus colonies, to judge from the very interesting, unpublished observations made by Mr. O. E. Plath at the Bussey Institution during the past summer.



Wheeler & Taylor — *Vespa diabolica*

Fig. 1. Combs from nest of Vespa diabolica taken by the senior author at Colebrook, Conn. The white croses at the left mark the large cells occupied by the larvæ of the parasite, Vespa arctica. Natural size.

Fig. 2. Typical nest of Vespa diabolica. about 2/5 natural size.

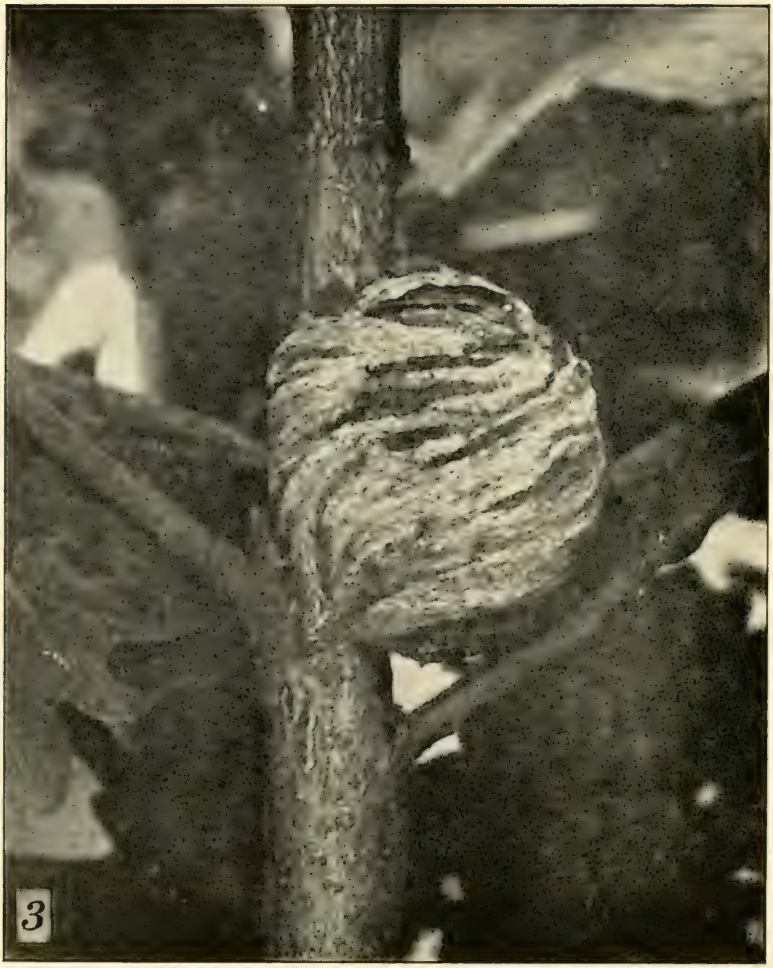


Fig. 3. Nest built by workers of **Vespa diabolica.** Natural size.

of *V. germanica* and *communis,* in which the mother queen is often found as late as the last of September or early October.

Perhaps the *diabolica queen* may resemble the *crabro* queen in her tendency to desert an incipient nest and found another, or perhaps, as a rule, she may desert her nest as soon as it is invaded by an *arctica* queen. That she is short-lived, like the queen of *media,* seems to be indicated by the following observations on uninfested nests:

July 21, the senior author asphyxiated a *diabolica* colony which was nesting very near the ground at the base of a cluster of goldenrods in a deserted pasture. The nest was well-developed, with two large combs and a very small, four-celled third comb. There were 76 workers but no queen, although her presence might have been expected, since the colony was asphyxiated after dark.

August 27, the senior author found depending from the ceiling of a porch a small abandoned *diabolica* nest. It had only a single small comb, about 3.5 cm. in diameter, containing some dead worker pupæ and small larvæ. A similar deserted nest was found earlier in the season attached to the limb of a tree.

Also on August 27 a large, well-developed *diabolica* nest was found under the roof of a water-tank. Two living workers were still clinging to the involucre, which contained three well-developed combs. There were a few living worker pupæ in the combs and a number of dead workers that had fallen from the nest. The males and virgin females had departed, so that the colony must have completed its development several days and possibly a few weeks before the first of September.

Of eight *diabolica* nests taken by the junior author before August 4, on the grounds of the Arnold Arboretum, only one contained an old queen, although in each case care was taken to secure the entire colony.

A flourishing colony of *V. diabolica* comprising 200 to 250 workers, also without a queen, was taken August 10. The apparently exclusive emergence of males from this colony, as a result of which there were scarcely 25 workers left in the nest by Sep-

tember 10, suggested that the queen might have been absent for some time before the earlier date.[1]

Of two *diabolica* nests taken September 14, one contained approximately 150 workers and 250 males, though the colony must have numbered fully a thousand during its prime. This nest had no queen, but in the other one killed the same day, along with 40 workers and 60 males, was a single virgin female, the last of a considerable number that the colony had produced.

Our observations on *V. arctica* and *diabolica*, though fragmentary, seem to justify the following conclusions:

1. The nest-founding queen of *V. diabolica*, like that of the European *media*, is rather short-lived, completing oviposition and perishing rather early in the season, probably not later than the middle or early part of August, at least during favorable summers.

2. There are some indications that the *diabolica* queen, like the *crabro* queen, has a tendency to desert her nest in an incipient stage and found another.

3. *V. arctica* is a permanent social parasite in the nest of *diabolica*, and her brood, consisting exclusively of males and fertile females, is reared by the *diabolica* workers.

4. The over-wintering queen of *arctica*, like that of *austriaca*, probably appears late in spring, at a time when the nests of the host-species are already established and contain enough workers to nurse her brood.

[1] In taking this nest at dusk the junior author failed to capture about a dozen workers which were still flying about, and which finally settled on the tree from which the nest had been cut. Deprived of their habitation, and even of the branch which supported it, these few workers were huddled together the next evening at a place remote from the original position of the nest. Closer observation revealed that they had already attached bits of newly-made paper to the bark of the tree. It was about this paper that the workers were congregated. By the end of the second day the wasps had suspended a single cell from a strong filament of paper after the manner of a queen in founding her nest in the spring, and in a few more days the structure had begun to assume the proportions of a normal nest. On September 10 it was about the size of a hen's egg and there were still two or three workers defending it (Fig. 3). Six days later this nest was found torn open, apparently by a predator, perhaps a bird, which had robbed it of whatever it might have contained, thereby preventing further observation.

The construction of nests by workers of European species of wasps has been observed by several authors, notably Janet (1903), who describes three new nests built successively by workers of the same colony. Other accounts are given by Ormerod (1859), Stone (1860), von Siebold (1871), Kristof (1878) and Marchal (1896).

5. The fate of the host queen in such nests is unknown. Whether she voluntarily deserts the nest soon after the parasite enters or is killed by the latter or by her own workers, or whether the parasitic queen has a tendency to enter young motherless nests of the host species, remains to be determind. That both queens may occasionally live side by side for some time, would seem to be demonstrated by the colony examined by the senior author.

6. From what is known of *V. arctica* and *austriaca* we may conclude that these workerless wasps have essentially the same relations to their host-colonies as the parasitic *Psithyri* and workerless ants (*Anergates,* etc.).

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NOTES ON DEFENSIVE SCENT GLANDS OF CERTAIN COLEOPTERA.

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The attention of the writer was first directed to the functions of defensive or repugnatorial scent glands in certain Coleoptera during the study some time ago of the biology of some of the more common species of Coleoptera belonging to the Tenebrionid tribe Eleodini, inhabiting portions of the central Great Plains region. Later, a growing interest led to closer field observation and to the examination, as opportunity offered, of available literature on the subject. The notes which follow are intended merely to supplement data already published, to which reference is made.

It is obvious to anyone at all familiar with insect life, that the degree of sensitiveness and response in insects to certain external phenomena is enormously greater than in vertebrates, and that their organs of sense are developed accordingly. It always has been a cause for wonder to human beings as to the means by which the various lower animals recognize, distinguish and communicate with each other. Although we know very little about the senses of the lower animals, it long has been known that such senses as sight or touch are not nearly so important to insects as to us. We know that insects actually do distinguish and communicate with each other, or are attracted or repelled by each other, and as the means of communication are not known to use, may we not safely assume that such is brought about through factors, the existence of which is not yet recognized or understood? Packard (1898) has called attention to the ease and rapidity with which exceedingly delicate, attenuated, and highly volatile odors unknown to us are perceptible to insects. McIndoo (1917) has suggested the presence of a chemical sense or senses, somewhat comparable to our olfactory sense, which receives and transmits stimuli in a way somewhat like that of odors, and has ably discussed the results of observations and experiments upon certain insects, and has given a short historical review of the literature on the subject. In fact,

the subject as a whole in its relation to animal ecology makes a powerful appeal to the human imagination.

It has been well understood that the presence of defensive or repugnatorial scent glands in certain insects exists in direct adaptation to the needs and habits of their owners and in close response to their environment; also that such glands are of very frequent occurrence and with much variation as to position, form, and function; and that their presence is of value to the insect for repellent, defensive, and warning purposes. These eversible glands most frequently occur in the form of simple hypodermic pouches from which can be emitted, when desired, varying amounts of an odorous spray capable of permeating throughout considerable surrounding atmosphere. Biologically speaking, the principle involved in such cases, though often modified, is practically identical with that of the mephitic, sulphuretted, oil-like fluid ejected by the skunks. Thus far anal glands are known to be present in the following families of Coleoptera: Cicindelidæ, Carabidæ, Dytiscidæ, Gyrinidæ, Staphylinidæ, Silphidæ, and Tenebrionidæ. The blood itself serves as a repellent fluid in the Meloidæ, and in the Coccinellidæ and Lampyridæ, and it issues from a pore at the end of femur as a yellowish fluid. The cantharidine in the blood of some species of Meloidæ, commonly known as "Spanish Fly," forms an especially caustic protection against birds, predaceous insects and reptiles. A number of the Carabidæ eject from a pair of anal glands a pungent, acid, and often corrosive fluid, staining the hands a rust-red color, and in *Galerita janus* Fab., the "Bombardier beetles" (*Brachinus*), and others, it "explodes" or volatilizes as soon as it comes in contact with the air, and the discharge and puff of vapor is accompanied by an audible report. This occurrence may be repeated over and over again in succession at frequent intervals. Westwood (1839) has recorded that specimens of a *Brachinus* of large size from South America, when captured "immediately began to play off their artillery, burning and staining the flesh to such a degree that only a few specimens could be captured with the naked hand, leaving a mark which remained for a considerable time." The odor of rose or hyacinth given out by certain Cicindelidæ, or the fragrance exhaled by the European *Aromia moschata,* are secretions probably formed by similar glands.

The larvæ of certain Coleoptera, notably in the Chrysomelidæ, also are supplied with eversible hypodermal glands of various kinds. Folsom (1906) states that "the larvæ of *Melasoma lapponicum* evert numerous paired vesicles which emit a peculiar odor."

Packard has divided all scent-producing organs into repugnatorial and alluring organs, and a third class including those for recognition only, has been suggested by McIndoo, who has directed attention to the fact that it often is impossible to determine purposes for which such organs are used.

During the summer and fall of 1914 and the spring of 1915 collections of various species of adults of Eleodiini for breeding purposes, aggregating several thousand specimens, were made by the writer over a considerable area in Western Kansas and Western Nebraska, and during this period there were many opportunities for making observations relative to a curious habit possessed by many members of that tribe. When disturbed, many of them have a habit of standing on their anterior and middle legs, elevating the abdomen to its utmost height, appearing at times fairly to stand upon their heads, and spurting sidewise right and left from their eversible repugnatorial glands, a persistently malodorous liquid having a peculiar penetrant odor, and capable, when brought into accidental contact with the skin of the human hand, of making a stain almost impossible to wash off, and the odor of which varies in intensity with some of the species.

"The smell of the glandular secretions," says Gissler (1879), "is to my knowledge incomparable to anything else." The glands of the species examined, *Eleodes gigantea* Mann., are in both sexes embedded in the fat bodies on each side of the intestinal tract, and consist of two reddish-brown organs about 6 mm. in length, somewhat cylindrical at one end and roughly flattened at the other. Gissler has records concerning the fluid that "When the secretion is spurted on a glass slide, it solidifies within a few seconds, forming an orange-colored magma of minute crystals, in other cases it only partially crystallizes, and in others it remains entirely liquid. It is in all cases of an acid reaction, and of an intensely penetrant odor, causing the eye to lachrymate. It is soluble in water, alcohol and ether. Boiled with concentrated sulphuric acid and alcohol an ethereal aromatic vapor is produced, indicating the

presence of one or more organic acids. . . . Having tested for valerianic acid in the usual way with neutralized soda solution upon sesquichloride of iron, no red precipitate of valerianate of iron was formed, nor have I obtained a bluish-white opalescent liquid of butyrate of copper on adding acetate of copper. Uric acid was also found to be absent, on treating with nitric acid and ammonia in the usual way; neither could I detect formic or acetic acid, nor did boiling with caustic soda liberate ammonia. A few drops of the secretion, put on a piece of dry caustic soda, turned at first dark green, became in a few seconds dirty brown, and cleared up to a brownish red after several hours."

It was interesting to note that the quantity of the secretion voided varies noticeably with the different species under observation, both under field and under laboratory conditions, and some of the species, notably *Eleodes tricostata* Say, undoubtedly have the habit of erecting the abdomen in a threatening manner when approached, though no secretion may be voided. Such species undoubtedly find protection through imitation of the threatening movements of their more formidable associates. Two of the characteristics of the Eleodes are their slowness of movement, and their habit of coming out of their hiding places about sunset for feeding purposes, and their presence is readily noticed on the bare sandy plains by birds, skunks, and other enemies, hence their protective secretion, or, in the absence of this, their threatening maneuvers are no doubt of highest value to them.

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A NEW SPECIES OF HETEROCAMPA (LEP., NOTODONTIDÆ.)

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Heterocampa amanda n. sp.

Head, thorax and abdomen light gray or brownish gray to dark gray. Tufts and tips of patagia darker. Pectinations of ♂ antennæ long, gray-brown; shaft with some light gray scales.

Primaries gray, the costa powdered with whitish scales and the veins in part somewhat darker than the ground color. Within the basal area, below Cu_2, and beyond the cell there are sometimes paler, somewhat brownish areas. Basal line geminate, the outer black, the inner gray, and the included space buff. T. a. line geminate, faint, outwardly convex between the veins. This line is oblique, almost reaching the middle of the inner margin, and is slightly curved. T. p. line similar but with scallops reversed and much slighter. This line is almost upright, but is slightly concave outwardly beyond cell and inside of Cu_1, leaving the usual square projection between Cu_1 and M_3. The s. t. line is made up of two blackish shades, one almost straight from near apex to M_3, the other beginning outside of the first on M_3, running thence to Cu_2, and then curving outward toward the anal angle. Both are followed by vague slender whitish lines. There is a blackish terminal line, sometimes cut by white on the veins, and the fringes are concolorous with the wing, but with blackish at the veins. Cell terminated by a curved blackish line. Secondaries white in male, the costa, outer margin (very slenderly), terminal quarter and sometimes a short median portion of veins marked with gray-brown. Fringes more or less grayish, darker at the veins. In the female the secondaries are more gray-brown with a variably definite band filling the terminal third and a less strongly marked median shade and discal spot. Fringes grayish white, dark at the veins. Under surface white in the male, the secondaries marked much as above and the primaries darker toward costa and apex, with only the markings of the fringes, a discal bar, and sometimes a paler terminal area visible. In the female this surface is much darker, as would be expected. The primaries are otherwise similar

to those of the male, while the secondaries have a terminal powdery whitish area, preceded by a broad vague transverse shade and then by a slender median shade, both of which lose their identity toward the costa. The discal bar is present. Expanse 35 to 45 mm., the sexes similar.

Described from ten specimens in coll. Barnes. Holotype ♂, 3 paratypes ♂ and one paratype ♀, from the Hualapai Mts., Mohave Co., Ariz., May. One paratype ♂ from the Planet Mine, Bill Williams R., Yuma Co., Ariz., and four paratypes ♀ from Mohave Co., Aug. In addition we have specimens from Yavapai and Cochise Counties, Ariz.

We place this species after *umbrata* Wlk. and its forms, though it is not closely related. Its superficial appearance suggests *Fentonia miranda* Dyar, but it is a true *Heterocampa* and this resemblance is only general.

NOTE ON THE SURGONOPODS OF CERTAIN MECOPTERA AND NEUROPTERA.

By G. C. Crampton.

Through the kindness of Mr. A. N. Caudell, I have recently been able to examine a specimen of the interesting Mecopteron *Merope tuber*, preserved in alcohol. Since the specimen was preserved in fluid, this permitted the moving of the parts without danger of breaking them, and enabled me to determine that the parts which I formerly considered to be the dorsal penis valves (i. e., the parts labeled "dv" in Fig. 24, Plate III, of Psyche, Vol. 25, 1918), from an examination of a dried specimen of *Merope* in the Cambridge museum, are in reality the surgonopods, or lateral appendages of the tenth abdominal segment. It would also appear that certain of the structures called gonopods in the Neuroptera shown in Figs. 14, 12, etc., of the article in question, are likewise homologous with the surgonopods, as I have pointed out in a paper which will later be published, dealing with the terminal structures of insects in general.

NOTES ON *ORCHESTES RUFIPES* LEC., IN NEW JERSEY.

By Harry B. Weiss and Ralph B. Lott,
New Brunswick, N. J.

According to Blatchley and Leng[1] this weevil is known to occur in New York, Vermont, Massachusetts, Newfoundland and Quebec. At Batavia, N. Y., according to H. H. Knight, it was abundant on the shining willow *Salix lucida,* the adults feeding on the leaves, July 1 to 15, the larvæ mining the leaves in August and September; other species of willow in the same locality were not infested. Gibson[2] states that in Ontario an outbreak of *rufipes* occurred locally on willow toward the end of May and during the first half of June at the Experimental Farm; beetles were first noticed on the laurel-leaved willow *Salix pentandra* on May 31, and were quite numerous by June 15, and their work noticeable. In one leaf, two and one quarter inches long and one inch wide, 329 feeding holes were counted. The species is not recorded in Smith's List of the Insects of New Jersey, although it is known to occur on *Salix lucida* and also on black willow *Salix nigra,* at Rutherford, where all of the observations recorded in this paper were made.

In New Jersey the beetles go into hibernation about the latter part of September and first of October, selecting such places as under loose bark, in partly dead wood, in dry stumps of limbs, etc. Here they may be found in colonies of varying numbers, depending on the size of their hibernation quarters. If suitable weather prevails a few beetles will emerge about the middle of April or even before and can be found crawling over the bark. Feeding soon takes places and by the last of April and first of May noticeable damage is being done to the leaves. Even at this early date many leaves will be brown and dry if the beetles are numerous. Feeding continues all during May, interrupted by copulation during the latter half of this month. Eggs are deposited during the last of May and first part of June, and by the middle of June hatching is under way and small mines are visible. By the last of June the mines, together with the larvæ, are good-sized and much in

[1] Rhynch. N. E. Amer., p. 282, 1916.
[2] 41st Ann. Rept. Ent. Soc. Ont., p. 15, 1910.

evidence. Practically all of the adults disappear by the middle of June. The mining of the foliage continues until about the end of the first week of July, at which time most of the larvæ are full grown and pupation is starting. This takes place within the mine, requiring about a week or ten days. By the middle of July many beetles are out and by the last of July the entire brood is in evidence, feeding on such green foliage as escaped the ravages of the larvæ and the hibernating brood of beetles. Feeding continues until cool weather forces the beetles to seek winter quarters.

As has been stated before, a noticeable browning of the foliage starts about the last of April or first of May. As the feeding increases so does the injury, and by the time the mines are starting much of the foliage is brown and dead. The larvæ complete the destructive work, and by the end of July infested trees have the appearance of having been swept by fire.

The adult eats a hole usually through the lower epidermis and then consumes the tissue and juices between the upper and lower epidermis for a short distance around the original opening. This results in a little circular or oval hollow area in the leaf along the inner edge of which is the opening through which the beak was inserted. Later, the lower epidermis over the hollow space dries and falls off. This leaves a depression on the under surface. Still later the upper epidermis over the eaten portion becomes brown, dries and cracks, and this may result in a hole through the leaf. The injury really consists of a skeletonizing of the leaf from the lower surface, but it is not accomplished directly as in the case of most skeletonizing by other species. In severe infestations the feeding punctures are so close that the entire leaf is covered by them.

The eggs are inserted singly anywhere under the lower epidermis in irregular oval cavities, which resemble feeding punctures. The tissue above and below the egg becomes brownish. The female cuts nearly a complete circular slit in the lower epidermis, leaving enough tissue for a hinge. This circular flap is pushed to one side and an irregular oval area cleaned out. This results in a somewhat oval cavity with the opening at one end. The egg is then inserted and the flap closed. Eggs were found in young and old leaves, even when they were considerably injurd by feeding.

The completed mines are blotch-like and usually extend from the midrib to the edge of the leaf, occupying from one-sixth to one-fourth of the entire leaf surface. They are visible plainest from the upper surface, where they appear as brownish, discolored, dead areas. As a rule, there is only one larva in a mine, but in many cases the mines merge, so that the entire leaf consists of a solid mine containing numerous larvæ. Many leaves contained from seven to twenty-two small mines. On account of the merging of some of these, and on account of the death of some of the partly grown larvæ, only from three to five completed large mines were found in most of the leaves at the end of the season.

Egg. Length, 0.32 mm. Width across middle portion, 0.2 mm. Oval, ends broadly rounded; translucent, somewhat whitish.

Larva. Length about 3.7 mm. Width of thorax about 1 mm. Form subcylindrical, thoracic segments wider than abdominal ones, body tapering slightly from thorax to posterior portion of abdomen. Segentation distinct. Whitish except for a median dorsal and ventral row of abdominal spots, the head and thoracic shield which are brownish (young larvæ is greenish-white, translucent). Head small, subcircular, sparsely hairy; collum absent; epicranial halves separated dorsally by faint median suture; front large, triangular; gula membraneous, indistinct; mouth parts small. Labrum triangular with truncate apex, anterior edge fringed with chitinous hairs. Mandibles broad across basal three-fourths, apical fourth narrow, acute, entire. Labium transverse with mentum and submentum fused, indistinct, anterior edge arcuate. Maxilla fused with labium to near apex, lacinia simple fringed with chitinous hairs on inner distal surface; maxillary palpi two-jointed. Thoracic shield transverse, covering most of prothoracic dorsum. Mesothorax and metathorax wider than all other segments. Sides of thoracic and abdominal segments produced laterally. True legs absent. Cerci absent. Anal segment wart-like. Body hairs short and sparse, more apparent laterally.

Pupa. Length about 2.6 mm. Oval, white to brownish black. Posterior dorsal portion of prothorax bearing prominent chitinized hairs, a transverse row of ten arising from dark, tuberculate bases, five on either side of middle. Dorsal posterior portion of abdomen terminated by a pair of upward-directed, stocky tubercles, tipped

with sharp chitinous points. Dorsal surface of abdomen and metathorax bearing a few minute hairs. Head and snout bearing several chitinized hairs. A single prominent chitinized hair arising from distal portion of each femur. Wing cases with longitudinal striæ. Each abdominal segment with a pair of dorsal foveolæ, one on either side of the middle.

ADULT. *Orchestes rufipes.* This was described by LeConte in 1876 (Proc. Am. Phil. Soc. Vol. XV, No. 96, p. 208) from Vermont specimens. The original description follows:

"Black, very thinly pubescent, with fine whitish hairs; beak finely punctured, head punctured, front narrow but distinct; prothorax finely punctured; elytra oval, rather flattened, deeply striate, interspaces rugosely punctulate. Antennæ and legs yellow, hind thighs dusky, very slightly incrassated; funicle six-jointed, second joint scarcely longer than the third; thighs not toothed; claws broadly appendiculate. Length 2 mm.; .08 inch."

Should it be desirable to control this insect, spraying with arsenate of lead is recommended. The poison should be applied to the lower leaf surfaces during the last of April or first of May. On account of the length of time during which the adults feed before depositing eggs, almost complete killing should be accomplished.

NOTES ON NOCTUIDÆ WITH DESCRIPTIONS OF SOME NEW SPECIES (LEP.).

By Wm. M. Barnes, M. D. and A. W. Lindsey, Ph. D.,
Decatur, Illinois.

Agrotinæ.

Prochloridea madonna n. sp.

Head and thorax clothed with a mixture of gray, whitish and mixed hairs and scales. Palpi dark gray outside, whitish within. Antennæ ciliate in the ♂. Abdomen shining grayish, touched with clay yellow.

Primaries with vestiture mixed black, whitish and gray scales in about equal parts, with two broad, light brown stripes radiating from base of cell toward apex and oval angle respectively. These stripes are sometimes scarcely visible, but are usually quite evident. T. a. line irregular, oblique, with a prominent tooth in costal region, one on cubital stem and one on anal vein; usually very vague but sometics well marked; single, pale gray, marked on costa by one or two blackish dots. T. p. line also pale gray, preceded by a fine dark shade, outwardly curved around end of cell and rather even except on this bend, where it is finely dentate; near the inner margin it curves basad. Orbicular and reniform very vague, sometimes evident as dark central spots surrounded by pale margins. In the terminal space there is a variable number of short longitudinal black dashes between the veins. Fringes with alternating light and dark patches of a "pepper and salt" appearance similar to the primaries. Secondaries white with a slight sprinkling of dark scales in the outer third, usually localized on the veins, and a similar terminal line. Fringes white with a few dark scales. Female similar. Expanse 31 to 33 mm.

Holotype ♂, allotype, 13 paratypes ♂ and 3 paratypes ♀ from Olancha, Inyo Co., Cal., June 8-30, July, Aug., in coll. Barnes.

Madonna is smaller and more grayish than the three females in the type series of *modesta* B. & McD., and the median line of the secondaries is very rarely suggested. In spite of these differences we should not be surprised to find that it is only a race of the

older species. Unfortunately the lack of males of *modesta* prevents our checking their relationship by an examination of the genitalia.

Lygranthœcia meskeana and **rufimedia** Grt.

These species are treated as synonymous in Smith's "Synopsis of the North American Heliothinæ" (Trans. Am. Ent. Soc. X, 235) and the latter is regarded as an aberration of the former by Hampson (Cat. Lep. Phal. B. M. IV, 65). We have recently had reason to consider these species, and find that the shades of the upper surface are so variable as to be confusing. On the lower surface, however, the pale areas are decidedly yellowish in *rufimedia*, but whitish in *Meskeana*. This difference appears to occur irrespective of sex or locality, and seems to be the most convenient criterion for the separation of the two.

Hadeninæ.

Lasionycta perplexa Sm.

This species is listed in the genus *Lasiestra* Hampson, which is characterized in the original description as having thoracic vestiture of rough hair. *Lasionycta* Auriv., on the other hand, is said to possess thoracic vestiture of hair and hair-like scales. The vestiture of *perplexa* is distinctly scaly and much less rough than in the other North American species which we retain in *Lasiestra*, and we therefore advocate its transfer to *Lasionycta*.

Nephelodes mendica n. sp.

Head and thorax with pinkish-brown vestiture, the hairs pale tipped. Abdomen more grayish with the usual clay-colored tinge.

Primaries similar, sprinkled with blackish scales along the veins. Median area filled with brown from radial stem to inner margin. T. A. line pale, oblique, vague. T. P. line sinuate, geminate, formed of a rather broad pale line preceded by a fine, dark shade, and very slightly crenulate. Orbicular and reniform variable in shade, in the holotype pale, with a few darker scales in the center. In one of the paratypes these spots are scarcely differentiated, except the outer part of the reniform, which is pale, and in the other they are concolorous, margined with darker scales. Median shade dark, vague. S. T. line faintly indicated by a contrasting dark shade, which is most noticeable in the costal region. Fringes

concolorous, with paler bases. One paratype is much paler and more evenly colored than the other specimens and has a series of terminal dark dashes. Secondaries white, veins darker; terminal area sparsely sprinkled with dark scales; fringes white. Expanse about 40 mm.

Three males from Eureka, Utah (Spalding): holotype Sept. 21, paratype Sept. 21, and paratype Aug. 24, in coll. Barnes.

This species appears to be most closely related to *pectinata,* and we place it at the head of the genus. The peculiar shade of brown, less smooth vestiture of primaries, and white secondaries, separate it readily from *pectinata.*

ACRONYCTINÆ.

Langona, gen. nov.

Proboscis aborted; palpi small, weak, slender, slightly drooping, not quite reaching front. Front smooth, without projection; eyes large, rounded. Antennæ of male bipectinate, the pectinations ciliate; of female lightly ciliated. Head and thorax clothed with scales with a few hairs intermixed, metathorax with a large tuft of spatulate scales. Pro- and mesothorax without tuft (?). Legs moderate; tibiæ without spines or claws. Abdomen without tufts. Primaries with costa long, nearly straight; apex rounded-acute, outer margin strongly oblique, bent at Cu, secondaries relatively small, apex broadly rounded; outer margin bent between Cu_1 and M_3; anal angle broadly rounded. Vein Cu_1 of primaries near end of cell; Cu_2 about 4/5 from base; R_4 and R_5 stalked, anastomosing with R_3, out of R_2, to form areole. Cu_1 and M_3 of secondaries contiguous at base; M_2 obsolescent, from middle of discocellulars; M_1 and R_5 short-stalked.

Type: *Langona grisescens* n. sp.

Langona grisescens n. sp.

Head badly rubbed in type; apparently clothed with gray scales. Thorax badly rubbed in ♀, slightly so in ♂'s; vestiture of pale gray scales tipped with blackish, and with a few hair-like scales of the same color. Metathoracic tuft of whitish scales with the broad tips blackish, shining. Abdomen with pale brownish-gray vestiture. Primaries with gray scales tipped with blackish-brown and sprinkled with white scales in costal and apical half, giving the

wing a hoary gray appearance. Transverse lines blackish; basal line from costa to anal vein. T. a. line oblique, bent outward before anal vein in the ♂, straight in the ♀; t. p. line bent outward below costa, where it is merged with a dark subapical shade, and more broadly in the median area, whence it curves inward to the inner margin, where it is followed by a small pale area. Subterminal area powdery gray; a fine, dark terminal line. Fringes concolorous. Reniform faintly indicated in all types and orbicular in ♂'s pale, with a darker edge. Secondaries powdery brownish-gray, paler at base. Fringes paler. Under surface of primaries even gray-brown with the sub-apical shade set off by some white powdering. Secondaries paler than above; terminal area and a discal spot darker. Expanse 24-27 mm.

Holotype ♂, Palmerlee, Ariz., allotype, S. W. Ariz., and paratype ♂, Hereford, Ariz., in coll. Barnes.

The species looks not unlike an Acopa, but is quite distinct from that genus.

Mominæ.

Although no members of this sub-family have yet been reported from our limits, we think that it must be accorded a place in our lists for the reception of Grote's genus *Trichocosmia* and both of the included species, *inornata* Grt. and *drasteroides* Smith. In both of these species the eyes are sparsely hairy and vein M_2 of the secondaries is very evidently nearer to M_3 than to M_1. They run to this subfamily in Hampson's key to the subfamilies of Noctuidæ (Cat. Lep. Phal. B. M. IV, 3 and 4).

ON *EUMENES ALLUAUDI* PEREZ, A PRECINCTIVE WASP OF THE SEYCHELLES (HYMENOPTERA).

By J. Bequaert,

American Museum of Natural History, New York City.

In my Catalogue of Ethiopian Diplopterous Wasps, published in 1918,[1] I have attempted to correlate the various described forms of African *Eumenes*. In many cases, where specimens were not available for study, my conclusions were based on such inferences as could be made from published accounts, and were therefore only tentative. *Eumenes alluaudi* J. Pérez,[2] for instance, I regarded at the time as one of the color variants of *Eumenes lepeleterii* Saussure, to which it was said to be related by the author of the species. Through the courtesy of Mr. A. S. Rohwer, I recently had opportunity to examine a series of specimens of *E. alluaudi* in the U. S. National Museum collection, and was surprised to find that this wasp is structurally very distinct from any of its congeners. Since it apparently is restricted to a very small range in the Seychelles and neighboring islands, and thus affords a typical illustration of the effects of oceanic isolation upon the appearance and preservation of specific characters, it may be useful to redescribe the form and to figure some of its most noteworthy peculiarities.

Female. Length (head+thorax+tergites 1+2) 21 mm.

Decidedly more slender than *E. maxillosus,* strikingly so in the abdomen. Head (Fig. 1*b*) from front view about as high as broad, due to the lengthening of the clypeus. Clypeus distinctly higher than broad; its apical free portion a little longer than its basal part and with more deeply concave sides than in *E. maxillosus;* its apical margin almost straight, slightly curved inward, with pronounced, but blunt lateral angles. Vertex without fovea. Eyes bare. Posterior ocelli about as far from each other as from the eyes. Mandibles shaped much as in *E. maxillosus;* long and slender, beak-like, the inner margin with three slight notches; near the base of the inner margin an indication of the raised fold which is so prominent in the male. Antennæ and mouth-

[1] Bull. American Mus. Nat. Hist., 39, 1918, pp. 274-283.

[2] Ann. Soc. Ent. France, 64, 1895, p. 206.

parts as in *E. maxillosus.* Shape and structure of thorax and legs also as in that species. Middle tibiæ with one spur. Abdomen more slender than in *E. maxillosus,* though of the same general shape. The basal, narrow portion of the petiole is fairly parallel-sided and about as long as, or but little shorter than, its apical, broadened part; the spiracles are prominent, placed a little beyond half the length of the petiole; the broadened, posterior portion

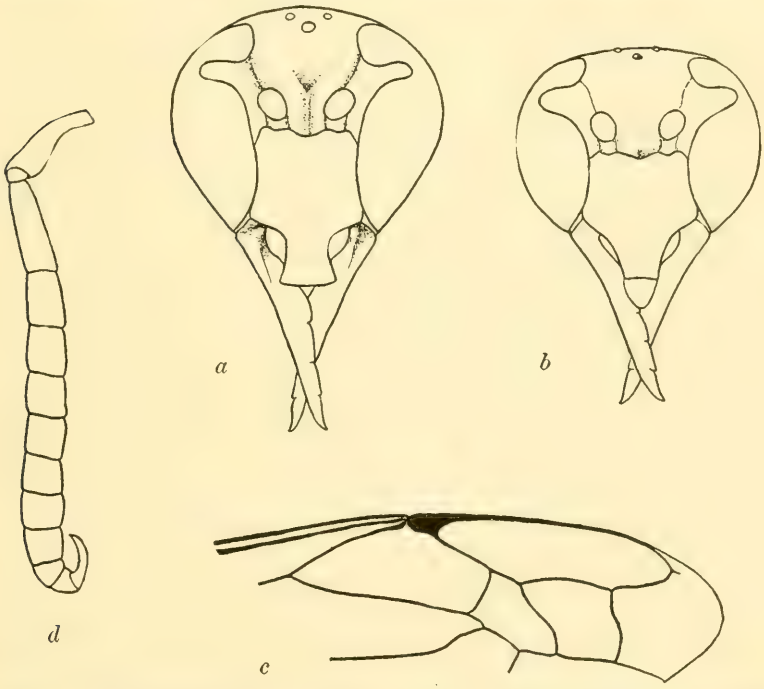

Fig. 1. Eumenes alluaudi J. Pérez. a, head of male in front view; b, head of female in front view; c, part of fore wing; d, antenna of male.

is nearly parallel-sided, but it has expanded apical angles as in *E. maxillosus.* In profile the posterior, broad portion of the petiole is less swollen and slopes more gradually toward the hind margin than in *E. maxillosus.* Second abdominal segment also more slender than in that species, with simple hind margin; its sternite regularly convex, but little if any flattened in the middle, never saddle-shaped. Fore wing (Fig. 1*c*) with the third cubital cell

much longer than in *E. maxillosus;* on the radial cell it is slightly shorter than high and about the length of the second cubital cell on the cubitus.

Punctation mainly as in *E. maxillosus.* The clypeus, however, is not dull and feebly shagreened as in that species, but shiny, varnished, with hardly any sculpture that can be discerned with a hand lens, except for a very few, scattered, minute dots toward the sides. The thorax is also somewhat more finely sculptured than in *E. maxillosus.* Pubescence a little more abundant than in that species, especially on the under side of the abdominal petiole.

Black, abundantly marked with chrome-orange (nearest orange rufous of Ridgway's color nomenclature). Head almost entirely chrome-orange, with the exception of the inferior margins of the eyes at the extreme base of the mandibles, the posterior half of the temples, the occiput, the vertex, and the emargination of the eyes, which are black. Antennæ orange-yellow, somewhat darkened above. Thorax chrome-orange; mesonotum black, except for a narrow, comma-shaped orange spot placed on each side of the middle line, close to the pronotum; most of the thoracic sutures more or less tinged with black. Legs chrome-orange. Abdominal petiole chrome-orange, except at its base, which is black. Remainder of the abdomen velvety pitch-black, except its last sternite, which is more or less ferruginous. Wings almost uniformly smoky, with a strong purplish effulgence.

Male. Length (head+thorax+tergites 1+2) 23 mm.

Differs from the female only in the secondary sexual characters. Clypeus much higher than broad, of a very peculiar shape (Fig. 1*a*): its basal portion is nearly rectangular and somewhat longer than its apical, free part; the latter forms a rectangular, projecting plate, abruptly narrowed from the basal portion and slightly widened at its feebly convex or nearly straight, apical margin; the lateral angles of the apical margin are blunt but prominent, bearing short, raised ridges. The inner margin of the mandibles has, near its base, a strongly raised, somewhat tuberculate fold. Antennæ (Fig. 1*d*) much as in the male of *E. maxillosus;* their last, hook-like joint intermediate in shape between that of *E. lepeleterii* and *E. caffer,* being long, almost uniformly thick for the greater

part of its length, feebly and gradually thickened toward its base, rather rapidly pointed at its apex, which is sharp and feebly curved; it can be folded into a small, deep, rounded pit at the extreme base of the under side of the tenth joint. Abdominal sternites three to seven more abundantly hairy than in *E. maxillosus.*

General coloration as in the female, but the posterior half of the petiole of the abdomen dorsally with a broad, heart-shaped, black mark (a black triangle with the apex directed posteriorly and the anterior base deeply emarginate). The last three abdominal sternites more or less ferruginous.

This species is evidently allied to *E. maxillosus,* but the male possesses such striking morphological peculiarities that it cannot be regarded as a color race of that species. I have been unable to find any close relative among the many species of *Eumenes* known from the Oriental and Indo-malayan regions.

The five females and two males seen by me are all colored much alike and come from the following localities: Mahé Island, Seychelles, 3 ♀♀; Seychelles, 1 ♀ and 1 ♂; Glorioso Islands, 1 ♀ and 1 ♀. All collected by Dr. W. L. Abbott.

E. alluaudi is known thus far only from the Seychelles and the Glorioso Islands (about 120 miles off the northern point of Madagascar, in the Strait of Mozambique), where no other species of the genus has thus far been collected. Very likely it is to be found also in the Comoros, although typical *E. maxillosus* alone has been recorded there. It evidently does not occur on Madagascar, which possesses two color forms of *E. lepeleterii* (*pensilis* Saussure and *guerini* Saussure) and one of *E. maxillosus* (*reginus* Saussure), all peculiar to that island, in addition to typical *E. maxillosus.*

J. Pérez described *E. alluaudi* originally from Mahé. Cameron[1] recorded it as common on Praslin and Mahé. G. Meade Waldo,[2] who gives Silhouette and Dennis Island as additional localities, notes that it "very often makes its cells in rooms; it was not observed in the highest forests." Its habits are thus evidently similar to those of *E. maxillosus.* The same author comments as follows upon the reddish chrome color pattern of *E. alluaudi* being

[1] Trans. Linn. Soc. London, Zool., (2) 12, 1907, p. 71.

[2] Ibid., (2) 15, 1912, p. 43.

repeated in *Odynerus seychellensis* Dalla Torre and *Crabro scotti* Turner: "It would seem that the insects with markings of this color are indigenous to the Seychelles, since none of the three species mentioned are found outside the group; on the other hand the widely spread and imported species preserve their normal type of marking."

EXCHANGE NOTICE.

WANTED:—Species of Tetraopes from all sections of the country, in exchange for Coleoptera of this region. Wm. J. Clench, Bussey Institution, Boston 30, Mass.

NOTES ON CANADIAN AND ARCTIC SPIDERS.

By J. H. Emerton,
Boston, Mass.

Since the report on the spiders of the Canadian Arctic Expedition of 1913 to 1916, the writer has had opportunity to examine a considerable number of arctic spiders from the American Museum of Natural History of New York and from the Zoological Museum of Copenhagen, Denmark, the latter including some from Iceland. The Iceland spiders appear to be mainly species living in the British Islands and Northern Europe, while those from Greenland are for the most part Canadian, extending westward to Alaska and Siberia, and southward through the bogs of Canada to the mountain tops of New England and the Rocky Mountains of Canada and the western United States. The following notes give the results of comparisons of spiders from Greenland with those of the same or similar species living in Canada and the mountains of the northern United States.

Hilaira (*Erigone*) **glacialis**. Thorell, 1871. Spiders of Spitzbergen and Beeren Islands.

Erigone vexatrix (Camb. 1877). Koch 1879. Spiders of Siberia and Nova Zembla.

Hilaira glacialis Kulczynski 1908. Spiders of Russian Expedition to New Siberia Islands.

Spitzbergen, Siberia.

Collinson Point, Alaska, Canadian Arctic Expedition.

Saunders Island, West Greenland, Crocker Land Expedition.

Hilaira (*Erigone*) **læviceps**, Koch, 1879.

Hilaira læviceps, Kulczynski, 1908.

Tmeticus brunneus, Emerton, 1882, Connecticut Academy.

Siberia.

Nome, Alaska, Canadian Arctic Expedition.

Banff, Alberta, Canada. Sulphur Mt., N. B., Sanson.

Mt. Washington, N. H. Emerton, Slosson.

East Greenland, Angmagsalik, 66° north, Kruuse.

Lophocarenum (*Erigone*) **barbata**, Koch, 1879.

Diplocephalus barbatus, Kulczynski, 1908.

Siberia.

Etah, West Greenland, Peary Relief Expedition, 1899.

Xysticus bimaculatus, Emerton, 1894. Canadian Spiders in Trans. Connecticut Acad.

Xysticus deichmanni, Sorensen, 1898. Vid. Med. Nat. For., Copenhagen.

Mt. Lincoln, Colorado, U. S., 10,000 ft. F. C. Bowditch, 1877.

Laggan, Alberta, Canada, 6,700 to 8,500 feet. Bean, 1890.

Eastern Greenland, 70° north. Deichmann, 1892.

Ashford, Washington, U. S. Emerton, 1905.

Arctic Canada, Bernard Harbor. Canadian Arctic Expedition, 1913 to 1916.

This species was found by F. C. Bowditch in 1877 on the upper part of Mt. Lincoln, Colorado, and it remained for a long time unidentified. In 1890 the females were found by Bean near Laggan in the Rocky Mountains of Canada, and described in 1894 by Emerton in a paper on Canadian spiders in the Transactions of the Connecticut Academy. About the same time it was found by Deichmann in Greenland and described in 1898 by Sorensen as *Xysticus deichmanni* in the Proceedings of the Natural History Society of Copenhagen, Denmark. The Canadian Arctic Expedition brought both sexes from the northern coast of Canada in 1916 and by comparison with these the specimens from Mt. Lincoln, Colorado, were at last identified.

Pardosa (*Lycosa*) **hyperborea**, Thorell, 1873, in Synonyms of European Spiders.

Pardosa luteola, Emerton, 1894. Canadian Spiders, Trans. Connecticut Acad.

Eastern Greenland, Th. Holm. Copenhagen Museum.

Southern Labrador, C. W. Townsend.

Quebec, Canada, Emerton.

White Mountains, N. H., in bogs at 4000 feet. Emerton.

James Bay, Canada, latitude 52½° north. F. Johansen.

Manitoba, Canada, west of Hudson Bay. Emerton.

Athabasca Landing, Canada, in bog. Emerton.

In bogs across Canada, from Greenland and Labrador to the Rocky Mountains and south to the mountains of New England and New York.

Pardosa furcifera, Thorell, 1873.

This is described by Emerton in Canadian Spiders, Trans. Connecticut Acad., 1894, as one of the varieties of *P. glacialis.* It occurs in Greenland, Labrador, and Arctic Canada. It is usually larger than the typical *glacialis* and lighter in color, with much bright yellow on the legs, especially the under sides of femora and coxæ. In the paper referred to, Fig 2a, Plate IV, represents this species, and 2b its epigynum. The palpal organ differs little from *glacialis* and its relatives, but the male palpus is more slender and not much darker in color at the end than at the base, without the close black hairs which are characteristic of *glacialis* and *brunnea.*

Lycosa exasperans, Cambridge, Ann. Mag. Nat. Hist., London, 1877, from English Exploring Expedition of 1875-76.

This species has been identified by Strand in Fauna Arctica, 1906, with *L. alpigera* = *L. insignita,* Thorell. It is, however, distinguished from that species by the dorsal markings. The middle stripe of the cephalothorax in *exasperans* narrows in front between the eyes, widens behind the eyes, and narrows again in its posterior half. In *insignita* it widens regularly toward the front, so as to enclose the whole eye area. The abdomen of *exasperans* has usually a series of dark marks in the middle and a row of black and white spots at the sides. *L. insignita* has a large white middle mark surrounded by a black border and the spots on the sides are indistinct.

L. exasperans was found by the Crocker Land Expedition, 1917, at Saunders Island on the west coast of Greenland.

L. exasperans resembles closely *L. pictilis*, Emerton, which has similar markings, but is larger, more largely marked with orange hairs, and has a more angular epigynum. *L. pictilis* is found on the Mt. Washington range above trees up to the highest summits, on the coast of Labrador, and on the arctic coast of Canada. The Labrador specimens unfortunately are all immature.

L. mutabilis and *L. poecila,* described by Kulczynski, from Siberia, appear to resemble closely *exasperans* and *pictilis,* and it seems probable that comparison of a larger number of specimens would show that all these are one species extending along the arctic coast from Siberia to Greenland and south through Labrador to the White Mountains.

Lycosa alpigena, Doleshall.
Lycosa insignita, Thorell, 1872.
Lycosa albohastata, Emerton, 1890.

Lycosa insignita, Thorell, supposed to be identical with *L. alpigena* of the Alps, is also the same as the American *L. albohastata*, Emerton. This species does not range as far north nor live at as high elevations as *L. exasperans* and *L. pictilis,* but it extends across America to the Rocky Mountains, being found several times at elevations of 5,000 to 6,000 feet at Banff. It occurs at low elevations on both sides of Hudson Bay, in Labrador, on the coast of Maine, and in the White Mountains just above the trees.

Drassus troglodytes, Koch, 1839.
Drassus troglodytes, L. Koch, 1866, Drassidæ.
Drassus robustus, Emerton, 1890, Trans. Connecticut Acad.
Southwest Greenland, Copenhagen Museum.
Iceland and Europe south to the Alps.
Massachusetts, New Hampshire, Mt. Mansfield, Vt.
Sandusky, Ohio, Chicago, Illinois.
Laggan, Alberta, Canada.
Vancouver Island, B. C., Canada.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

At the meeting, May 10, the committee on public lectures reported that four lectures had been given on Saturday afternoons in March and April in one of the small halls in Tremont Temple, on "Butterflies," by W. L. W. Field, on "Dragonflies," by R. H. Howe, Jr., on "Ants," by W. M. Wheeler, and on "Gall Insects" by A. C. Kinsey. An admission fee of 50 cents was charged, and there was an attendance of from one hundred to one hundred and fifty persons, so that enough was received to pay expenses of the course within ten dollars.

Mr. Reynolds reported the recent meeting of the New England Federation of Natural History Societies, in which three members of the Club took part.

Prof. C. T. Brues described a new minute Proctotrypid (Dol-

chotrypes) parasitic on Cecidomyid larvæ which live in the sap vessels of freshly cut wood. The parasite has a long slender abdomen which varies in length in different individuals and is used in placing the eggs into the vessels of the wood.

Mr. Frost spoke of recent collecting of beetles and the different identifications of them by several experts whom he had consulted.

Mr. Walker spoke of finding a small insect larva in freshly exuded spruce gum. This led to a discussion of insects in gum and amber, which was joined in by Mr. Denton, Prof. Wheeler and several other members.

At the meeting of June 14, Mr. L. W. Swett, who had lately been to the White Mountains, reported an unusually early season. At the Glen lilac and apple were in bloom, *Papilio turnus, Colias philodice, Pieris rapæ, Argynnis bellona* and *Thecla læta* were flying. The nights were warm, 55° to 60°, and collecting by light was tried on the Mt. Washington carriage road. Many species were taken, but in small numbers.

Mr. Dodge showed 140 species of Coleoptera, all taken on June 12, near Wilmington Junction.

The first meeting of the autumn was held on September 13, and Mr. C. W. Johnson gave an account of collecting at Mt. Desert, Maine, in June. The mountain maple, several species of Cornus, and raspberries were in bloom, and many insects were swept from the plants, among them many not before found on the island. Two thousand species of insects are at present known on Mt. Desert, more than half of them Diptera and Lepidoptera.

Mr. O. E. Plath showed several nests of bumble-bees which he had kept in boxes through the summer, and told about his observations on them, which will be published later in the year.

PSYCHE.

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INDEX TO SUBJECTS.

All new genera, new species, and new names are printed in Small Capital Letters.

CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p. m. at the Bussey Institution, Forest Hills, Boston. The Bussey Institution is one block from the Forest Hills station of both the elevated street cars and the N. Y., N. H. & H. R. R. Entomologists visiting Boston are cordially invited to attend.

PSYCHE

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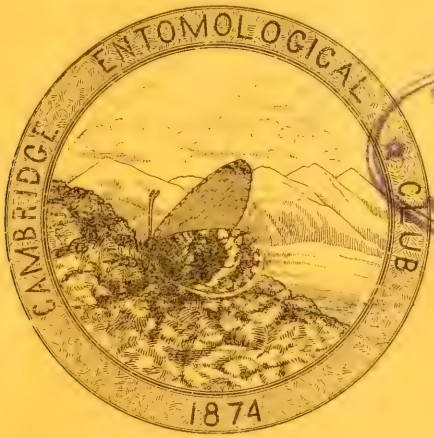

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EGGS OF THREE CERCOPIDÆ.

By Geo. W. Barber and Wm. O. Ellis.

Bureau of Entomology, U. S. Department of Agriculture.

In Eastern Massachusetts, *Philænus leucophthalmus* Linn, and *Philænus lineatus* Linn which Prof. Herbert Osborn (Bull. 254, Me. Agri. Exp. Sta. 1916) has designated as the Meadow Froghopper and the Grass-feeding Froghopper respectively, are undoubtedly the most numerous species of Spittle insects. *Philaronis bilineata* (Say) is also found, sometimes in large numbers, usually on grasses, near or on the extensive salt marshes of this region.

In August 1921, the writers confined adults of these three species in separate lantern-globe cages in which plants of *Setaria glauca* were growing. This grass was used because it was near at hand—not because these insects had showed any partiality for it as a food plant.

Eggs were easily obtained in this way, and the method of oviposition was found to agree exactly with that observed during 1920 when eggs of *P. leucophthalmus* Linn. were obtained in confinement and found in the field on Tansy, *Tanacetum vulgare*.

Oviposition of these three species is very similar indeed. Individual eggs nearly agree both in shape and in color and are deposited in the same manner. The eggs are laid in single rows, side by side, in numbers of from 2 to 24. Individual eggs are imbedded in, and the entire mass is surrounded with a white, frothy appearing material which is tough and inelastic and securely holds the individual eggs so that they can be dissected from it only with difficulty. This protective material is more plentiful about the edges of the mass and becomes sparse at the top and bottom where the mass lies in close contact with the stem and sheath of the plant.

The eggs are inserted between the stem and the leaf sheath at a point where the sheath adheres closely to the stem, the mass lying parallel with and very near to the edge of the sheath. It is evident from all the egg masses thus far observed that the female does not thrust her ovipositor thru any portion of the plant tissue,

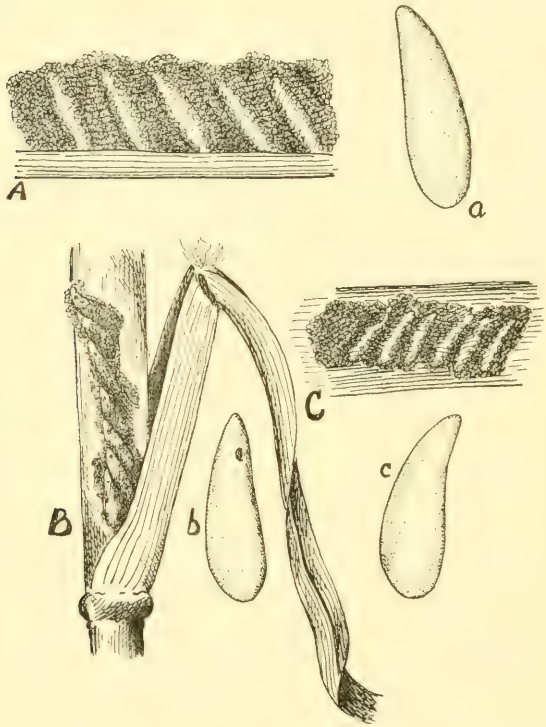

Fig. 1. A, *Philaronia bilineata* (Say), egg mass; a, egg of same; B, *Philaenus lineatus* Linn. eggs in situ; b, egg of same; C, *Philaenus leucophthalmus* Linn. egg mass; c, egg of same.

but merely inserts the eggs between the stalk and leaf sheath. Frequently the masses can be seen thru the leaf sheath, particularly when the latter is dried. Sometimes a portion of the mass can be seen exposed along the edge of the sheath.

Individual eggs are smooth, shining, slightly flattened, more than two times as long as wide, one end tapering, the other bluntly rounding; sides each convexly curved or with one side slightly incurved. They are light yellow in color, usually with a slight lemon tinge.

Prof. Osborn (ibid 1916) described and figured the eggs of *P. leucophthalmus* Linn. dissected from the female adult. Our description nearly coincides with his.

Philænus lineatus Linn.[1]

Egg; Length. 98 mm; Width .37 mm. Protecting material only moderately abundant to sparse; individual eggs scarcely separated Eggs per mass 2 to 24.

Philænus leucophthalmus Linn.

Egg: Length 1.03 mm; Width .39 mm. Protecting material abundant; individual eggs slightly separated. Eggs per mass 2 to 18.

Philaronia bilineata (Say.)

Egg: Length 1.22 mm; Width .42 mmm. Protecting material abundant; individual eggs more noticeably separated by protecting material. Eggs per mass 5.

[1]Since this paper has been in the hands of the publisher there has appeared a study of *Philaenus lineatus* Linn., (Philip Garmon, Conn. Agri. Expt. Sta. Bulletin 230, in which the eggs are described.

A NEW SPECIES OF NEW ENGLAND COLEOPTERA.

By C. A. Frost, Framingham, Mass.

Cantharis (*Telephorus*) *andersoni*, sp. nov.

Size and form of *rotundicollis* Say. Color entirely testaceous except for the following black, or at least dark piceous areas: the outer joints of antennæ, a diamond-shaped spot on the vertex a spot between the front coxæ and one on each side of the gular suture, the meso and metasternum, the greater part of the first six ventral segments, the hind tibiæ and generally the middle tibiæ and the distal ends of the hind femora, a dark spot occasionally on the middle femora above at the knees, the scutellum generally dark and sometimes black, the tarsi more or less dark especially beneath. Head sparsely punctured and pubescent, tumid between and in front of the antennæ, with a transverse impression above each antenna, the second joint of which is short and the rest subequal. Thorax orbicular, nearly smooth and sparsely pubescent; front and side margins translucent and reflexed, more deeply concave at the sides before the middle, the tumid cordiform area of the disk abruptly limited by a deep groove in front of the hind margin of the thorax, the median impressed line faintly indicated at the middle becoming deeper and broadly triangularly depressed behind. Elytra more densely pubescent with yellowish hairs, smooth (finely punctured at the insertions of the hairs) at the base, becoming gradually strongly granulato-rugose to the apex. Beneath finely punctured and pubescent, more sparsely so on the abdomen. Anterior claw on all the tarsi with a basal tooth which is more slender and with the inner edge more curved on the hind and middle ones. Length 11 to 13 mm.

The sexual characters are as usual not strongly indicated. The male antennæ are slightly longer, the second joint being shorter in comparison with the third, and the basal tooth of the claw on the anterior tarsi are broader than in the female; the seventh segment of the abdomen is broadly emarginate, exposing an eighth segment, in the male.

There seems to be little variation in the 13 males and 8 females from Belmont, Mass., or in the two males and four females from Mt. Desert Island, Me. One of the females has the elytra distinctly darker and in another the occipital spot is obsolete. The dark portions of the 5th and 6th abdominal segments show a tendency to vanish on the median line behind and almost disappear in some of the males.

This species belongs near *rotundicollis* but can easily be distinguished by the color, orbicular thorax and sculpture of the elytra. Specimens of both these species were sent to Dr. Horn of Berlin, Germany, who writes that they are distinct from known European forms although the present species slightly resembles *obscura* L.

The species was first brought to my attention by a specimen in some material sent me in the summer of 1920 by Mr. C. S Anderson to whom the species is dedicated. On May 28 he took 50 specimens at Belmont, Mass. May 18, 1921, a few specimens were seen and on May 20 he made a special visit there without success. On May 22 he found them present in great numbers on Japanese barberry, and also in lesser numbers on grasses and other plants; 72 were taken, and 50 more on the 25th. The owner of the estate said they had first been noticed in 1918 but in much less numbers. A few scattered specimens were noticed in Arlington in June and July. Mr. G. C. Wheeler took two specimens in Forest Hills on English elms. Mr. C. W. Johnson took one specimen on July 18, 1919 at Jordan's Pond on Mt. Desert Island, Me., and on June 7 and 8, 1921 he found it very common around hedges and on fences at Bar Harbor on the Island.

Like the parallel case of *C. neglectus* Fall (which is, however, much less strikingly differentiated from its congener *carolinus* with which it was undoubtedly confused) we have here a still stranger and more sudden appearance in numbers of an undescribed species of this genus in these comparatively well-collected regions. It would seem to have been extremely rare or local to have escaped the notice of Dr. Harris, Frederick Blanchard

and the many other assiduous collectors who have diligently combed this section of New England.

Paratypes are in the collections of Mr. H. C. Fall, C. S. Anderson, Col. T. L. Casey, U. S. National museum, Boston Soc. Nat. History, Museum of Comparative Zoology at Cambridge, and the National Museum at Ottawa, Canada.

THE EMBOLEMID GENUS PEDINOMMA IN NORTH AMERICA.

By Charles T. Brues.

Bussey Institution, Harvard University.

Several years ago Dr. Joseph Bequaert showed me a strange wingless Hymenopteron that had been collected by Mr. Wm. T. Davis on Staten Island, New York in 1910. Neither of us was able to recognize it at the time and he kindly allowed me to retain the specimen for closer study. During early May of the present year, when collecting insects in the Stony Brook Reservation near Boston, Mass., Professor W. M. Wheeler found a second specimen beneath a stone which I saw at once was exactly similar to the one obtained by Mr. Davis. During the remainder of the afternoon we searched carefully for further specimens in the neighborhood, but were unsuccessful.

The insect proves to be a species of Pedinomma, a genus described nearly a century ago by Westwood[1] and not known outside of Europe till 1912 when Kieffer[2] described as *P. angustipenne* a species obtained by Prof. F. Silvestri at Coipué in Chile.

The North American specimens agree quite closely with Westwood's European species, *Pedinomma rufescens* as nearly as I can ascertain from descriptions which have been given by several writers[3], but it does not seem probable on account of its wingless condition that our American species can be identical with the palæarctic one.

[1]Mag. Nat. Hist., vol. 6, p. 496 (1833).
[2]Bol. Lab. Zool. Gen. Portici, vol. 6, p. 174.
[3]Westwood (loc. cit.), Förster, Keiffer and Marshall.

Pedinomma[1] *nearcticum* sp. nov.

♂ Length 4-4.3 mm. Fulvo-ferruginous; flagellum, palpi, legs beyond femora and the adbominal segments beyond the middle of the second, lighter; first and basal half of second abdominal segments and teeth of mandibles darker, more or less fuscous. Head and thorax, except as noted, subopaque finely, granular. Head seen from above one-half longer than broad, its sides parallel behind the eyes, the centers of which are at the anterior third of the head; narrowed obliquely in front of the eyes so that the short antennal prominence is one-third as wide as the vertex. In profile the head is an almost equilateral triangle gently convex above and below. Eyes ovoid, placed near the top of the head, broadest in front, separated by a little more than their length from the base of the antennæ and as broad as the thickness of the scape. Maxillary palpi short, 3-jointed; first joint very short; second broad, enlarged at apex; third slender, pointed, nearly as long as the second; labial palpi 2-jointed, short. Mandibles broad, with four subequal teeth, clypeus clearly separated, one-third as long as the face, with large lateral foveæ. Antennæ 10-jointed; scape as long as the head, as long as the four following joints; second twice as long as thick and two-thirds as long as the third which is two and one-half times as long as broad; following gradually more attenuate, but not perceptibly shorter; last (the tenth) one-fourth longer than the ninth. Ocelli entirely absent. Thorax three times as long as broad above where it is barely as wide as the head; widened below, especially in front so that the pleuræ are visible from above; dorsal surface almost flat above; pronotum as long as the propodeum, but the mesonotum and scutellum together about half as long as either of the others; prothorax with a distinct constriction near the anterior edge extending from the lateral edge entirely across the middle; anterior to this it is indistinctly transversely aciculate. Mesonotum very small, in front two-thirds as wide as the pronotum, and narrowed behind, with the lateral edge raised and preceded by a

[1]Westwood applied the name Myrmecomorphus to his species, but Förster considered this as a homonym of Dufour's dipterous genus Myrmemorpha since the latter word is incorrectly formed. Later authors have used Förster's name Pedinomma and I have here followed them

groove. Tegulæ large and distinct; wings reduced to small oval bulbs, but little longer than the tegulæ, lying in depressions at the side of the mesonotum and scutellum. The latter small, broader than long with a pair of deep, nearly conflunt foveæ at the base. Propodeum a little longer than wide, sides parallel, apex of dorsal face truncate, apical angles each with a minute tooth; posterior face nearly perpendicular. Meso and metapleuræ and sides of propodeum obliquely rugoso-striate; propodeal spiracle elongate, almost linear. Abdomen not depressed, nearly circular in cross-section, strongly bent downwards at apex, the upper surface smooth, without any constrictions, the tergites extending well down on the sides; first one almost as long as second; third, fourth and fifth each about two-thirds as long, subequal; apical segments short. Anterior femora and tibiæ greatly thickened; middle legs slightly so; hind legs moderately slender. Tarsi, especially the four posterior ones long and slender; inner spur of hind tibia oval, pad-shaped, outer one narrowly spatulate, but not pointed at tip and less than one-third as long as the metatarsus. Claws slender, simple.

Type from Stony-brook Reservation, Boston, Mass., May 8, 1921 (W. M. Wheeler); paratype from Wyandauch, Long Island, N. Y., May 1, 1910 (W. T. Davis)

I have stated that the specimens are males as the antennæ are 10-jointed although I cannot be sure, and Kieffer was also in doubt as to the sex of the Chilian species. Both sexes of the European form are practically apterous, although the Chilian, *P. angustipenne* has very short, strap-shaped wings.

As already noted, *P. nearcticum* is very close to *P. rufescens*, but the comparative lengths of the antennal joints are different. Several European varieties have been based on slighter variations of the same sort, however, and the American form may possibly prove to represent only a variety or subspecies. Pedinomma is not known from Asia, but it is a very rare insect in Europe and may quite possibly range far to the east of its present known habitat.

A NEW SCHENDYLOID CHILOPOD FROM MEXICO.

By Ralph V. Chamberlin,

Museum of Comparative Zoology, Cambridge, Mass.

The type of the interesting new chilopod described below was taken by Dr. Wm. M. Mann several years ago at Guerrero Mill, Hidalgo, Mexico. It represents a new genus related to the North American genera Nyctunguis Chamberlin and Nesonyx Chamberlin in having ventral pore areas in the anterior region and in possessing a well developed claw on each anal leg. It differs from these genera in having only a single coxal pore on each side. In this respect it agrees with the West African Mesoschendyla of Attems, but the latter genus has no claw on the anal legs.

Mexiconyx, Gen. nov.

Claw of the second maxillæ pectinate. Labrum with median arc bearing true teeth which are well chitinized and have distinct roots. Mandible with a single pectinate lamella. Ventral pores present on sternites of the anterior region. A single coxal pore on each side, this simple or homogeneous. Anal legs terminating in a normal claw.

Genotype.—*M. hidalgoensis*, sp. nov.

Mexiconyx hidalgoensis, sp. nov.

Head longer than wide, widest in front of middle; anterior margin convex or very obtusely subangular, the caudal margin straight and the lateral margins convex and converging caudad from in front of middle. Prebasal plate not exposed, the head well overlapping the basal plate, the exposed portion of which is rather short. Claws of prehensors when closed surpassing the head, reaching to the end of the second antennal article or nearly so. Joints of the prehensors unarmed within. Prosternum also unarmed; without chitinous lines. Labrum rather deeply excavated at the middle and bearing in the type twenty-two teeth of which those of the median arc are more strongly chitinized and differentiated; five teeth at the crest of the arc are directed ventrad. Dentate lamella of mandible presenting six or seven

conical and strongly chitinous teeth which do not seem to be segregated in distinct divisions. Ventral pores present in a circular area on sternites of anterior region but absent from middle and posterior regions, last ventral plate wide. Coxal gland one on each side, this homogeneous, and, while large, was evident in the type only after clearing of the specimen. Anal legs long, with well developed claws, with sparse stiff hairs over surface in general and numerous finer and shorter ones on ventral surface of proximal joints in particular, as usual, e. g. in species of Nyctunguis. Palpus of second maxilla rather short and stout; claw short, excavated, pectinate along the edge to and around the end, the setæ long. Number of pairs of legs, in female, fifty-five. Length, about 18 mm.

PARASITIC HYMENOPTERA FROM THE FIJI ISLANDS.[1]

By Charles T. Brues.

Several years ago when Dr. Wm. M. Mann visited the South Seas, he collected extensively in the British Solomons and in Fiji where he obtained a small number of Parasitic Hymenoptera. These he very kindly gave me for study and those from the Solomons have already been dealt with.[2] Meanwhile Turner has published a list and descriptions of some new Hymenoptera from Fiji in which he enumerates 53 species.

Of Mann's material there remains a smaller, but perhaps even more interesting series from Fiji and many of these are treated in the present paper. I have also included one particularly curious genus contained in a small lot of Serphoidea from Fiji sent me by Mr. F. Muir who collected it when he visited these islands in 1905.

As will appear evident from the context, these groups at least, show a strong Australian element in the fauna, but suggest the probable occurrence of a considerable number of peculiar endemic genera.[3]

[1]Contribution from the Entomological Laboratory of the Bussey Institution Harvard University, No. 197.

[2]Bull. Mus. Comp. Zool., vol. 62, No. 3, pp. 97-130, pl. 1 (May 1918).

[3]Turner (Trans. Ent. Soc. London, 1918, p. 334) has expressed a similar opinion, based mainly on the aculeata of these islands.

Family Evaniidæ.

Hemifœnus extraneus Turner.

Trans. Ent. Soc. London, 1918, p. 342 (*Hyptiogaster*).

♂ Length 7-8 mm. Dark reddish brown, varied with lighter brown, the paler markings, not very sharply defined, as follows: head below the antennæ, entire orbits, vertex, neck behind, irregular streaks on mesonotum, margin of propleura, mesopleura except behind, propodeum except for a median dark line, lateral spot at middle of first and at tip of first, of second and of third abdominal segments, posterior margin of following segments, base of antennal scape and four anterior tibiæ; hind legs with the femora and tibiæ lighter on the lateral surfaces. Wings hyaline, stigma and veins piceous. Head distinctly wider than the thorax, one-half broader than thick, occipital margin sharp, but not strongly elevated; ocelli in a triangle, as far from one another as from the eye-margin. Eyes with their facial margins parallel, surface sparsely but distinctly hairy; almost touching the base of the mandibles. Occiput irregularly, transversely aciculate, the striæ oblique to the side of the ocelli and very fine and more or less concentric about the base of the antennæ; clypeus and face below antennæ smooth, except for very delicate dense punctures at the sides just below the antennæ. Mandibles large, the basal and the apical tooth long. Antennæ inserted just above the middle of the eye: scape and first flagellar joint about equal, each two and one half times as long as the pedicel; second and third flagellar joints equal, together barely one-third longer than the first, each nearly twice as long as thick; following gradually decreasing in length, the penultimate but little longer than thick. Head behind the eyes smooth, the foraminal margin higher than on the occiput, transparent. Neck barely as long as the distance from tegula to anterior margin of mesonotum, with a very strong median carina below. Mesonotum with a V-shaped impression formed by the parapsidal furrows which originate on the sides at the anterior third and meet medially behind at the posterior third; between them near the anterior margin are traces of two delicate impressed longitudinal lines; surface coarsely transversely striate,

these striæ curving backwards on the lateral lobes; scutellum flat, the postscutellum concave with raised lateral and posterior margin, almost contiguous with the tubercle upon which the abdomen arises. Thorax in lateral view slightly higher than long, the propodeum almost vertical behind. Propleura smooth except for a few short coarse horizontal striæ centrally, below, and along the posterior margin; mesopleura punctulate, but smooth and polished behind; metapleura [smooth and polished; propodeum reticulate, more coarsely so medially in front, with a distinct transverse carina just behind the middle (obliterated in some specimens). Abdomen three times as long as the thorax; petiole smooth, as long as the three following segments together, the spiracle at the middle; second to sixth of about equal length, the whole abdomen formed as in Gasteruption; polished basally and subopaque beyond. Hind coxæ striate above, smooth below; femora slender, the tibiæ constricted at base, but not greatly swollen apically, not broader than the femora; hairy, but without any short stiff spinules; longer tibial spur a little more than half the length of the metatarsus, the latter at least four times as long as thick and as long as the following joints together; claws long, slender, simple. Wings with the basal nervure arising considerably to the base of the stigma; cubitus arising just behind the middle of the basal; first section of radial vein two-fifths as long as the second which is reduced in thickness on its apical half; recurrent nervure entering the first cubital cell just beyond the basal third; anterior discoidal cell more than twice as long as the posterior one which is open behind; nervulus interstitial. Hind wing with three frenulum hooks.

Six males from Fiji (W. M. Mann). One specimen is from Navai and all the others from Nadarivatu. Turner records Cuvu.

Turner (*loc. cit*) has placed this species in Hyptiogaster and compared it with *H. darwinii* Westw. If Kieffer's genus Hemifœnus is distinct, it seems to me that the Fijian form must be placed there on account of the very short thorax. *H. darwinii* was unknown in nature to both Schletterer and Kieffer, and the latter author (Das Tierreich, Lief. 30, p. 212) refers it to Pseudo-

fœnus, giving a translation of Westwoods original description which did not enable him to place the species generically.

The type and only species so far referred to Hemifœnus is from Australia. No specimens are available for comparison, but from Kieffer's comprehensive description[1] it is evident that the Fijian species differs in several respects from his *H. brevithorax.* The eyes are pubescent, not bare and the posterior femora are but slightly swollen, scarcely "keulenförmig" as in *H. brevithorax.* Unfortunately all the known examples are males and the type species is known in the opposite sex only, which might account for these rather pronounced differences. Turner's type is also a male although both sexes of *darwinii* are known.

Evania impressa Schletterer.

Ann. Hofmus. Wien, vol. 4, p. 153 (1889)

Enderlein, Arch. Naturges. 1901, p. 191.

Bradley, Trans. Amer. Ent. Soc., vol. 34, p. 173 (*Acanthinevania*)

Kieffer, Das Tierreich, Lief. 30, p. 109 (1912).

Turner, Trans. Ent. Soc. London, 1918, p. 342.

Two males and two females from Lasema, Fiji (W. M. Mann). Both females and one male show a distinct, although very short, median keel on the face just below the antennæ and the abdominal petiole in all is distinctly longer than the distance from its base to the base of the propodeum. The Fijian examples therefore approach the Australian *E. angulata* Schlett. which I am inclined to believe is not a distinct species.

Family Braconidæ.

Exobracon nitidulus sp. nov.

♀ Length 7-9 mm.; ovipositor 4-5 mm. Head, prothorax and first segment of abdomen, except tip, pale yellow; thorax bright ferruginous; abdomen, beyond petiole black above, except for a narrow white band just before apex; venter white between the small, white sclerites; sheaths of ovipositor black; antennal

[1]Ann. Soc. Ent. France, vol. 80, p. 182 (1911) and Das Tierreich, Lief, 30, p. 192 (1912).

scape black, flagellum brown; wings very dark brown, yellowish, and with the viens lighter, near their bases; body sparingly clothed with short, sparse yellowish brown hairs. Head but little wider than long, the temples broadly rounded and the occiput weakly excavated; front with a slight impression above the antennæ ocelli small, very close together. Eyes large, distinctly emarginate opposite the base of the antennæ; malar space short, with a weak furrow; mandibles bidentate, black at tips; head smooth, except for some very minute punctures on the face. Scape of antennæ simple, twice as long as thick; first flagellar joint less than twice as long as thick; second and all the following, quadrate or nearly so. Prothorax entirely smooth, above with a sharp transverse groove which extends to the middle of the propleuræ. Mesonontum highly polished, the parapsidal furrows impressed, but not very deep. Propodeum smooth and polished, with a linear groove just below the small, round spiracle. Abdomen smooth and shining, with few minute scattered punctures on the second and following segments. Median area of first segment nearly as broad as long, side pieces with a longitudinal groove, the segment about as long as wide; second segment twice as wide as long, with a large basal median area that is as long as wide and reaches nearly to the posterior margin, just outside it is an oblique furrow, parallel with the lateral margin of the segment and not attaining the posterior margin; third segment a little shorter and considerably wider than the second, anterior corners produced forward; but not separated by a furrow; fourth and fifth segments narrower, but nearly as long as the third; following very short. Hypopygium cultriform, but not exceeding the pygidium. Pleuræ smooth, the metapleura indistinctly punctulate. Sheaths of ovipositor nearly bare. Legs stout, but not thickened; hind coxæ short, flattened and much expanded inwardly at the base. Radial vein arising at the middle of the rather broad stigma, not attaining the wing tip, third section as long as the other two combined; cubitus bent at base, recurrent nervure interstitial with the very oblique first transverse cubitus; second cubital cell scarcely half as high as long above, the sides parallel; nervulus postfurcal,

not oblique; nervellus arising below the middle of the cell; submedian cell in hind wing very short.

♂. Length 7 mm. Similar, but with the middle part of the first abdominal segment longer and blackened on the apical half. Eyes no longer than those of the female.

Type from Lobasa, Fiji; eleven female and one male paratype from Lobasa, Navai and Vunisea, Fiji (W. M. Mann).

I have not been able to compare this with any other species of the genus, but am satisfied that it is properly placed. It differs from Archibracon (*Pseudobracon*) in the basally bent cubitus, shorter, distinctly ovate abdomen and more clearly cubical head. It is evidently a common Fijian species.

Palinzele Gen. nov.

Related to Zele Curtis, but differing in the immargined head, non-convex propodeum, with the abdomen inserted well above the hind coxæ. Malar space as long as the basal width of the mandible; hind coxæ long and slender; nervulus post-furcal; second cubital cell elongate; ovipositor very short; spur of hind tibia half as long as the metatarsus; tarsal claws simple.

Type: *Palinzele oceanica* sp. nov.

This genus is similar to Zele, but differs in the absence of a margin on the head behind and in the higher insertion of the abdomen. The slender hind coxæ as well as the other two characters just mentioned are similar to Macrocentrus and the several genera grouped about it. On account of the very short ovipositor and habitus, however, the type appears to approach Zele and its allies more closely.

Palinzele oceanica sp. nov.

♀. 8-8.5 mm. Pale ferruginous, the face and anterior legs paler yellowish; flagellum of antennæ, ocellar space and sheaths of ovipositor black; hind tibiæ, except knees, and hind tarsi piceous; wings subhyaline, with a brownish tinge, stigma and veins very dark brown. Head more than twice as broad as thick, not margined behind; its surface smooth, except for minute punctures on the face, more conspicuous medially and on the clypeus;

clypeal foveæ deeply impressed, nearly as far from one another as from the eye; face slightly tuberculate above each fovea and clypeus strongly elevated centrally; malar space one-fourth the eye-height, with a distinct furrow; mandibles large, inner tooth well developed; palpi short, third joint of the maxillary ones scarcely two-thirds as long as the first flagellar joint; ocelli well separated, the lateral ones separated by their own length from one another and from the eye margin. Antennæ with about 55 joints, considerably longer than the body; second joint of flagellum practically as long as the first, the following growing very slightly shorter. Mesonotum and scutellum smooth; median lobe highly convex; furrows crenulate, basal scutellar impression cross-striate. Propodeum granulate, finely reticulate apically; the subspiracular carina complete, but the transverse one entirely wanting; spiracle small, oval; upper surface oblique, not convex in profile, the abdomen inserted well above the hind coxæ. Pleuræ sparsely, minutely punctate, the propleura smooth, except at center. Abdomen slightly longer than the head and thorax together, compressed apically; first segment as long as the scutellum and propodeum; four times as long as broad at apex which is twice as wide as the base, spiracles at the basal fourth; entire abdomen smooth, conspicuously yellowish pilose apically. Legs rather long and slender, the hind coxæ about three times as long as broad. Hind tibiæ and tarsi very slender, but the longer apical spur fully half the length of the metatarsus; the tibia distinctly flattened, except on the basal third. Radial cell not attaining the wing tip; first section of radius more than half as long as the second which is less than half as long as the third; first discoidal cell not petiolate; nervulus perpendicular, distinctly postfurcal; recurrent nervure entering half its length before the tip of the first cubital cell; second cubital cell narrowed apically, the second transverse cubitus half as long as the first and three fourths as long as the second section of the radius; nervulus arising at the lower fourth of the discoidal cell; last section of cubitus imperfectly chitinized. Radial cell of hind wing enlarged basally and constricted, but not divided medially.

Type and paratype from Fiji (W. M. Mann); the former from Vunisea and the latter from Levuka.

Aulacocentrum Gen. Nov. (Fig. 1, A, B, C.)

Related to Macrocentrus, but differing especially in the following particulars: mandibles very small and acute, with the apical tooth very small; clypeus highly convex, not distinctly separated from the face; first segment of abdomen somewhat longer than the distance from the tegulæ to the apex of propodeum, six times as long as wide at the apex which is but little wider than the base, its spiracles projecting as tubercles at the basal third; second and third segments equal, together one-third longer than the first and very narrow; radial cell in hind wings divided by constriction, the apical part narrow, the basal broad, with the radial vein thick and heavily chitinized.

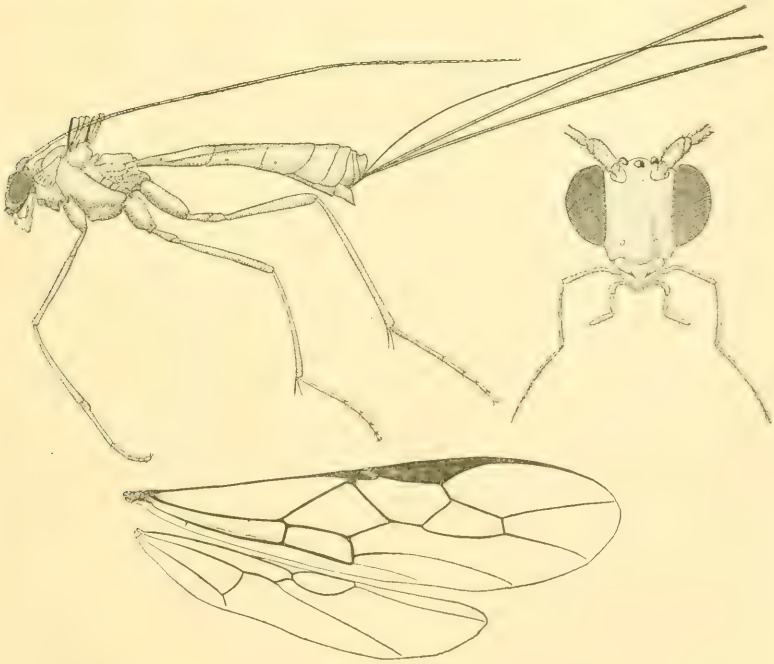

Fig. 1. *Aulacocentrum pedicellatum* sp. nov. ♀; profile view of body, front view of head and wings.

Head three times as wide as thick; not margined behind; ocelli very large; maxillary palpi long, five jointed; labial palpi 4-jointed; eyes large and strongly projecting, antennæ thin, longer than the body. Mesonotum strongly trilobed; propodeum and pleuræ finely sculptured; spiracle minute, circular. Legs very slender; ovipositor longer than the body. Recurrent nervure entering the first cubital cell; first discoidal cell barely sessile above; nervulus postfurcal; nervellus issuing at the lower third of the discoidal cell.

Type: *A. pedicellatum* sp. nov.

Aulacocentrum pedicellatum sp. nov.

♀ Length 13 mm.; ovipositor 15 mm. Dull ferruginous; antennæ black, except on scape above; lateral lobes of mesonotum, tegulæ, four anterior legs beyond coxæ and abdomen toward tip, flavous. Wings hyaline at base, the apical half distinctly infuscated; venation piceous, the stigma dark, but with a pale central streak. Ovipositor ferruginous, its sheaths black. Face faintly punctate, shining; malar space one-fifth as long as the eye-height; vertex and head behind smooth. Antennæ with about 55 joints, the first flagellar joint nearly as long as the eye-height, following decreasing in length, those near the middle of the flagellum thrice as long as thick. Mesonotum shining, the furrows deeply crenate, meeting near the middle; lobes smooth and shining. Scutellum highly convex; finely, closely punctate. Propodeum above minutely rugulose-recticulate, irregularly transversely striated behind the spiracle; anteriorly below the spiracle with a longitudinal carina; sides below confluently punctate; margin next to the mesopleura impressed, cross-striated; spical angle at base of the hind coxa produced. Mesopleura with an oblique impression, below sparsely punctate. Propleura smooth, with a median impression. First segment of abdomen transversely aciculate (as in Stephanus); second segment and base of third somewhat irregularly longitudinally aciculate; apical segments faintly punctulate. Tibial spurs of hind leg less than half as long as the first tarsal joint; claws minute, simple. Second section of radius twice as long as the first, third longer than the other two; nervulus received less than

half its length from the base of the first discoidal cell; recurrent nervure entering nearly its own length before the apex of the first cubital cell; second transverse cubitus half as long as the first; basal part of radial cell in hind wing oval, one third as broad as long.

Type from Suene, Fiji (W. M. Mann).

Family Ichneumonidæ

Echthromorpha immaculata Krieger.

Mitt. Zool. Mus. Berlin, vol. 4, p. 331 (1909).

Morley, Revis. Ichneum. British Mus., pt. 2, p. 47 (1913) (*diversor*).

Bridwell, Proc. Hawaiian Ent. Soc., vol. 4, p. 110 (1919).

Turner, Trans. Ent. Soc. London, 1918, p. 344.

There are numerous specimens of both sexes from Vunisea, Labasa, Somo-somo, Wainunu, Vagasau, and Ovalau. Bridwell records Viti Levu from material collected by Muir, and lists *E. diversor* described from the Solomons or New Hebrides as a synonym.

Paniscus fijiensis sp. nov.

♀ Length 14-16 mm. Uniformly pale dull ferruginous, with the head, except ocellar tubercle and posterior margin pale yellowish; antennæ blackened, except at extreme base; wings hyaline, with the stigma ferruginous and the venation piceous. Face very slightly narrowed below; clypeal foveæ contiguous to the eyes; emargination of eyes strong and acute. Ocelli separated by distinctly less than their diameter, the posterior ones touching the eye margin. Apex of mandible long and acute, inner tooth short and blunt. First joint of flagellum fully one-half longer than the second which is barely longer than the third. Thorax more noticeably pubescent than usual, its surface appearing dull and conspicuously silvery; sculpture very delicate, consisting of dense, very minute punctures; on the upper side of the propodeum these merge to form extremely fine transverse aciculations. Transverse carina of propodeum indicated only as a lateral tubercular ridge; subspiracular carina complete,

delicate; profile of propodeum oblique, only slightly curved. Tibiæ and tarsi of all legs spinulose; external hair brush of hind tibiæ distinct, extending from the constriction at basal fourth to the apex. Nervulus postfurcal by two-thirds its own length, strongly arcuate above, but scarcely oblique; second recurrent nervure bifenestrate; apical vein of areolet obsolete below, not produced apically; tip of recurrent nervure distinctly beyond the hayline side of the areolet.

♂ Differs only by having the aciculations of the propodeum more clearly indicated medially, and by the white face and orbits, as well as the larger ocelli. The lower outer side of the areolet is more distinct.

Type, six paratype females and six males from Vunisea, Fiji and one male from Lau, Fiji (W. M. Mann).

This is evidently related to *P. productus* Brullé, with which it shares the externally angulate, although not appendiculate areolet. The propodeal striæ are, however, not "very distinct" as described by Brullé for his species, and the stigma is not red as described by Morley from Tasmanian examples, this island being the type locality for *productus*. From *P. contrarius* Morley, the present form differs entirely in the position of the nervulus, the only character which he gives to separate this Queensland species from *productus*. Turner has recorded the widespread *P. opaculus* (*testaceus*, var.) from Fiji, but the present series do not belong to that species; the propodeum is scarcely curved above, the tibial spinules more sparse and the second flagellar joint longer.

Henicospilus turneri Morley.

Revis. Ichneum., vol. 1, p. 51 (1912).

One female from Vunisea (W. M. Mann).

Henicospilus apicifumatus, Morley.

Entomologist, vol. 48, p. 139 (1915).

One female from Labasa (W. M. Mann).

Family Scelionidæ.

Platyscelio Kieffer.

Ann. Mus. Civ. Genoa, Ser. 3, vol. 2 (42), p. 11 (1905).

This remarkable genus of Scelionidæ, with greatly flattened body was first found in New Guinea from whence Kieffer (*l.c.*, p. 12) described the type, *P. pulchricornis* in 1905. Since then it has been found in Indo-malaya, Australia and Polynesia (Guam). All of the species so far described appear to be very

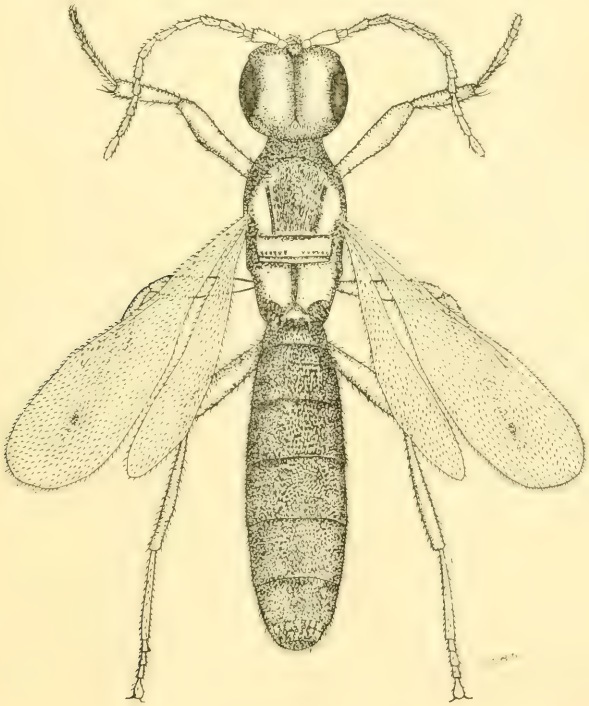

Fig. 2. Platyscelio sp. ♂

closely related, and from the several descriptions I have been unable to distinguish clearly two male specimens from Fiji which quite possibly represent an undescribed species. These were collected on Rewa of the Fiji group by Mr. F. Muir in 1905. As the genus has never been figured, except for a diagram of the

female antenna by Kieffer (*l.c.*). I have taken this opportunity to publish a figure (Fig. 2) of the complete insect which was drawn by my wife several years ago.

As Fiji is so far removed from the localities where the other species have been taken, it would appear probable that the present species is new. From the Australian *P. mirabilis* Dodd (Trans. Roy. Soc. So. Australia, vol. 37, p. 132 (1913) and *ibid.* vol. 39, p. 444 (1905) it differs in having the propodeal groove trongly crenate and also in having the apical abdominal segments entirely punctate. However, my only specimen of the Australian species is a female, and the male may be still more similar. From the type species, *P. pulchricornis* Kieffer (*l.c.*) it differs by the presence of oblique striæ on the propodeum behind and by a longer marginal vein (six times as long as thick) which extends only to the middle of the wing. From *P. abnormis* Crawford (Proc. U. S. Nat. Mus., vol. 38, p. 126 (1910) known from Manila, it differs by lacking distinct punctures in the groove along the anterior orbits and the antennæ are blackened apically. From Fullaway's, *P. wilcoxi* found on Guam, (Proc. Hawaiian Ent. Soc. ,vol. 2, p. 283 (1913) it differs in having the abdomen entirely black and in having the apical antennal joints elongate; it is possible however, that Fullaway may have had a female and not a male as he supposed at the time the description was written; *P. punctatus* Kieffer. (Insecta Rennes, vol. 3, p. 321, (1914) may be the same species.

So far the habits of these strangely flattened insects do not appear to have been observed. Neither have those of the Australian *Platytelenomus* Dodd (Ent. News, vol. 25, p. 126 (1914) which is modified in the same way. Dodd refers to the latter as common in "forest country" and as it is probably an egg parasite, the females may find their hosts beneath bark as appears to be the case with the greatly flattened although much larger Braconids of the genus Platybracon.

EVIDENCES OF RELATIONSHIP INDICATED BY THE VENATION OF THE FORE WINGS OF CERTAIN INSECTS, WITH ESPECIAL REFERENCE TO THE HEMIPTERA-HOMOPTERA.

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In the August issue of Psyche for 1921 (Vol. 28, p. 116) Mr. F. Muir offers a criticism of certain views proposed by me concerning the origin and relationships of the Hemiptera, and since Mr. Muir's criticism is apparently based upon a complete misunderstanding of my contentions concerning the interrelationships of the insectan orders in general, and the Hemiptera and Homoptera in particular, I would take this opportunity of correcting the mistaken impression given by Mr. Muir in his criticism. It is necessary first, however, to clearly understand the interrelationships of the lower forms and allied insects, before taking up the discussion of the phylogenetic development of the Hemiptera and Homoptera, and on this account I would postpone the discussion of Mr. Muir's criticism until the evidence of relationship to be gained from a study of the venation of the fore wings has been presented.

The discussion of the evidences of relationship in the different orders of insects indicated by a study of the venation of the fore wings has been taken up in the present paper because the wing veins are practically the only structural details preserved in a condition suitable for a comparative study in the fossil precursors of living insects, and because the evidence of the wing venation is apparently the only evidence of relationship which recent students of insect phylogeny deem worthy of their consideration! So far as possible, however, I have used the evidence of the wing veins to corroborate the evidences of relationship drawn from the study of numerous other structures of the body as well, thereby obviating the danger of being deceived by convergent development—as might be the case if one were to depend upon the evidence of one set of structures, such as the wing veins, alone.

The anatomy of the body in general in the Plecoptera indicates that they are among the most important of the living forms which have departed but little from the condition typical, in many respects, of the ancestors of the Orthoptera-like insects, and the higher orders. The venation of the fore wings of recent Plecoptera, however, does not furnish a particularly favorable basis of comparison in attempting to determine the paths of development followed in the evolution of the higher orders of insects, while the venation of the Protorthoptera in particular, and in some respects that of the Protoblattids, (Propalæoptera) Hadentomoids, (Proplatyptera) Megasecoptera etc., as well, apparently furnish certain servicable clews for tracing the origin of some of the developmental (evolutionary) tendencies exhibited in the wing venation of certain of the higher orders of insects.

Since the Protorthoptera appear to be as important as any of the fossil forms suggestive of the precursors of the higher insects, it is of some interest to establish as closely as possible the types ancestral to the Protorthoptera. Handlirsch apparently derives the Protorthoptera directly from the Palæodictyoptera (or from the Synarmogoidea, which he derived from the Palæodictyoptera); but a comparison of the wings of such a Protorthopteron as *Spaniodera ambulans*, or even the Protorthopteron shown in Fig. 30, with the Protoblattid shown in Fig. 32, would indicate that the Protoblattids are intermediate between the Protorthoptera and the Palæodictyoptera. In the forewings of the lower Protorthoptera and in certain Protoblattids, the anal veins are numerous, and in the hind wings of certain Protorthoptera there occurs an anal fan very suggestive of that found in many Protoblattids. The character of the cubital vein with its numerous oblique branches (cubital bars) and its rather wide extent in the posterior portion of the fore wing, is strikingly similar in both Protorthoptera and Protoblattids, and the nature and extent of the subcostal bars, or veinlets extending from the subcostal vein to the anterior margin of the wing, are much alike in both groups of insects (Protorthoptera and Protoblattids). When the more primitive

representatives of the Protorthoptera are compared with certain Protoblattids, it may readily be seen that the branches of the median and radial veins are also much the same in both groups of insects, so that the Protoblattid types of wings may be regarded as representing as nearly as any known forms, the precursors of the Protorthopterous types of wings; and the Protoblattids serve to connect the Protorthoptera with the Palæodictyoptera. I do not believe that the Protoblattids themselves are to be derived directly from the Palæodictyoptera, however, but their ancestors were possibly intermediate between the Palæodictyoptera and the ancestors of the Synarmogoids; and the Protorthoptera possibly sprang separately from the same stock, although the Protorthopterous and Protoblattid lines of descent apparently merge as we trace them back to their common stem, so far as the evidence of the wing veins would indicate.

In the reduction of the anals, the shortening of the cubital bars, and the reduction of media to two branches, the fore wing of the Hadentomoid shown in Fig. 10 presents many features suggestive of a rather close relationship with the Protorthoptera, such as the ones shown in Figs. 28 or 26, and the nature of the radius and subcosta is quite similar to that of certain other Protorthoptera. On the whole, however, the type of Hadentomoid wing shown in Fig. 10 might more readily be derived from the type of Protoblattid wing shown in Fig. 12, and it is quite possible that the line of development of the Hadentomoids arose from ancestors anatomically intermediate between the Protoblattids and the Protorthoptera very near the point where these two lines of descent began to diverge from their common Protoblattid-like forebears. The Hadentomoid type of venation is a very important one in suggesting a possible starting point in the the development of the types of venation occuring in the Embiids and their allies, as will be shown later.

The character of the anal, subcostal and cubital veins of the Mixotermitoid fore wing shown in Fig. 25, is very suggestive of both Hadentomoids (Fig. 10) and Protorthoptera (Fig. 28), and the character of the median vein is somewhat suggestive of

that of certain Protorthoptera (Fig. 9), while the branching of the radial vein is somewhat suggestive of the condition occurring in other Protorthoptera—although the nature of the median and radial veins in the Mixotermitoids is much more suggestive of the Palæodictyoptera. The ancestors of the Mixotermitoids were possibly intermediate between those of the Hadentomoids and those of the Protorthoptera, though the Mixotermitoid type apparently harks back to the Palæodictyoptera in many respects.

In the general character of the anals and the cubital veins, and more strikingly in the nature of the branching of the median vein, the fore wing of the Hapalopteroid insect shown in Fig. 6 approaches the Protorthopteron type (Fig. 9) more closely than any other, so far as I am aware, and the precursors of the Hapaloteroids are doubtless to be sought among the Protorthoptera or their forebears. I formerly adopted Handlirsch's suggestion that the Hapalopteroids were very like the ancestors of the Plecoptera; but a closer examination of the venation of the Hapalopteroid wings would not bear out this assumption.

The more primitive types of forewing venation in the Plecoptera, such as that of *Eusthenia* shown in Fig. 13, apparently hark back to a Protoblattid type resembling in some respects the one shown in Fig. 12, in the nature of the cubital and anal veins; and the anal fan in the hind wing of *Eusthenia* is suggestive of the anal fan of the Protoblattid hind wing. On the other hand, I find much in the venation of the Plecoptera which is suggestive of a rather close relationship to the Protorthoptera, and an even closer relationship to the Hadentomoids, particularly in the nature of the branching of media and radius in the fore wing, as may be seen by comparing Fig. 11 with Fig. 10. Furthermore, if we compare the fore wing of the Plecopteron shown in Fig. 11 with the fore wing of the Embiid shown in Fig. 8, the branching of cubitus, media and radius is strikingly similar, and the evidence of the venation is therefore in harmony with that drawn from the study of other structures of the body indicating a close relationship between the Embiids and the Plecoptera—and if the Embiids are to be derived from ancestors resembling the Haden-

tomoids and Protorthoptera in many respects, their near relatives, the Plecoptera should also be derived from ancestors resembling the Hadentomoids and Protorthoptera in many respects. It is quite possible that the line of development of the Plecoptera branched off from the common Protoblattid- Protorthopteron stem very near the point of origin of the Hadentomoid line of descent, or paralleled these lines very closely and the Plecoptera thus inherited characters found in all three of these groups (Protoblattids, Protorthoptera and Hadentomoids) from the common ancestors which combined all of their common characters in themselves.

As was mentioned above, the Embiid types of fore wings (Fig. 8 and 7) could be readily derived from precursors resembling the Hadentomoids (Fig. 10); but the Embiid types likewise approach very closely to the Protorthopteron types of venation, as one may see by comparing the anal, cubital, and median veins of the Embiid shown in Fig. 8, with these veins in the Protorthoptera shown in Figs. 26 and 28. The second and third branches of radius have begun to coalesce in the Protorthopteron shown in Fig. 26, thus indicating a tendency toward the further coalescence of these veins which has reached completion in the insect shown in Fig. 8; and in the Protorthopteron shown in Fig. 4, the second and third branches of radius coalesce and the fourth and fifth also unite, as is the case with the Embiid shown in Fig. 7. Furthermore, the tendency for all of the branches of media to coalesce exhibited by the Embiid shown in Fig. 7, also occurs in certain Protorthoptera, such, for example, as the one shown in Fig. 30, in which the media consists of but a single branch. From the foregoing facts, it is evident that the tendencies exhibited by the veins of the Embiids could be traced back to Protorthopteron predecessors quite readily. On the other hand, the character of the anals, cubitus, media, radius and subcosta of the Embiids shown in Figs. 8 and 7 is strikingly similar to the branching of these veins in the Hadentomoid insect shown in Fig. 10, and I am convinced that the ancestors of the Embiids must have resembled both the Hadentomoids and the Protorthoptera in many respects. The general anatomy of the

Psocids such as *Embidopsocus*, for example, suggests a very close relationship between the Psocids and Embiids, and since the Psocids were apparently derived from Protorthoptera-like ancestors (as will be presently discussed) it is to be expected that their near relatives, the Embiids, would also be derived from Protorthoptera-like ancestors, so that in indicating an ancestry for the Embiids anatomically intermediate between the Hadentomoids and Protorthoptera, the evidence of the wing venation is quite in harmony with that from other sources as well.

The venation of the Psocid wing shown in Fig. 1 is so similar to that of the Zorapteron shown in Fig. 3, that both were evidently derived from the same source, and what applies to one applies to the other as well. The Psocid and Zorapteron wings shown in Figs. 3 and 1 could readily be derived from the Embiid type of fore wing shown in Fig 7 (as is indicated in the hypothetical intermediate condition shown in Fig. 5)* in the following way. The second branch of cubitus of Fig. 7 might become more vertical, while vein M, which arises from M+Cu and coalesces for a short distance with Rs. in Fig. 7, might unite with Rs further from the base of the wing thus lengthening that portion of M which extends between M+Cu and Rs, as in Fig. 3. R2+3 of the radial sector, Rs, bends upward toward R_1 in Fig. 7, and if R4+5 were to unite with it to form a single branched Rs bending forward to meet R_1, the condition exhibited by Rs in Fig. 3 would be produced. A deposition of chitin and pigment in the space between Sc and R_1 (as indicated in Fig. 5) would produce a pterostigma such as the one labeled "ps" in Figs. 1 and 3. Judging from the same developmental tendencies found in the Psocids, Zoraptera, and Embiids, it would appear that all three were derived from a common ancestral source, and many of the genes, determinants, or factors occurring in this common source were inherited by the three derived groups, although they were naturally slightly modified by other factors in the derived groups, as would be expected. As is pointed out in the next paragraph, the ancestors of the Psocids were apparently very similar to the Protorthoptera, and since the Psocids, Zoraptera

*The figure in the left hand column between Figs. 3 and 7 is Fig 5. The label was lost from this figure, having been pasted on too insecurely.

and Embiids apparenty sprang from the same source, it is very probable that their common ancestors were very like the Protorthoptera in many respects.

That the fore wing of a Psocid could be readily derived from a Protorthopteron prototype may be seen by comparing the fore wing of the Psocid shown in Fig. 2 with that of the Protorthopteron shown in Fig. 4, since the venation of the two wings is strikingly similar, and the Protorthopteron type is evidently the more primitive one, since it is one of an older and lower group, and the branching of the veins in general begins nearer the base of the wing—which is usually a more primitive character than for the branches to come off nearer the apex, since the latter usually indicates a degree of coalescence, and hence a specialization, in the veins. The three anal veins are much alike in Figs. 2 and 4, and the forking of the cubitus in the Protorthopteron shown in Fig. 4 (or better still in the Protorthopteron shown in Fig. 26) is strikingly like that of the Psocid shown in Fig. 2. The three branches of media, and the two branches of Rs are also strikingly similar in the insects shown in Figs. 4 and 2, and the nature of the first branch of radius and the subcostal vein is much the same in both. The Psocids and Protorthoptera thus apparently have many developmental tendencies in common, and probably inherited them from a common ancestry which was very like certain Protorthoptera in may respects, and as was mentioned above, the ancestors of the Zoraptera and Embiids probably also resembled the Protorthoptera in many respects. As will be shown in the next paragrpah, the Psocids and Hemiptera-Homoptera have so much in common, that they also in all probability were derived from the same type of ancestors which must likewise have resembled the Protorthoptera in many respects, although the ancestors of the Homoptera in all probability resembled the Protoblattids as well, and the "roots" of the Homopteron stem apparently strike somewhat more deeply down into the Palæodictyopterous types.

The peculiar bulging antefrontal region of the head incorrectly called the "clypeus" in Cicadid Homoptera and Psocids, the peculiar lengthening of the segments of the antennæ, which, so

far as I am aware, occurs exactly in that fashion only in the Homoptera and Psocids, the nature of the thoracic terga and wing bases, the nature of the tarsal segmentation, and other regions of the leg, the nature of the abdominal segments in general, the segments of certain males and the ovipositors of certain females in particular, and many other features too numerous to mention at this point, all clearly indicate so close a relationship between the Psocids and Homoptera, that it would be stretching the laws of probability and chance far beyond the breaking point to claim that the marked similarity in all of these structures from all parts of the body, and extending through a wide-ranging series of forms, is merey the result of "convergence," and it would be very interesting to learn from those who continually cry "convergence" whenever similarities are pointed out between the Psocids and Homoptera, just how "convergence" could be brought about in so wide a range of forms and in such a multitude of details from all parts of the body! That the many similarities in structures from other parts of the body extend to the venation of the wings as well, in the Psocids and Homoptera, is shown in the series of insects figured in Figs. 17 to 24, which includes some of the most primitive, and the most highly specialized, as well as the intermediate types of venation, in the two groups of insects. Thus, the peculiar "broken" character of the venation of the apical portion of the Psocid wing shown in Fig. 24 is paralleled by the wing of the Homopteron shown in Fig. 23, although the fore wing of the Homopteron *Cercopis* sp., figured by Handlirsch, 1909, would have been better for a comparison with the Psocid shown in Fig. 24, than is the case with the Homopteron shown in Fig. 23. The broader more primitively veined Psocid wing shown in Fig. 22 is paralleled by that of the Homopteron shown in Fig. 21, and the venation in the two is quite similar. Turning next to the intermediate type of venation shown in Fig. 18, it is quite evident that the Psocid shown in Fig. 18 is approached by the Homopteron shown in Fig. 20, especially in the character of the anals, and the branching of cubitus and media, which is strikingly similar in the two groups of insects, and there is evidently a tendency toward the formation of a pterostigma

between the first branch of radius and the anterior margin of the wing, as well as a tendency for Rs to turn forward toward the anterior margin of the wing. In order to make the series include as wide a range of types as possible, I have included some of the most specialized types as well, and, as one may see by comparing Figs. 17 and 19, in which radius and media are practically the only veins retained in a well develped condition, there is a marked parallelism in the more highly specialized members of the two groups, as well as in the intermediate and more primitive representatives of the Psocids and Homotera. This parallelism in a wide range of wing types, as well as in a multitude of structures from all parts of the body, can be explained only as the result of the operation of the same developmental tendencies (i.e. the expression of the presence of the same genes, determinants or factors—albeit these are modified to some extent in the derived groups by the influence of other factors) inherited from a common ancestry.

From the foregoing facts, I would conclude that the Psocids and Hemiptera-Homoptera were descended from very similar ancestors, and since the Psocids were apparently descended from ancestors closely resembling the Protorthoptera in many respects, it naturally follows that the ancestors of the Homoptera must also have resembled the Protorthoptera in many respects. The fact that the saltatorial Orthoptera, which are the modern representatives of the Protorthoptera, have likewise retained many features suggestive of affinities with the Hemiptera-Homoptera is also in harmony with such a derivation of the Homoptera; but there are other factors involved, which further complicate the question of the origin of the Homoptera. The primitive type of venation exhibited by the fore wing of the Homopteron *Hotinus* sp., figured by Handlirsch, 1909, appears to be of a lower type than that of most Protorthopterous fore wings, and suggests affinities with the Neuroptera and Protoblattids. The venation of the Homopteron *Ormenis* is also very suggestive of that of certain Neuroptera such as *Psychopsis*, particularly in the peculiar arrangement of certain small cross veins which unite end-to-end to form a paramarginal line extend-

ing parallel to the margin (but at some distance from it) in the fore wing. The nature of the thoracic sclerites of the Homoptera would lend further weight to the view that the ancestors of the Homoptera were very like those of the Neuroptera, and the fact that many insects descended from the common Neuropteroid stem, such as the Mecoptera (and even the Siphonaptera) exhibit very similar tendencies in the specialization of their mouth-parts (which tend to lose the ligula, while the labial palpi become approximated and unite to some extent, and the maxillæ become much elongate and somewhat stilet-like) would suggest that they and the Homoptera inherited these tendencies from a common ancestry. Furthermore, the fore wings of certain primitive Trichoptera and Mecoptera, which were derived from a common Neuropteroid stem, show undoubted affinities with certain types of Homopterous fore wings, and lend further weight to the supposition that the ancestors of the Homoptera resembled those of the Neuropteroid insects in many respects. Thus, the Trichopterous fore wing shown in Fig. 27 is remarkably like that of the Homopteron shown in Fig. 29, especially in the character of the anal and cubital veins; and the other veins of the wing are also of much the same type in the two wings under consideration. All of these facts, which indicate that the ancestors of the Homoptera and Neuroptera were very closely related, are in harmony with the fact that the Homoptera and Psocids are also very closely related, since the Psocids themselves are clearly related to the Neuroptera, and their line of development apparently merges with that of the Neuroptera near its point of origin, thereby involving the line of develpoment of the Homoptera with that of the Neuroptera through their mutual relationship to the Psocids, as well as through the more direct affinities of the Homoptera themselves with the Neuropteroid insects. I have therefore maintained that the ancestors of the Homoptera were intermediate between those of the Psocids and those of the Neuroptera, and the present study of the fore wing venation would uphold the correctness of this view.

If one compares the wing of a Neuropteron such as the one shown in Fig. 34, with the wing of a Protoblattid such as the one

shown in Fig. 32, there is a pronounced similarity between the two types of wings, especially in the nature of the anal veins, and the cubital and subcostal bars. The character of the median vein is also quite similar in both, although the radial veins are not quite so much alike in the two insects. While there is considerable evidence pointing to the Protoblattids as the probable precursors of certain primitive types of Neuropterous wings, some of the Neuropterous types, on the other hand, have retained certain Palæodictyopterous characters which suggest that they hark back to Palæodictyoptera-like forebears. Handlirsch suggests that the Megasecoptera represent the precursors of the Neuroptera, and certain tendencies in the Megasecopterous wing, such as the tendency toward the anastomosis of the radial sector, media, and cubitus, are certainly very suggestive of similar tendencies in the wings of certain Neuroptera. I would not derive the Neuroptera directly from the Megasecoptera, however, as Handlirsch does, since the Neuropterous wings evidently partake of certain characters in common with the Protoblattids in addition to preserving certain features suggestive of the Palæodictyoptera, so that all of these lines of descent apparently either branched off near the base of the common Protorthopteron-Protoblattid stem, or they parallel each other remarkably closely as we trace them all back to their common Palæodictyoptera-like ancestors.

In the nature of the branching of its anal, cubital, and median veins, *Eugereon*, the supposed ancestor of the Hemiptera and Homoptera (Fig. 31) is apparently a Palæodictyopteroid insect resembling, in some respects, the Palæodictyopteron shown in Fig. 33, while in many features the wing of *Eugereon* is very suggestive of the Megasecopteron type. The primitive type of Homopterous wing shown in Fig. 29 is not very similar to *Eugereon's* wing (Fig. 31), and it would be very difficult to derive the primitive type of venation exhibited by the Homopteron *Hotinus* (which is more like a Neuropterous or Protoblattid type) mentioned above, from a wing such as that of *Eugereon*, since the latter appears to be somewhat more specialized than the venation of *Hotinus*. Taking all of the facts into con-

sideration, it would appear to be more probable that instead of arising from *Eugereon*, the line of descent of the Homoptera arose at the base of a common Protorthopteron-Protoblattid stem, or it parallels the common Protorthopteron- Protoblattid stem very closely as we trace them all back to their common ancestors resembling the Palæodictyoptera, which gave rise to such forms as *Eugereon*, and the Megasecoptera.

In the nature of their mouthparts, their widely separated coxæ and broad sterna, and to some extent in the nature of their ovipositors, etc., the Thysanoptera exhibit many features suggestive of a relationship with the Hemiptera; but the venation of the Thysanoptera is too highly specialized to be of much value in determining the origin and affinities of the Hemiptera, although they do offer certain points of contact with both Hemiptera and Psocids, which would be expected if the Psocids and Hemiptera were related both to each other and to the Thysanoptera. The character of the radial and median veins which extend parallel to each other down the center of the wing of the Psocid shown in Fig. 17 is very suggestive of the character of the radius and media which also extend parallel to each other down the middle of the Thysanopteron wing shown in Fig. 15. The radial and median veins of the Orthopteron shown in Fig. 16, however, likewise extend parallel to each other down the center of the wing, and the character of the cubital vein, and the branches of the radial vein of the Orthopteron shown in Fig. 16 are even more like those of the primitive Thysanopteron shown in Fig. 14. These similarities may be taken to indicate that the Orthoptera, Psocids and Thysanoptera were all descended from Protorthoptera-like precursors, and inherited much the same tendencies from this common ancestry, although these tendencies (or the genes, determinants, or what not, which they express) were slightly modified by different factors in the different lines of development derived from this common source If the Hemiptera-Homoptera were also descended from ancestors similar to the Protorthoptera in many respects, this might also account for certain similarities between the Hemiptera-Homoptera and certain Orthoptera, which are too evident to be entirely passed over.

The facts brought out in the foregoing discussion would indicate that the ancestors of the Hemiptera-Homoptera arose from forms anatomically intermediate between the ancestors of the Psocids and those of the Neuropteroid insects. In other words, the ancestors of the Hemiptera-Homoptera were apparently anatomically intermediate between the insects forming the common Protorthopteron-Protoblattid stem and the Megasecoptera, and their line of descent either merged with that of the Protorthopteron-Protoblattid stem and the Megasecoptera, or paralleled them extremely closely, as they all approached their common origin in an ancestral group resembling the Palæodictyoptera in many respects. The interrelationships of the primitive forms grouped about the base of the lines of descent of the Homoptera and the Neuropteroid insects is shown in the appended diagram (Text figure 1) in which the lines of descent in

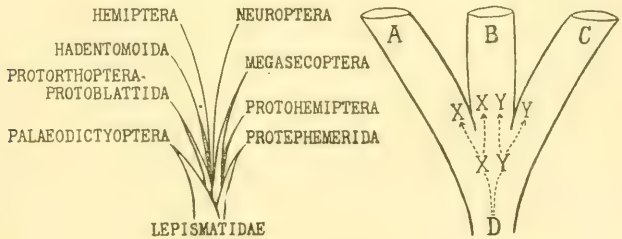


Fig. 1 Fig. 2

question are represented as though branching off in different directions, since this method apparently is more in accord with the facts of a complicated interrelationship between these groups of insects than is the case when one attempts to represent their lines of descent by means of a dichotymously branching tree.

Having repeatedly stated that no living forms can be derived from other living forms (see footnote to page 148 of the American Naturalist, Vol. LIII, 1919, etc.) and since this fact is so widely accepted as to be more of the nature of a truism, it hardly seemed necessary to waste energy and space by repeating this utterly obvious fact every time a living insect was compared with a

another living insect belonging to a more primitive group; and on this account it is amazing that Mr. Muir should accuse me of deriving *living* Psyllids from *living* Psocids especially since I definitely state in a paragraph *which he quotes*, that the lines of descent of the Homoptera, Thysanoptera, Psocids Hymenoptera and related forms "apparently arose from ancestors intermediate between the Zoraptera (with the Isoptera) on the one side, and the Coleoptera (with the Dermaptera) on the other." In other words, the ancestors of the Homoptera, Psocida, Hymenoptera, etc., were very similar to the Protorthopteron-like and Protoblattid-like ancestors of the Zoraptera and Coleoptera. This is surely a very different matter from claiming that the Homoptera were descended from living Psocids! I have always been careful to state that the Psocids were in many respects *very like* the ancestors of the Homoptera, just as the chimpanzees are in many respects *very like* the ancestors of man (i.e. the *Pithecanthropus*-like forms), yet such a statement by no means implies that men were descended from living chimpanzees—and the same principle holds true in the comparison of the Homoptera with the Psocids, abeit the groups compared in the latter case belong to different orders instead of belonging to different families of the same order, and the differences are naturally somewhat greater in the one instance than in the other. The idea which I intended to convey is that the Psocids and Homoptera are very closely related (i.e. they have both inherited many tendencies in common which cause their lines of development to parallel each other quite closely) and since the Psocids have evidently departed less than the Homoptera have from the common ancestral types, the ancestral features which they have preserved in a less modified condition, enable us to form some conception of the character of these features in the ancestors of the Homoptera.

Starting with the false assumption that I would derive living Homoptera from living Psocids (an obvious impossibility), Mr. Muir proceeds to a second equally false assumption that I would derive all Homoptera from living Psocids by way of the highly specialized recent family Psyllidæ, simply because I

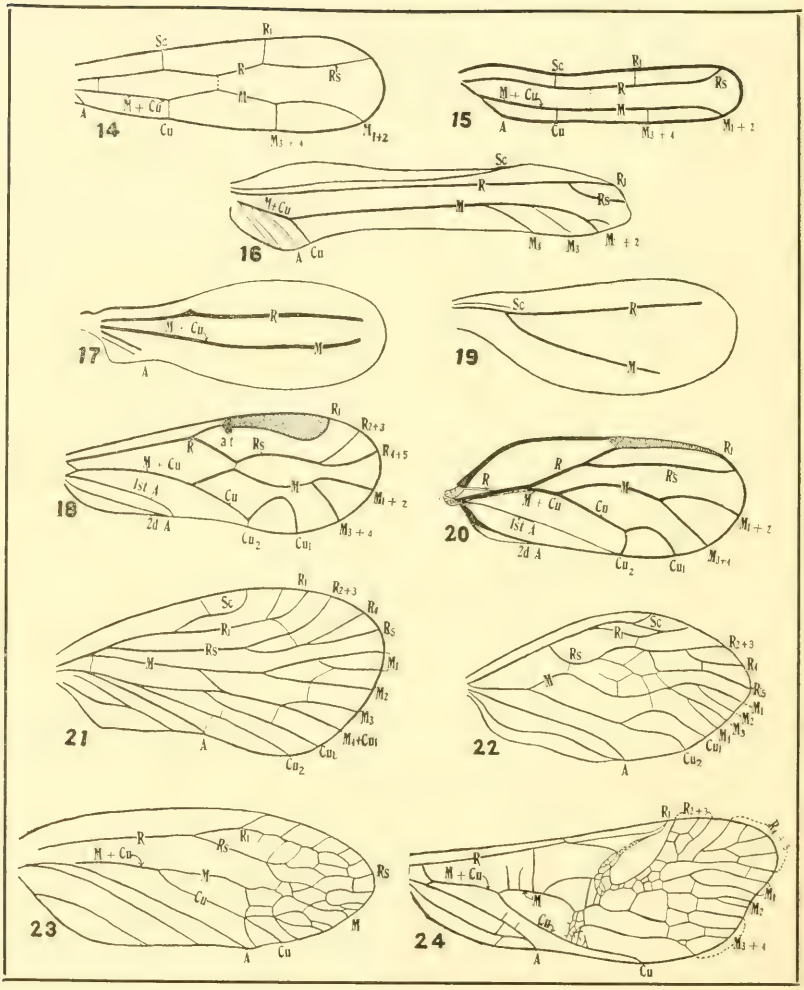
chanced to use a fore wing of an insect belonging to the genus *Psylla* to illustrate the operation of the same developmental tendencies in the evolution of the wing veins throughout the orders Homoptera and Psocida. The wing type exhibited by *Psylla*, however, is but one of a wide-ranging series of forms (a few of which are shown in Figs. 17 to 24), extending from the lower Psocids and Homoptera to the higher specialized members of the two groups, in which the developmental tendencies operative in directing the evolution of the various types of venation in the Psocid wings are closely paralleled throughout the series by similar developmental tendencies operating in the evolution of the various types of Homopterous wings. In other words, the same genes, determinants or factors were in many cases inherited in both groups from a common ancestry, although they were naturally modified somewhat by different factors in the two distinct orders of insects. This again is a very different matter from claiming that all Homoptera were descended from the highly specialized recent Homopterous family Psyllidæ, and I am at a loss to understand how Mr. Muir could have so completely misconstrued my meaning in this matter.

As a final and culminating false assumption, Mr. Muir implies that I "believe that new orders arise as hybrids from the crossing of individuals belonging to different orders" of insects! The fact that every student of evolution knows full well that the offspring of crosses between different species are generally sterile, and those between different genera are almost invariably so (save in the plant kingdom) should have deterred Mr. Muir from making this curious mistake. However, lest others be misled by Mr. Muir's implication, I would endeavor to indicate graphically by means the diagram shown in Text figure 2, how a third order of insects may partake of characters present in two other orders, without being the result of the crossing of members of the other two orders possessing characters in common with it. I have drawn a similar diagram, and explained it, in an article published in the Fiftieth Annual Report of the Ent. Society of Ontario for 1919; and in order to use the same concrete examples, let us suppose by way of illustration that "A" in Text figure 2

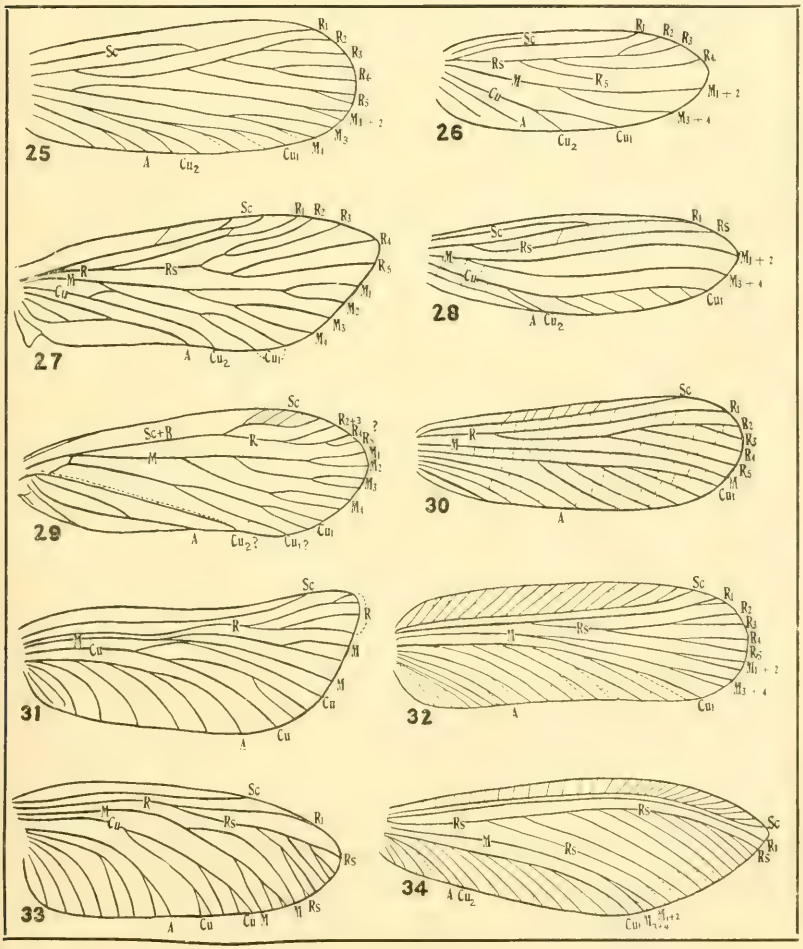
represents the line of development of the higher Crustacea (Isopods, etc.), while "B" represents the line of development of the lower Insecta, and "C" represents the line of development of the "Myriopoda", all of which were derived from a common ancestral group "D", some of whose members contained the factor or group of factors "x", which produces a flat head with mandibles extending up the sides of the head to a point behind the eyes (as the insect *Lepisma*, and the isopod *Asellus*) while others of the ancestral group contained the factor "y," which produces a pyriform head with cryptognathous (endognathous) mouthparts (as in the insect *Campodea* and the "myriopod" *Scolopendrella*). It should be quite evident from the diagram in Text figure 2 that certain insects in "B" could inherit the characters "x" (flat head with huge mandibles) from the "side" of, or in common with, certain higher Crustacea in "A", having inherited these tendencies or factors from the common group "D", which gave rise to both "A" and "B", while certain other insects in "B" could inherit the characters "y" (pyriform head with cryptognathous mouthparts) from the "side" of, or in common with certain Symphyla ("myriopods") in "C", having inherited these tendencies from the common ancestral group "D", which gave rise to both "B" and "C", without postulating that members of "A" and "C" must have interbred to produce these characters in "B". In order to apply the same principle to the orders of insects, let us suppose that "A" represents the line of development of the Psocids, "B" that of the Hymenoptera, and "C" that of the Coleoptera, all of which were descended from ancestors resembling the Protorthoptera in many respects, which may be represented by the ancestral group "D". If "x" represents the factor or factors producing colonial tendencies, while "y" represents the factors producing styli-bearing ovipositors, for example, it should be readily apparent from the diagram, that some members of both Psocids ("A") and Hymenoptera ("B") could inherit tendencies toward "social" life (represented by "x") from a common source in "D", while some members of both Hymenoptera ("B") and Coleoptera ("C") could inherit their tendencies toward the development of styli-bearing ovipostors (represented by "y")

from a common source in "D", without postulating that Coleoptera with styli-bearing ovipositors mated with "socially" inclined Psocids to produce Hymenoptera possessed of these qualities, and it is difficult to understand how Mr. Muir could have arrived at such an obvious "*reductio ad absurdum*" in this matter.

From the foregoing discussion, it is evident that it would be impossible to accurately represent the lines of development of the various insectan orders by means of a dichotomously branching tree, since such an arrangement ignores the evident interrelationships between *several* orders of insects which apparently have sprung from a single ancestral group, and I know of no developmental law necessitating that all evolution in living things shall follow a dichotomously branching path. In fact, the known evidence would seem to indicate that such a method is extremely rare among insects, and it is better to make a theory to fit the facts, than to adhere to some hypothesis which is not in accord with most of the facts which one encounters in his observations. I would therefore prefer to represent the orders comprising the lines of descent of the three sections of winged insects by means of cone-like figures in which the closely interrelated orders converge to a common point of origin in each section. Of these three Pterygotan sections, the higher insects or Neuropteradelphia include the Neuropteroid super-order (Neuroptera, Hymenoptera, Mecoptera, etc.) and the Psocoid superorder (Psocids, Zoraptera, Homoptera, etc.); while the intermediate insects or Orthopteradelphia include the Orthopteroid superorder (Orthoptera, Phasmids, etc.) the Blattoid superorder (Blattids, Isoptera, Mantids, etc.) and the Plecopteroid superorder (Plecoptera, Embiids,, etc.); and the lower insects or Plectopteradelphia include the Palæodictyoptera, Odonata, Ephemerida, etc. The final assignment of certain aberrant orders of obscure affinities has not been definitely determined, but in the main, the venation of the fore wings is in agreement with the grouping of insects into superorders given on page 114 of Vol. 53 of the Canadian Entomologist for 1921.



CRAMPTON—WINGS OF HEMIPTERA-HOMOPTERA



CRAMPTON—WINGS OF HEMIPTERA-HOMOPTERA

Fig. 14.—Thysanopteron Palæothrips fossilis, from Crampton, 1921, after Scudder, 1890.

Fig. 15.—Thysanopteron *Aelothrips nasturii*, from Crampton, 1921, after Jones, 1912.**

Fig. 16.—Orthopteron *Dioconema ornata*, redrawn from Handlirsch, 1909.

Fig. 17.—Psocid *Embidotroctes paradoxus* from Crampton, 1921 after Enderlein.

Fig. 18.—Psocid *Hemicaecilius bogotanus* from Crampton, 1921, after Enderlein, 1903.

Fig. 19. —Coccid *Pseudococcus citri*, redrawn from Patch, 1909.

Fig. 20.—Psyllid *Psylla* sp., from Crampton, 1921.

Fig. 21.—Fulgorid *Bothriocera prosignoretti*, redrawn from Metcalf, 1913.

Fig. 22.—Psocid *Calopsocus infelix*, redrawn from Enderlein, 1903.

Fig. 23.—Cercopid *Monecphora bicincta*, redrawn from Metcalf, 1917.

Fig. 24.—Psocid *Neurosema apicalis*, redrawn from Enderlein, 1903.

Fig. 25.—Mixotermitoid *Mixotermes lugauensis*, redrawn from Handlirsch, 1920.

Fig. 26.—Protorthopteron *Delopterum latum*, redrawn from Handlirsch, 1920.

Fig. 27.—Trichopteron Rhyacophila redrawn from Betten, 1913, and Tillyard, 1919.

Fig. 28.—Protorthopteron *Probnis speciosa*, redrawn from Handlirsch, 1920.

Fig. 29.—Homopteron *Dictyophora europæa*, redrawn from Handlirsch, 1909.

Fig. 30.—Protorthopteron *Gyrophlebia longicollis*, redrawn from Handlirsch, 1920.

Fig. 31.—Protohemipteron *Eugereon bœckingi*, redrawn from Handlirrsch, 1920.

Fig. 32.—Protoblattid *Protophasma dumasi*, redrawn from Handlirsch, 1920.

Fig. 33.—Palæodictyopteron *Homoioptera woodwardi*, redrawn from Handlirsch, 1920.

Fig. 34.—Neuropteron *Nymphites braueri*, redrawn from Handlirsch, 1920.

*The label was accidentally scraped off from this figure, which is the third from the top in the right hand column of figures.

**The basal portion of this figure was not inked in, (through an oversight) and consequently does not appear in the plate.

THE SEAL OF THE CAMBRIDGE ENTOMOLOGICAL CLUB

By A. P. Morse, Wellesley, Mass.

[The following note concerning the seal recently adopted by the Club has been supplied by A. P. Morse to whom we are indebted, not only for the design, but also for its artistic execution in the final form which appears on the cover of the present issue of Psyche. Editor]

The Cambridge Entomological Club has always recognized New England as its special and appropriate tho not exclusive field of activity. It is, therefore, fitting that a typically New England insect, the Semidea butterfly, whose habitat is the alpine zone of the Presidential Range of the White Mountains of New Hampshire, should be chosen for representation on its Club Seal.

The insect is here shown perched characteristically on the dark gray, deeply weather-bitten rock-fragments of its mountain home, whose tints and texture its own so closely resemble, that when lying on its side with wings closed to escape the wind it becomes almost invisible. Beyond it at the right is suggested the sedgy slope of "Semidea plateau" (so christened by Scudder) with its rock-rivulets in whose crannies the butterfly often seeks shelter from the furious blasts which sweep over the summits even in midsummer. Beyond, from the depths of the Great Gulf, rise the slopes of the northern peaks, Mts. Jefferson, Adams, and Madison, with Mt. Washington suggested at the left. Over all float the summer clouds which often shroud the summit of Washingion for days at a time even when the other peaks are free.

CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p. m. at the Bussey Institution, Forest Hills, Boston. The Bussey Institution is one block from the Forest Hills station of both the elevated street cars and the N. Y., N. H. & H. R. R. Entomologists visiting Boston are cordially invited to attend.

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CONTENTS

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PSYCHE

VOL. XXIX. APRIL 1922 No. 2

MICROSANIA, A GENUS OF THE PLATYPEZIDAE[1]

By A. L. Melander,
Pullman, Wash.

Microsania Zetterstedt, Isis, 1837, i. 30 [1837]; Ins. Lapp. 534, note [1838]; Dipt. Sc. i. 333 [1842];
Bigot, Ann. Soc. Ent. Fr. [6] ix. 123 [1889];
Melander, Williston's 3d. Man. 225 [1908];
Lundbeck, Dipt. Dan. Emp. iii. 18 [1910];
Wahlgren, Ent. Tidskr. xxxi. 43, 47 [1910]

Microcyrta Bigot.
Bigot, Ann. Soc. Ent. Fr. [3] v. 557, 564 [1857]; Coquillett, Proc. Ent. Soc. Wash. v. 253 [1903];

Pachypeza Lioy, not Serville, Coleoptera, 1835; Lioy, Atti. Inst. Veneto [3] ix. 723 [1863]; Coquillett, Proc. Ent. Soc. Wash. v. 255 [1903].

Platytelma Rondani.
Rondani, Dipt. Ital. Prodr. i. 138 [1856]; Coquillett, Proc. Ent. Soc. Wash. v. 256, 261 [1903].

Small, hunchbacked species with open venation and inflexed hypopygium. Head rather globular, eyes bare, of the male entirely contiguous above the antennæ, the facets of the upper two-thirds large, of the female broadly separated, the facets uniform, the front of the female with one pair of vertical and two pairs of orbital bristles, the lower pair converging, and a pair of diverging supraantennal interfrontal bristles; face of the male deeply concave, its sides divergent below, of the female strongly convex below, almost nasiform; proboscis fleshy, short, not extending beyond the broad oral cavity, palpi very wide, disciform and appressed against the cheeks; occipital hairs sparse but stiff; antennæ short, basal joints small, the third joint orbicular, with a terminal tapering arista at whose base are two minute segments. Chaetotaxy of the thorax as follows: one humeral, two or more posthumeral, four to six notopleural

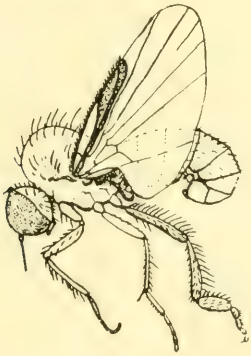
[1]Joint contribution from the Bussey Institution of Harvard University No. 150, and the Zoology Laboratory of the State College of Washington.

arising as an oblique row, several supraalar, one postalar, four scutellar, about ten dorsocentral and a single median row of acrostichal bristles; pleuræ entirely bare. Abdomen cylindrical but curving downward in the male, the hairs of the male long, the eighth segment of the female retracted and blunt, the basal three ventral segments of the male inflated, the sixth and seventh segments forming a stout pedicel to the large globose inflexed hypopygium which bends forward under the abdomen. The hypopygium is bilaterally symmetrical and terminates in a pair of small bristly ovate valves and a subdorsal median prong. Legs rather short, the middle tibiæ with an apical flexor bristle, hind femora pectinate above, hind tibiæ somewhat compressed clavate, pectinate on the extensor edge, the posterior side tomentose like the swollen metatarsus. Wings very broad at the base, the anal angle very full and rectangular, costa abruptly thinned at the end of the first vein, two basal bristles present and also numerous costal setulæ but no hairs, auxiliary and first veins strong, the other veins very weak and almost straight and radiating, stigma very prominent and so sharply limited behind as to present an extra vein between the first and second veins, the second vein ending near the tip of the wing, anterior crossvein wanting, a terminal spur of the anterior fork of the fourth vein present, discal cell open, only a trace of the crossvein at the end of the minute second basal cell, anal cell short and apically acute, alula well developed and margined with long flattened scale-like hairs. Type species, *M. stigmaticalis* Zetterstedt.

The genus *Microsania* includes very small, inconspicuous flies that are rarely observed by the general collector. Because of a superficial resemblance in the open venation to the species of *Bicellaria* (*Cyrtoma*) previous authors have been led to locate the genus in the Empididæ. A close inspection discloses that the resemblance gives way to far more significant differences, and that *Microsania* is not an empid but is closely related to *Platycnema* and *Opetia*, forming with them a group of the Platypezidæ characterized by an open discal cell and by the presence of a distinct humeral bristle. *Microsania* differs from *Platycnema* and *Opetia* in lacking the anterior crossvein and in

having a heavily thickened stigma formed about the shortened first vein.

Microsania departs from all empid genera in possessing a large and inflexed hypopygium and a single median row of acrostichal hairs. The anal crossvein continues toward the hind margin of the wing forming a pointed anal cell and this important phyletic character thus suggests the Hybotinæ. *Microsania* differs from all the members of this subfamily in the interrupted setulose costa, open venation and short fleshy proboscis, and shows no evident relationship to this group.



Microsania pectipennis Meig.
Male x 20.

The platypezid traits of *Microsania* are as follows: The antennal excision of the eye is no stronger than in *Opetia;* strong interfrontal bristles are present; the arista has two basal joints; the proboscis is short and fleshy; the notopleural suture is very short and above it is a vertical row of notopleural bristles; posthumeral bristles are present; the middle tibiæ have strong apical bristles; the hind tarsi are large, compressed and sericate within; the pedicel of the second and third veins is long, and a distinct alula is visible. Such differences as the large broad palpi, swollen clypeus of the female, more bristly thorax, rounder coxæ and pectinate hind legs, and short bristly costa and open neuration are no more empidine than platypezine.

Three species of *Microsania* are known: *pallipes,* with light colored legs; *stigmaticalis,* with minute costal setulæ; and *pecti-*

pennis, with longer costal setulæ. All three occur in Europe, the last two are here recorded also from America, where *stigmaticalis* has been previously known under the name of *Platycnema imperfecta* Loew. The two American species are separable on the following characters:

First section of the costa with evident setulæ, second section with more than ten setulæ; hind femora pectinate above with long bristles, hind metatarsi setose above; bristles black; 2-2.25 mm. *pectipennis* Meigen.

First section of the costa with very weak setulæ, second section with less than ten setulæ; hind femora short-pectinate, hind metatarsi not setose above; bristles at least of the lower occiput and of the front coxæ whitish; 1-2 mm. *stigmaticalis* Zetterstedt.

I have specimens of *pectipennis* from the Pacific slope, its range indicating a continuous distribution through to northern Europe. The following localities are represented: Yellowstone Park, Wyoming; Bovill, Coeur d'Alene, Collins, and Potlatch, Idaho; Olga, Pullman, Spokane, Tacoma and Woodland, Washington; Douglas, Alaska; and Eureka, California.

M. stigmaticalis, as *P. imperfecta*, was described from the District of Columbia. There are no further records of its occurence in America. I have specimens from the following widely separated localities, which have been compared with Dr. Loew's type of *imperfecta*, now located in the Agassiz Museum of Harvard University, and with European specimens of *stigmaticalis*. Boston, Massachussetts; Cold Spring Harbor and Ithaca, New York; Philadelphia, Pennsylvania; Washington, D. C.; St. Augustine, Florida; Paris, Texas; Chicago, Illinois; Brookings, South Dakota; Lawrence, Kansas; Thompson, Montana; Coeur d'Alene and Potlatch, Idaho; Colfax, Friday Harbor, Index, Mount Rainier, Pullman and Quilcene, Washington; Nelson, British Columbia; and Panama.

Males of both species have been taken in a light trap at night. Most of the females were caught on windows in houses, a habit originally noted by Zetterstedt. On several occasions

the species have been found running about on a tent while in camp in the woods. Quite a few of the specimens are heavily parasitized by mites, of which several species are distinguishable, clustering on the underside of the abdomen.

Summary.

The genus *Microsania*, hitherto assigned to the Empididæ, belongs to the Platypezidæ. There exist in America two species, idential with two of the three European species. One of these, *M. stigmaticalis*, has previously been known from North America only through its original finding which was recorded under the name of *Platycnema imperfecta*. The genus is widely distributed from Alaska to Florida and Central America and apparently from its prevalence in Northern Europe and the mountainous districts of Western America has a circumpolar range.

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Aldrich, Cat. Dipt. 342 (1905) ? *Platycnema.*

NOTES ON THE BIOLOGY OF CERTAIN WASPS OF THE GENUS ANCISTROCERUS (EUMENIDÆ)[1]

By Leland H. Taylor.

During the summer of 1921, while attempting to get some material for the study of the biology of the Chrysididæ, I was able to make some fragmentary observations on three species of Eumenidæ which I present here.

The biology of various species of Eumenids has received much attention from both European and American observers, whose work cannot be reviewed in this paper. Particular mention should be made of the observations of Fabre (1882, 1884, 1891), Ferton (1895, 1901-1921) and Roubaud (1916) among Europeans, and of the studies of such American workers as the Peckhams (1900, 1905), Hartman (1905), Hungerford and Williams (1912), Isley (1913) and the Raus (1918). With the exception of *Ancistrocerus capra* de Saussure, the species of Eumenidæ treated in this paper have not been studied, and it is hoped that these notes, if presenting nothing particularly new, will help to confirm previous observations on this highly interesting group.

The species which I have been permitted to observe are apparently those which are usually accustomed to nesting in suitable cracks and crevices of stone and wooden walls. Under ordinary circumstances, therefore, their workings are practically inaccessible, but by the use of artificial nesting places[2] it has

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 198.

[2]Both solitary wasps and bees have been induced by other investigators to nidificate in tubes of glass. See the papers of Fabre (1884) and Bordage (1912).

been possible to keep in close touch with the operations of nest construction and also to observe the development of egg, larva and pupa.

About the middle of June sixty artificial nesting places were put out on the window sills and in other situations near the walls of the Bussey Institution where Eumenids had been noticed searching for places in which to nidificate. These nesting places were crudely and variously constructed, all, however, consisting of glass tubes inserted in holes bored in blocks of wood. A type of the apparatus used is shown in figure 1; others were more simple, but all were so constructed that the tube could be expeditiously removed and replaced. It was found by trial that tubes having an inside diameter of from six to eight millimeters were preferred by the wasps. Individuals repeatedly entered and examined tubes of greater diameter, but in no instance did they make use of them.

That these tubes were acceptable to the wasps is shown by the fact that no less than three started their building within the first three days after the tubes were placed out, one nest having been entirely completed during that time. The device proved to be convenient for the study of the occupants but for two disadvantages. First, the condensation of moisture on the inside of the glass tubes sometimes caused the egg or young larva to adhere to the walls so that it was prevented from reaching its food. The moisture also accelerated bacterial infection which in some cases destroyed both egg or larva and provisions. Second, the activities of the larva after the spinning of the cocoon could not be well observed without breaking the tube.

I wish to thank Doctor Joseph Bequaert of the American Museum of Natural History who has very kindly determined the species of Ancistrocerus mentioned in this paper.

Ancistrocerus tardinotus Bequaert MS.

This species of Ancistrocerus is treated in detail, as I had the opportunity to observe rather closely the nest-building activities of two females. It will also serve as a type of the work done by other Eumenids which came to my notice.

Nest No. 2.[3] Scarcely 24 hours had passed after the tubes had been placed out, when a wasp was seen (June 13) entering one of them carrying mud or gravel which she got at a driveway 25 feet distant. Between each trip for gravel, which always took several minutes, she took a shorter flight which I could not follow, probably to her water supply. She continued in this way from four until five o'clock P. M., when I was obliged to leave. At six P. M. she entered her nest carrying beneath her body a small green caterpillar, which she quickly deposited, then flew away. Between six and seven o'clock she made about six or seven visits to her nest, each time bearing a similar caterpillar. One of her absences from the nest was of only two or three minutes duration, but usually she did not meet with such prompt success. She spent no more time within the nest than would allow her to deposit her prey. From this time on I observed her only sufficiently to state that she worked quite consistently for the next two days and completed her nest at some time just previous to four P. M. on June 15.

Nest No. 3. On June 16 at four P. M. a wasp of this species, possibly the same one as described above, was seen to enter one of the nesting places not far from nest No. 2. An examination of the tube at this time showed two cells already completed. Outside the closing partition of the second cell was a third egg and a single caterpillar. The wasp continued to work until seven P. M. at which time she had nearly completed the closure of her third cell. During the night she did not occupy the nest as these wasps commonly do, possibly because there was hardly sufficient room. Indeed, it seemed that she would not be able to construct an additional cell in such a limited space. Observations at 5:30 and at 7:30 the next morning showed that the wasp had not resumed her work, but by 8:30 she had already finished the closing partition of the third cell and had laid her fourth egg. During the morning she caught and deposited three caterpillars and at 10:45 she brought the bit of cement that would have closed the last cell had I not captured her for identification before she had been able to apply it.

[3]The numbers designating the nests described in this paper are the original ones used in my field notes; they are thus not consecutive.

The two nests built by wasps of this species did not differ greatly from each other or from those constructed by the other wasps noted in this paper. Wasp No. 2 built her nest (Fig. 1) in a tube which had an inside diameter of 7.5 millimeters. It contained four cells whose respective lengths were as follows: cell No. 1[4], 14mm.; No. 2, 8 mm.; No. 3, 6 mm.; and No. 4, 5 mm. In each cell at about two millimeters from the inner wall was suspended from above by means of a fine thread about a millimeter in length a white, glistening egg. The egg, which resembled almost exactly eggs of other members of this genus which I have observed, was about 2.5 mm. long, subcylindrical, concave dorsally (?) and convex ventrally (?) (Fig. 3). In some cells it hung freely; in others, where the provisions were more tightly packed, it was pushed firmly against the upper wall of the cell. Cell No. 1 was provided with ten caterpillars, No. 2 with six, No. 3 with three and No. 4 also with three. The caterpillars were of uniform size, about 12 mm. long and all appeared to be of the same species, probably of the family Tortricidæ. They were imperfectly paralyzed and responded to mechanical stimulus by quick, jerky movements of the abdomen. The head and thorax, however, seemed little capable of movement, the mouth parts and legs scarcely responding to the touch. It would seem then that the sting of the wasp must be introduced in the region of the thorax, thus bringing about partial paralysis of the parts which might tend to injure the egg or young wasp.

The cells of the nest were separated by partitions one millimeter in thickness, constructed of earth of a fine clayey consistency and moistened with water (and perhaps secretions) to form a cement which at first had a brownish color but became gray after drying. The partitions were not laid with precision transversely in the tube, but were often irregular with a slight oblique tilt. The inner surfaces of the partitions appeared more rough than the outer surfaces, due to their having been smoothed out by the wasp's mandibles. In constructing these partitions the wasp first lays down the rim, flattening out her first lump of

[4]In designating the cells of a particular nest the numbers 1, 2, 3 etc. refer to the order in which the cells were constructed by the wasp. Thus the innermost cell is no. 1, the next, no. 2 and so on.

mud between the mandibles and adding further material concentrically within until only a minute opening remains. This she plugs with a small bit of mud and then apparently smooths out the surface of the whole. In the nest of wasp No. 2 a vacant space about 10 mm. long was left between the outermost occupied cell and the entrance.[5] The closure was flush with the surface of the entrance block; it was a plug of cement twice as thick as the partitions within and not smoothed off outwardly.

The nest of wasp No. 3 was made in a tube which differed slightly from that shown in the figure (Fig. 1) in that the outer end of the tube was flush with the entrance, there being no entrance block. In this nest the outermost cell reached the entrance of the nest, no empty space having been left by the wasp as in the former case. The glass tube had an inner diameter of only 5 mm. The wasp had adapted her construction to this smaller diameter by making the cells longer. The comparative lengths of the cells in this nest and the number of caterpillars provided in each were as follows: cell No. 1,-17 mm., 6 caterpillars; No. 2,-17 mm., 7 caterpillars; No. 3,-11 mm., 3 caterpillars; No. 4,-5.5 mm., 3 caterpillars. The caterpillars appeared to be of two species and perhaps represented two families (Pyralidæ and Tortricidæ?).

The following tabulation gives the life histories of the wasps in nests 2 and 3.

Nest No. 2.

Date of	*Cell No. 1* ♀	*Cell No. 2* ♂	*Cell No. 3* ♂	*Cell No. 4* ♂
Oviposition	June 13	June 14(?)	June 14(?)	June 15(?)
Hatching	June 16	June 17	June 17	June 18(?)
Cocoon spinning	*	June 23	June 23	June 23
Pupation	June 30	June 29(?)	June 29(?)	June 30
Imagination	July 13	July 9(?)	July 9 (?)	July 10(?)
Emergence	July 15	July 11	July 11	July 11
Death	Oct. 15	July 19	Oct. 15**	Aug. 17

*This wasp curiously spun no cocoon, only a few loose threads. It became inactive June 25.

**Death of this male may have been hastened by falling into the sirup, supplied as food.

[5]According to Roubaud (1916) such empty cells are evidently for the purpose of confusing parasites.

Nest No. 3.

Date of	*Cell No. 1* ♀ (?)	*Cell No. 2* (?)	*Cell No. 3* ♂	*Cell No. 4* ♂
Oviposition	June 16(?)	June 16	June 16	June 17
Hatching	*	June 19(?)	June 19(?)	June 20
Cocoon spinning	.....	**	June 24	June 25
Pupation	.....	.....	June 29	June 30
Imagination	.....	.....	July 10	July 10
Emergence	.....	.....	July 14	July 11***
Death	.....	.....	Oct. 6	Aug. 27

*Did not hatch.
**Died June 22.
***Emergence probably premature; cocoon broken open for observation.

The above tables give the following as the lengths of the stages in the life of *Ancistrocerus tardinotus*: egg, 3 days; larva, 10-14 days; pupa, 11-14 days. The larger figure for the larval and pupal stages represents the length of these stages in the single female which reached maturity, from the innermost cell of nest No. 2. The other five individuals which matured from these two nests were all males.

The eggs of this species, like those of other species noted here, show the first sign of hatching by a swelling of the chorion on one or both sides. This seems to be due to the flattening of the larva, the pleura becoming somewhat protuberant. (Fig. 4). The chorion then becomes ruptured at its anterior or lower end, and the minute larva by slow movements works about three-quarters of its body out. Thus suspended it remains for half or three-quarters of an hour during which time it appears to derive some nourishment through the integument of the caterpillars which it may be able to reach. Figure 5, sketched from an undetermined larva of Ancistrocerus illustrates the appearance of the larva in this position. Soon freeing itself from the chorion, the larva moves about actively, finally taking a position with its mouth closely applied to the integument of one of its caterpillars often just behind or near the thorax. At first it appears to feed

without biting the skin of its prey and its feeding is indicated only by the rhythmic movement of its body, but as it increases in size it may be seen to bite rather ferociously at its caterpillar, sinking its mandibles and even its entire head into the now lacerated body. Growth is rapid and usually the food is consumed to the last bit, even the heads being eaten by some of the more voracious individuals. When all the food is gone the larva may be observed moving about its cell, its mandibles constantly working along the walls. Whether it is searching for more food or attempting to begin its cocoon is not entirely evident. At any rate, the result of this activity seems to be that all the detritus in the cell, including the excrement of the caterpillars and whatever of the food supply may occasionally remain uneaten, becomes gathered at one end or along the lower wall of the cell, so that it does not interfere with the spinning of the cocoon. Before actually spinning the cocoon the Ancistrocerus larva makes a rather coarse-meshed network closely applied to the walls of the cell, entirely lining it and excluding all debris. The cocoon is variable in shape, irregularly cylindric-elliptical with one of its ends and its lower surface touching the walls of the cell, usually at the inner and lower end. It is tough, closely woven, translucent and semi-transparent, usually of a pale brownish tint with a slight silky lustre. Figure 2, though perhaps of a different species, illustrates the position of these cocoons *in situ*. Pupation does not take place immediately, the larva remaining quiescent in the cell for from five to seven days.

As in most nidificating Hymenoptera which construct similar nests, the outermost occupant of the nest is the first to emerge, though it is necessarily the product of the most recent egg laid by the builder. All the males reach the adult stage at about the same time, but until the one nearest the entrance makes its escape, there appears to be no attempt on the part of the others to break out, though they often may have already broken from their cocoons and are free to emerge as soon as the way is clear. Once the first male has made its escape the others follow in rapid succession, the females only remaining after the males have been gone for some little time.

In the species of Ancistrocerus which have come to my notice, the wasps which have developed from the innermost cells of a nest have been invariably females. These inner cells are always of greater capacity and more bountifully provisioned than the smaller, outer cells, which are destined to give forth males[6]. In a very painstaking study Fabre (1884) found a similar distribution of the sexes in the nests of certain solitary wasps and bees. Later Verhoeff (1892a, 1892b) made like observations and gave the name *proterothesie* to this phenomenon. Bordage (1912) and Roubaud (1916) have found it also in solitary wasps of the Malagasy and Ethiopian regions. This disposition of the males and females is supposed by authors to permit the males on emerging to fly about and thus come in contact with females from other nests, achieving cross-fertilization. In one of the nests which I had in confinement, however, (nest no. 2) one of the first two emerging males constantly sat at the entrance of the nest from which it had just escaped, apparently waiting for a female. The next wasp to emerge was another male; the new arrival was met with palpations of the antennæ similar to those which precede copulation. In nature, however, this might not have occured.

In confinement copulation was witnessed. The female apparently copulates but once, as the one observed repeatedly rejected males after having been fecundated. The males, on the other hand, are apparently able to fertilize more than one female, since they make repeated attempts after their first mating.

The tables given above show several instances of longevity among individuals of this species, both in males and in the single female, one individual of each sex living longer than three months. Whether the period of life would be as long under normal conditions of subsistence and expenditure of energy is perhaps questionable, but it seems highly probable that a single female lives sufficiently long to construct several nests of the type described in this paper.

[6]This difference in size is evidently the general rule. Aberrations have been noticed and one of these is shown in figure 2, where cell No. 2 is larger than No. 1. This condition seems to be exceptional.

Ancistrocerus capra de Saussure.

The habits of this wasp have been recorded briefly by the Peckhams (1900), who describe three successive nests constructed by this species in the mouthpiece of a tin horn. Their observations differ from mine in that they found the duration of the egg stage to be four days instead of two. These authors point out the similarity of the habits of this species to those of the European *A. nidulator* de Saussure, observed by Fabre (1891). The Raus (1918) have published observations on a nest made by *capra* in a woody elder twig, in which the innermost cell was of much greater capacity than the seven (one empty) additional cells, but no mention is made of the sex of the wasps reared from the nest. Observations of Rev. T. W. Fyles, reported by Ashmead (1894), show that this species provisions its nest with larvæ of the larch saw-fly (*Lygœonematus erichsonii* Hartg.) Unfortunately I did not preserve any of the larvæ used by *capra*, but I am almost certain that in this case they were lepidopterous rather than of saw-flies. It seems probable that species of Ancistrocerus do not limit themselves to a particular kind of caterpillar, but avail themselves of whatever desirable food may be abundant.

Nest No. 6. At 3:30 P. M. on June 20, I observed a large Ancistrocerus apparently just selecting her nesting place. She made repeated entrances, coming out each time and flying off for a short distance, apparently carrying nothing. She was possibly making a long distance locality study. Soon she began to bring in mud, out of which she constructed a basal partition at about 7 mm. from the interior end of the tube. During the construction of this partition I took many liberties with the nest, removing the glass tube during the wasp's absence and sometimes failing to get it replaced before she returned. She seemed little disturbed. Once, as she hovered before the window sill where her nest should have been I slowly placed it in front of her and she entered as though nothing had happened. Perhaps as a result of this interference, she abandoned her first partition and started another about 5 mm. from the first. When this was

finished the wasp backed out of the tube, turned about and backed in presumably to oviposit, but strangely no egg was laid until half an hour later (5:30 P. M.). At six o'clock she brought in a caterpillar and suspended operations, remaining asleep in the cell all night.

During the building of the partition described above, I removed a small stone which had been resting on the nesting block and placed it a few inches to one side of the nest while the wasp was away. On her return, instead of flying directly to the entrance as she had been doing, she made for a position just beneath the misplaced stone. Discovering her mistake, she soon found her nest by flying about at a few inches from the wall. A little later, while examining the tube during the wasp's absence, I placed the entrance block on the window sill at a short distance from its right position. The wasp returned and entered the hole in the entrance block. Finding nothing behind it, she retreated for some distance, and the nest meanwhile having been replaced, she then entered without hesitation. This would seem to indicate that certain objects, such as the stone, serve as guides to the wasp, but this and further observations show that the wasp is not helpless when such guides are removed, since after once finding her nest in the absence of the stone she apparently made use of other means to locate her nest.

June 21 at 9:15 A. M. wasp No. 6 was carrying in mud. This she deposited and went off again returning with a drop of water shining at her mouth. She was apparently just finishing a partition, for she appeared at the entrance, came out and backed in, remaining within for three minutes to lay an egg. Oviposition finished, she appeared at the entrance and after excitedly waving her antennæ, flew off.

At this time I made a further test of her ability to locate her nest by placing a similar nesting block about five inches away from the original and marking it with the stone which had formerly served as a guide. At 10:00 A. M. the wasp came back, bearing a large green caterpillar; she flew directly to the wrong nest, but did not enter, retreating from it and approaching it

several times, finally flying to a tree twenty feet distant. The stone was then replaced on the true nest. The wasp returned, still bearing her prey, tried the false nest as before, but almost immediately went to the right nest and entered.

This wasp was captured for identification as she was about to complete her nest at 1 o'clock (June 21).

Nest No. 7. Another *Ancistrocerus capra* was discovered constructing her nest on the same day at 5 P. M. Two hours later she had made a basal wall of mud, deposited an egg and was resting in the tube.

During the mud-carrying operations of this wasp, I removed the stone which marked her nest and placed it six inches to one side. Returning, she flew directly for a point beneath the removed stone, discovered her error and flew along the wall in a horizontal direction, pausing before another nesting block, similarly located on an adjacent window ledge and similarly marked by a small stone. She hovered in front of this empty nest, still holding the lump of mud she was carrying, then suddenly made a swift flight perpendicularly from the building, turned and made a bee line for her true nest, which she found without delay. The stone was not immediately replaced, but the wasp on subsequent trips entered her nest without hesitation, approaching it, however, in a perpendicular direction, instead of obliquely as she had done before her landmark had been misplaced. When the stone was replaced she continued to enter the nest without confusion.

The second day of this wasp's activities was extremely hot and humid. I had always believed that such a day would be particularly conducive to work with the wasps, and was surprised to find that this individual responded to the heat in much the same manner as her observer, for she remained in her nest the greater part of the day and brought in only three caterpillars, one in the early morning and two in the late afternoon. The following day (June 23) heavy clouds kept off the heat of the sun during the morning so that by ten o'clock four caterpillars had been stored. A half hour later the rim of the closing partition of

a second cell had been made. The mid-day heat doubtless delayed the closing of the entrance until about 4 P. M., when the wasp was captured before she had quite finished.

The nests built by these two individuals of *Ancistrocerus capra* were similar to those described for *A. tardinotus*. As mentioned above nest No. 6 had two basal partitions, one 7 mm. from the inner end of the tube and the second about 5 mm. from this. There were four cells, the first, between the two basal partitions, empty; the second, 28 mm. long, was provided with a suspended egg and four caterpillars; the third was 26 mm. in length and had the same amount of provisions with an egg; the fourth cell was 25 mm. long and quite empty, its closing partition, incomplete, was about 12 mm. from the entrance. The entrance was not closed, as the wasp was captured before she had been able to do so. The inside diameter of the tube was 6 mm.

Nest No. 7 contained a tube having an inside diameter of 7.5 mm. Its basal partition was constructed at about 15 mm. from the inner extremity of the tube. The first cell was 25 mm. long and contained its suspended egg and seven caterpillars; the second cell was empty, its length about 40 mm. and at about 8 mm. from its base was a very light rim of cement where the wasp had started and abandoned a partition. The closing partition of this long empty cell was about 12 mm. from the plug which closed the entrance, the latter being incomplete since the wasp was captured during its construction.

I was unsuccessful in rearing the wasps from nest No. 6. The egg in cell No. 1 adhered to the wall of the tube, because of excessive moisture and did not develop. The second egg became detached from its filament, hatched in two days and lived two days longer, attaining a length of about 7.5 mm., when it succumbed to the unfavorably moist conditions.

The single egg in nest no. 7 hatched (June 23) also in two days, after having become detached from its hanging position. On June 28 it had reached a length of 15 mm. and was vigorously feeding on the remnants of its provisions. In feeding it held itself in a curled up position, its back nearly forming a circle, the

piece of food held down against its ventral abdominal segments beneath its head. On June 29 it started spinning, but did not finish its cocoon until July 2. Six days later it pupated and on July 24 shed its pupal skin, emerging the next day. In captivity this wasp, a female, lived until August 22, nearly a month after emerging. The lengths of its stages were as follows: egg, 2 days; larva, 15 days; pupa, 16 days.

Ancistrocerus albophaleratus de Saussure.

Two nests built by wasps of this species came under observation. Ashmead (1894) records it as having been bred from an oak gall in Massachusetts.

Nest No. 14. This nest was started July 4 at about 4 P. M. The nest builder was observed rather constantly until July 10, when she was found dead within the entrance of her uncompleted nest. The preceding day had been rainy and may have brought about her untimely death, but the somewhat erratic construction of her nest may indicate that she was at the end of her resources.

Nest No. 21. This nest of *albophaleratus* was commenced July 19 and finished five days later. During a cool, wet day the wasp was inadvertently knocked from her nest, while she was apparently sleeping and lost in the grass. Although she returned the next day, her absence may have given an opportunity for a fly to enter her nest and deposit eggs, the larvæ from which later destroyed the entire nest and its contents.

The tube in which nest no. 14 was built had an inside diameter of 7.5 mm. Its inner end being completely closed, the wasp built no basal partition. The first cell was 18 mm. long and contained about 14 caterpillars; the second, 15 mm. in length, contained only six; the third cell, 16 mm. long, was empty; the fourth cell had a very imperfect basal partition, in which spaces had been left and was 10 mm. long. There was an egg suspended in this cell, but no caterpillars had been provided. It was in this cell that the wasp was found dead. A rim of mud about the periphery of its outer end showed that an attempt

had been made to close the cell. Evidently the wasp had been unable to provision this last cell and was in the act of closing it when she met her death.

The tube utilized by the other wasp of this species (No. 21) had an inside diameter of 6 mm. The nest had three cells,the basal partition of the first having been built about 5 mm. from the plug of cotton which stopped the inner end of the tube. Cell No. 1, 30. mm. long, had 13 caterpillars, cell No. 2, 28 mm. long, had seven and cell No. 3, 13 mm. long, contained eight. All were provided with eggs suspended in the usual manner. The entrance to the nest had no closing plug, the outer wall of the third cell being about 12 mm. from the entrance and the space beyond it was entirely vacant.

Only one wasp from these nests reached maturity, a female. The duration of the stages in her life was as follows; egg, 3 days; larva, 16 days; pupa, 13 days. The larva became inactive about six days after hatching and spun no cocoon. The imago lived thirty-five days.

Miscellaneous Notes.

Other nests built by undetermined species of Ancistrocerus were observed during the summer, but with most, because of parasites or other unfavorable conditions, the data obtained are too fragmentary to be of further use than to substantiate the findings on the species treated in more detail. In general the observations on these nests are consistent with what has already been recorded.

Nests started later in the summer (four in number, built Aug. 8, 16, 17, and 22) have a somewhat different history. Instead of pupating a few days after spinning, individuals from these nests still remain as larvæ during the winter and will probably not complete their development until the following June.

Not a few nesting places presented evidence of nests having been started by wasps and abandoned in an incipient stage. In some basal partitions were made, never to be utilized. In two

tubes an initial cell was provided with an egg and several paralyzed caterpillars and then abandoned. In both of these, eggs and caterpillars disappeared within a day, and the presence of ants in both leads me to believe that these depredators may have been guilty of the robbery. Whether the nests were abandoned by their builders before the incursions of these ants or whether the desertion was a result of their intrusion could not be determined. The paralyzed caterpillars and the wasp egg would doubtless be attractive to these insects and it is not unlikely that the presence of a few worker ants in a nest would drive the owner away.

Three nests of Ancistrocerus were infested by dipterous larvæ. In one of these the eggs were very evidently deposited in the nest by the adult fly; the others may have been deposited on the caterpillars before they were brought to the nest. In all three nests the behavior of the fly larvæ was the same—they devoured everything. After consuming the contents in one cell they broke through the mud partition and fed on the contents of the next and so on until the entire nest was destroyed. Attempting to rear the adults for identification, I placed the pupæ of these Diptera in glass tubes fitted with tight cotton plugs, thinking to prevent their escape. But the adults were evidently well provided with means for escaping from wasp's nests, for on emerging they worked their ways through the cotton and were lost.

An undetermined species of Chrysidid, which I shall mention elsewhere, was also associated with wasps of the genus *Ancistrocerus* observed during the summer of 1921.

Summary and Conclusions.

Observations on the three species of Eumenidæ treated in this paper (*Ancistrocerus tardinotus* Bequaert, *A. capra* de Saussure and *A. albophaleratus* de Saussure) bring out the following facts concerning their biology.

1. These species appear to nest usually in suitable cracks and crevices adapted to their needs.

2. The nests made by these wasps in glass tubes have the following characteristics:

a. Tubes having diameters of from six to eight millimeters were utilized by the wasps.

b. Nests consist of from one to four cells, these apparently varying in length conversely to the diameter of the tube, the inner cells being usually larger than the outer. The cells are separated by partitions of mud which the wasp makes by mixing fine sand and water.

c. The cells are each provided with an egg, suspended by a filament from above and each contains from three to fourteen caterpillars; these are supplied after the egg has been deposited.

3. The caterpillars are paralyzed by the wasp by stinging probably at some point near the thorax.

4. From rather fragmentary evidence it appears that the larger, inner cells contain eggs which are destined to produce females, while the smaller, outer cells contain those which are to become males.

5. There are probably two generations of these wasps annually, the eggs of the first being laid from mid to late June, the adults from them appearing during the first half of July. The eggs of the second generation are laid during the latter part of July and the first of August, the wasps from them hibernating as larvæ and probably emerging in June.

6. From the longevity of certain of these wasps in captivity it is concluded that the females live long enough to construct several nests of the sort described here.

7. The females are apparently guided to their nests by certain landmarks, but are not helpless when such landmarks are removed or distrubed.

8. Dipterous larvæ, Chrysididæ and perhaps ants have been observed as enemies of the species studied.

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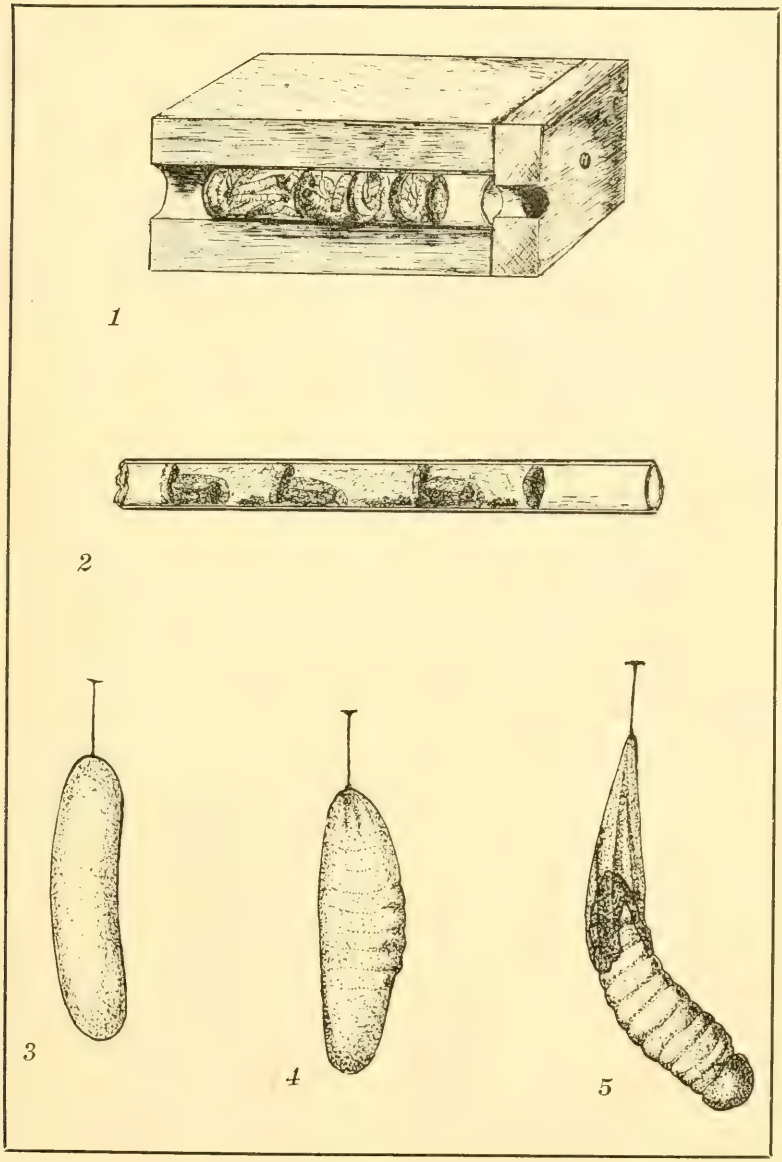

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Explanation of Plate IV.

Fig. 1. Longitudinal section of nesting block, showing glass tube in position and nest no. 2 containing four cells, each with its egg and caterpillars. (⅔ natural size.)

Fig. 2. Nest built by *Ancistrocerus* sp. showing three cells with larvæ in cocoons. (⅔ natural size.)

Fig. 3. Egg of *Ancistrocerus* sp. with suspending filament. (This and the next two figures enlarged about fifteen times).

Fig. 4. Same egg as in figure 3, about to hatch.

Fig. 5. Larva (just hatched from egg shown in figure 3) suspended from the shrunken chorion.

BIOLOGICAL NOTES ON PARTHENOGENETIC *MACROSIPHUM TANACETI* LINNAEUS (APHIDIDÆ, HOMOPTERA)[1]

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The data on which the present paper is based have been collected while I was conducting experiments on *Macrosiphum tanaceti*, in connection with another problem. The work was done at the Bussey Institution during the earlier part of the summer of 1921. A few of the facts brought out in the discussion are somewhat fragmentary, and require more thorough investigation; but, in view of the scarcity of such records of aphid behavior in the literature, they have been introduced here, in the hope that they may help to stimulate further research along these lines.

I. *Ecdysis.* There are no appreciable differences in the behavior of *Macrosiphum tanaceti* during the four successive molts. No attempt, therefore, will be made in the present paper to describe the methods separately for each ecdysis. Preliminary to the process, the nymph ceases to feed for a few minutes, and in the meantime holds with its claws on the surface of the supporting part of the plant. The position of the insect during molting has always been found to be such that the head points toward the ground. The legs are spread far apart, so that the prothoracic pair is directed anterolaterally with reference to the insect's body; the mesothoracic, ectolaterally; and the metathoracic, posterolaterally. The haustellum is held close to the sternum. The subcaudal portion of the abdomen almost touches the surface of the plant. The antennæ are directed posteriorly, and are subparallel to the lateral margin, but diverge at an angle of about thirty degrees above the dorsal surface of the body. A longitudinal mesal rupture then appears at the head, adjoining

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 199.

the base of the clypeus. The insect slowly forces its way through the opening thus made, in the meantime increasing the length of the rent posteriorly along the dorsomedian line of the body, until the caudal margin of the metanotum is reached. The method of formation of the initial rupture has not been observed. Neither has the mechanism of propulsion of the aphid, as it glides by degrees forward, out of the exuviæ, been satisfactorily determined. It is, however, evident that the legs are not of assistance until later in the process. In all probability, the force of expansion of the insect's body itself directs the course of the movement through the slit, this opening furnishing the point of least resistance in the tightly fitting exuviæ. The head naturally goes out first, being nearest the rupture; and the opening enlarges as the more bulky thorax and abdomen pass out. The pro- and mesothoracic legs soon become disentangled, and it is remarkable how quickly the insect is able to spread them apart and use them to help force the rest of the body out. Apparently, sometime before, or during the earlier part of ecdysis, the chitinous coating of the appendages of the future succeeding instar has a chance to harden. The concluding part of ecdysis, when only the caudal portion of the abdomen and a fraction of the metathoracic tibiæ and their tarsi remain in the exuviæ, goes on as slowly as the earlier part of the process. The insect never seems to be in a hurry about extricating itself, and, on the whole, the molting of an aphid is an extremely sluggish operation. Finally, the hind legs are set free, but, even then, the insect continues to remain attached with the abdominal cauda enclosed within the ensheathing exuviæ. The legs sway up and down and the antennæ remain in their posteriorly directed position. Apparently this delay in freeing itself is an important step in the molting process, as it enables the chitinous layer of the body and of the appendages to get dry in the outside air and increase in firmness, until it is safe enough for the insect to turn itself loose. After about five minutes, or so, the fore and middle legs execute a forward crawling motion and the hind legs kick against the exuviæ, the aphid ultimately making its escape in this manner. The entire molting process, from the appearance of the initial

rupture to the final escape of the insect, lasts from about twenty to about thirty minutes.[2] The freshly molted aphid is at once able to walk, but is incapable of resuming feeding until about one-half hour, or more, later.

One other point may be noted here in connection with ecdysis The layers of the black pigment which in this species give the antennæ, haustellum, wing-pads, legs, cornicles, and abdominal cauda their characteristic piceous color are intimately associated with the chitinous exoskeleton, and are cast off with the exuviæ at each molt. They are then formed anew in the succeeding instar. The freshly molted *Macrosiphum tanaceti* is uniformly light green, except the eyes, which are reddish vermillion. The light green color is due to the presence of characteristic green substance in the fat cells and other body tissues, which shows through the semitransparent cuticle. This coloring matter has been the subject of investigation years ago by various workers, notably by Macchiati (1883), who claims to have found chlorophylloid substances in *Siphonophora malvæ* and in *S. rosæ*, and by Przibram (1906, 1909), who has observed that aphids fed on etiolated leaves of onion plants that have been kept in the dark assume the pale yellow color of the latter, suggesting thereby that the green chlorophyll of the plant probably has some relation to the green substance in the aphid tissue. More recently, Glaser (1917) has reported that by chemical tests he has been able to detect the presence of red pigments in *Pterocomma smithiæ* Monell which seem to be localized in the cytoplasm of the fat cells, and which give color reactions suggestive of anthocyanin found in plants.

The characteristic piceous color of the exoskeleton in the regions enumerated above is restored in less than an hour after molting. How this relatively rapid change in color is brought about is difficult to explain. Two possible conditions suggest themselves: (1) After molting, these pigments, with their definitive dark color, are segregated as such by some very active physiological process; or (2) prior to, or during, molting the

[2]About the same length of time has been observed in *Toxoptera graminum* Rondani by Webster and Phillips (1912).

future dark pigments are deposited in the form of certain achromatic substances and in the succeeding instar assume their characteristic tint upon exposure to light and to other external stimuli.

Janet (1909) has classified in a succinct form the steps involved in ecdysis among insects into four general successive phases. The following quotations from this author are reproduced here for the purpose of comparison and correlation with the foregoing observations and deductions on aphids.

1. "Le décollement de la cuticule ancienne, décollement qui commence généralement dans la région supérieure de la capsule céphalique et se propage vers l'arrière. La cuticule ancienne, décollée, demeure autour du corps sous forme d'une exuvie libre, intacte, et constitue une enveloppe protectrice, momentanément indispensable à cause de la délicatesse de l'épiderme mis à nu."
2. "Accroisement en surface ou transformation du modèle de l'épiderme libéré de sa cuticule."
3. "La formation des premières strates de la cuticule nouvelle, cuticule dont l'apparition rend inutile la protection que fournissait l'ancienne cuticule exuviée."
4. "Le déchirage et le rejet de l'ancienne cuticule."

It appears in the case of the aphids, as well as of other insects, that the above four steps overlap, one into the other. During the detachment of the old cuticle from the insect's body-wall, there undoubtedly occurs simultaneously an increase in surface area of the hypodermal layer. In fact, the stretching effect resulting from the latter cause, together with the steadily augmenting pressure from the developing internal organs, evidently provides the immediate mechanical means for separating the old chitinous from the hypodermal layer. Under the protective cover of the freshly loosened exoskeleton, the new chitinous layer which has been secreted by the hypodermal cells has a chance to develop a firm, although somewhat delicately soft, consistency before the initial rupture appears in the exuviæ. In aphids, the hardening of the newly formed exoskeleton occurs mainly during the lengthy process of casting off the old skin.

Summary of Section I. Feeding ceases a few minutes prior to molting. The head of the insect is pointed toward the ground

during the process. The rupture of the chitinous exoskeleton appears first near the base of the clypeus and extends dorsomedially to the posterior margin of the metanotum. The entire molting process, from the formation of the initial rupture until the aphid extricates itself, lasts about thirty minutes. It is able to walk soon after escaping from the exuviæ, but is incapable of resuming feeding until about one-half hour, or more, later.

The characteristic piceous color in certain parts of the body is either located in, or intimately associated with, the chitinous exoskeleton, and is cast off at each ecdysis, reappearing, however, in the newly formed integument in less than an hour after molting. The light green color which characterizes the larger portion of the body is due to certain substances in the fat cells showing through the semitransparent cuticle.

The new chitinous layer is deposited sometime before the molt. It has a chance to harden during the lengthy process of casting off the old exuviæ.

II. *Locomotion.* The principal and usual method of locomotion, even in alate individuals, is by walking. The wings are used very rarely, and perhaps in connection only with migration from one plant to another when the aphids on a particular host begin to become overcrowded or when the supply of plant sap becomes inadequate. The flight is very feeble, and it is doubtful if the insect can traverse any considerable distance by this means alone.

In walking, the antennæ are directed anteriorly, describing in that position an angle of about forty-five degrees. They continually sway obliquely in alternate turns in an entodorsal and ectoventral direction. The rate of this movement is apparently correlated proportionately with that of the legs; and under ordinary conditions, when the insect is not disturbed, or otherwise excited, the antennæ sway one hundred and twenty times in one minute. This figure has been found to be approximately correct for all instars.

After numerous attempts at following the movements of the legs while the aphid is walking, I have come to the conclusion

that they do not follow any regular schematic sequence. Further, it appears that no two legs move synchronously in the same direction, and that there is no definite rule as to the order in which the legs follow one another. The time intervals between successive steps, irrespective of the sequence of leg movements, appears to be maintained at a uniformly similar rate for a given speed.

Summary of Section II. 1. The principal method of locomotion, even in alate individuals, is walking, the feeble wings being used rarely.

2. The rate of diagonal swaying of the antennæ and the rapidity of walking appear to be correlated, the movement of the former being in direct proportion to that of the latter.

3. The movement of the legs do not follow any regular schematic sequence, although the time intervals between successive steps appear to be uniformly maintained in a given speed. No two legs move synchronously.

III. *Feeding Habits. Macrosiphum tanaceti* has been known to occur only on *Tanacetum vulgare* Linnaeus. This species of aphid apparently has no secondary host plant.

No attempt will be made in the present work to describe the mechanical and physiological relation of the mouth-parts to the plant tissue during the process of feeding. Considerable work has been done in connection with this problem in comparatively recent years, notably by Büsgen (1891), and by Zweigelt; the latter author has been working on this and related subjects during the past decade. Zweigelt (1915) suggests the following three possible means by which suction of plant sap is accomplished in aphids.

"1. Eine bestimmte Zelle wird angestochen und ohne Verletzung der äusseren Hautschicht des Protoplasten ausgesaugt; 2. die Aussaugung bestimmter Zellen erfolgt während deren vollständiger Durchbohrung; 3. die Aussaugung geht zufolge einer dem Speichel innewohnenden starken osmotischen Saugkraft bei interzellularem Stichverlauf ohne mechanische Verletzung der Zellen vor sich."

Macrosiphum tanaceti feeds on the growing regions of the stem, on which different instars of this species are found in large numbers from early spring until late in the fall in Boston and vicinity. The more succulent portions of the petioles are also feeding places for the later nymphal instars and the adults, although they are found here only occasionally. While the aphid is feeding, its head points toward the ground, the antennæ are directed lateroposteriorly with reference to the body, and the legs are spread apart. The haustellum is at right angles with the body or inclined somewhat anteriorly. The labium, which serves as the sheath for the rest of the mouth-parts, except the labrum, remains straight. No posterior bending is observed at the point of junction of any two labial segments, which is a characteristic feeding habit of the members of a closely allied order, the Heteroptera. The latter group resorts to this contrivance in order to enable the setæ to penetrate deeper into the plant tissues. In *Macrosiphum tanaceti* the tips of the setæ apparently do not go far beneath the epidermis of the plant, perhaps reaching only a small portion of the cortical layer. This supposition is based on the fact that in all the specimens examined while in the act of feeding it was found that the setæ protrude less than a millimeter beyond the distal end of the labial sheath.

The position assumed by the insect while feeding is interesting. It is not easy to see why the insect should prefer to remain in that seemingly uncomfortable posture in which the abdomen is situated uppermost. The following experiments were conducted in order to find out the possible explanation for this peculiar habit:

Growing tips of *Tanacetum vulgare*, with numerous tansy aphids in different instars feeding on them, were carefully bent down without injuring the plants and were made to remain in this position by fastening them with strings. In this way, the aphids, without being disturbed, are reversed in their position, now with the head uppermost. These experiments were performed in the morning when it was still cool, at noon, when the sun was very bright and the temperature was about 32° C. (90° F.) and in the evening when it was almost dark. The results in all

cases have been found to be identical: The aphids sooner or later return to their former position, that is, with the abdomen uppermost and the head directed toward the ground. The degree of ability to orient itself in this manner apparently differs with the age and morphological characters of the individual. The alate adults turn around almost instantly after their former position is reversed. The nymphs in the first instar are the slowest to respond to the treatment. The later nymphal instars of the future alate and apterous individuals and the apterous adults do not react at once, as in the case of the winged adults, although the repsonse takes place much more quickly than in the first-instar nymphs.

The following interpretations are offered for the foregoing behavior: the tansy aphid, like the parthenogenetic forms of the other species of this family, feeds practically all the time. It is interrupted in this activity only when it changes its feeding location, after the supply of food material in a given part of the plant becomes temporarily used up. In a healthy plant, where there is an abundance of succulent tissue at the growing region, this change in location takes but a short time. The feeding operations, of course, require that the aphid remain stationary in one poistion during the process, and, consequently, it has to stand still almost all the time. Now, under these conditions, prolonged exposure to the direct rays of the sun, especially at midday, when they are very intense, is undoubtedly uncomfortable, if not ruinous, to the eyes of the aphids. The tansy plants generally grow in unsheltered places and the growing tips on which the aphids feed are fully exposed to the sun. The habitual position of *Macrosiphum tanaceti* is probably an adaptation to that environmental condition. By locating itself on the plant in such a way that the aphid's head is directed downward, the rays of bright sunlight from above do not strike the eyes directly. With this view in mind, however, it is difficult to find an explanation for the maintainance of the same behavior by the insect in the morning, when the rays of light are not so intense, and in the evening when it is almost dark. One probability is that the heliophobic reaction of the aphid has brought about secondary

effects which cause the insect to assume this position irrespective of the immediate presence of the causative stimulus.

One other explanation may be offered here: The aphid possibly assumes this position for mechanical advantage, in the way of bringing about optimum efficiency in the functions of the sucking mouth-parts, and of minimizing the strain on the muscles of the legs and other parts of the body which is occasioned by the insect's having to remain in one position for considerable lengths of time while feeding.

The fact that the aphids turn around and resume feeding in the reverse direction with respect to the plant when the tips of the tansy on which they are situated are bent indicates that this behavior of *Macrosiphum* has not been brought about as an adaptation to any peculiarity in the structure of the host.

The characteristic feeding position of *Macrosiphum tanaceti* has also been observed by me in other species of *Macrosiphum*. It is interesting to note that the aphids of other genera which I have studied[3] do not seem to exhibit this peculiarity. They almost all indifferently assume any position while feeding. It may be mentioned, as a possible explanation of this difference in behavior, that these other aphids generally feed on the nether surface of broad leaves, or are otherwise protected from the direct rays of the sun. Thus the main stimulus which, as I have suggested above, is probably responsible for the characteristic position of the *Macrosiphum* species is suppressed in the case of the other aphids.

Summary of Section III. 1. *Macrosiphum tanaceti* appears to be confined to a single host plant, *Tanacetum vulgare*. From early in the spring until late in the fall in Boston and vicinity, this aphid in different instars is found feeding on the more succulent portions of the plant, principally on the growing regions of the stem.

2. The head of the insect is directed toward the ground

[3]Anoecia, Lachnus, Longistigma, Drepanaphis, Drepanosiphum, Myzus, Eriosoma, unidentified aphids on *Berberis vulgaris* Linn., *Celastrus scandens* Linn., *Lythrum salicaria* Linn., *Sherpherdia* (*Elaeagnus*) *argentea* Nutt., and *Viburnum* sp., and others.

during feeding, as in ecdysis, which has been previously described. One or both of the following explanations may account for this peculiar behavior: (1) In order to avoid the rays of the sun from streaming directly into the eyes. (2) For mechanical advantage, the feeding apparatus perhaps attaining its maximum efficiency or the strain on the muscles being probably minimized when the aphid assumes this position. The second explanation is purely speculative. This characteristic position is evidently not an adaptation to any peculiarity in the structure of the host.

3. The setæ of this aphid apparently do not penetrate very deeply into the plant tissue.

IV. "Death-Feigning." The habit of dropping to the ground when disturbed and remaining motionless for a time is a very peculiar characteristic which is exhibited by many species of *Macrosiphum*.[4] *M. tanaceti* responds readily in this manner and on reaching the surface of the ground, the insect behaves in either of the following two ways, depending on its position after it drops: (1) If it lands on its ventral side, it simply stands on its legs and remains motionless in this attitude. The antennæ are directed posteriorly. (2) If it lands on any part of the body other than the ventral side, the legs are folded so that the tibiæ are also directed posteriorly and the insect remains perfectly quiet.

The nymphs of the first instar do not seem to have the ability of "death-feigning" to any marked degree. They are practically the only ones that remain on the plant, after the latter is jarred and individuals of the second and later instars drop to the ground. The adult individuals always regain their standing position very quickly and remain in this position, no matter which portion of the body touches the ground first. The wings remain folded and the insect does not seem to use them as it falls.

The biological significance of this peculiar behavior has been the subject of discussion and speculation by various workers who

[4]In my own work, I have not come across a single species of *Macrosiphum* which does not exhibit "death-feigning." However, Dr. A. C. Baker, of the Bureau of Entomology, U. S. Department of Agriculture, in a letter dated at Washington, D. C., January 18, 1922, informs me that there are some *Macrosiphum* species which do not possess this habit. He further mentions the interesting fact that "death-feigning" is not confined to *Macrosiphum*, for this peculiarity is also met with in the Callipterina.

have observed it in other groups of insects, notably by Fabre on *Scarites gigas* Fabricius (Coleoptera); by Holmes on *Ranatra* sp. (Heteroptera); and by Rabaud and by Bohn on several orders (Bouvier, 1919, pp. 79-89). In *Macrosiphum* the habit of dropping to the ground and remaining motionless for a time is evidently a means of eluding a pursuing enemy.

Summary of Section IV. Many species of *Macrosiphum* possess the habit of "death-feigning" when disturbed.

2. The habit is exhibited by *Macrosiphum tanaceti* in all of its stages, except in the first instar.

V. Parturition. At birth, the caudal portion of the nymph appears first at the vaginal slit. The antennæ are directed posteriorly and closely appressed to the body walls. The legs and cornicles are also in the same condition, the appendages thus following the general contour of the body. The tarsi of the metathoracic legs are in intimate contact with each other, forming at the caudal portion of the abdomen a conspicuous acutely subconical projection. The color of the nymph at birth resembles that of the freshly molted nymph or adult. The body and appendages are uniformly light apple-green and glossy, and the eyes are reddish vermillion. The enveloping membrane covering the young at birth, which has been described by Webster and Phillips (1912) in *Toxoptera graminum* Rondani, by Baker (1915) in *Eriosoma lanigerum* Hausman, and by other authors in other species of aphids, has also been observed by me in *Macrosiphum tanaceti*. The results of the present work agree with Baker's account in that the envelope ruptures while the nymph is partially extruded from the vaginal slit of the mother. The nature of this membrane is still in question; although, from my observations on *M. tanaceti*, I am led to believe that it probably arises from the follicular epithelium, which persists to this stage without degenerating. A more detailed discussion of this subject will be given in a later paper on aphid embryology which I am publishing. If my observations, therefore, are correct, this envelope is not a homologue of the vitelline membrane of the eggs of amphigonous aphids, as Webster and Phillips have

claimed, since the latter membrane arises as a secretion of the egg-periplasm, and has no direct relation to the follicular epithelium.

The extrusion of the nymph from the vagina, from the time the caudal portion of the abdomen of the former begins to protrude until the entire body is exposed, takes about five or ten minutes. The insect remains in the condition described above attached by the anterior margin of the head and the bases of the antennæ to the external opening of the mother's vagina for about ten or fifteen minutes. At the end of this time, the young insect has dried its skin well enough to set the appendages free from their attachment to the body. A waving motion of the antennæ and of the legs then ensue; but the nymph does not seem to struggle to make its final escape. After about five more minutes, the chitinous exoskeleton has probably hardened sufficiently, and the mother then executes two or three sudden peristaltic movements of the abdomen, which set the young nymph free. The newly born aphid usually remains in close proximity to the place where it is deposited by the mother. In about fifteen or twenty minutes after birth the nymph begins feeding, and by this time also the characteristic colors of the body and appendages become evident.

The position of the mother during parturition is the same as that described in connection with her feeding habits. The abdomen is situated uppermost and the head directed toward the ground. In fact, parturition goes on simultaneously with feeding, apparently without in the least interfering with the latter process.

Summary of Section V. 1. At birth, the young makes its appearance with the caudal portion of the body first.

2. After extrusion from the vagina, the nymph remains attached by the anterior margin of its head to the vaginal slit of the mother until the exoskeleton of the young hardens. The process requires about ten to fifteen minutes, when the nymph finally becomes separated from the mother.

3. At birth, the nymph is covered with a membraneous envelope which usually ruptures when the former is partially extruded through the vaginal slit. The nature of this envelope is still in question. I infer from my own observations on *Macrosiphum tenaceti* that the membrane arises from the egg-follicle, which apparently does not degenerate.

4. The nymph begins to feed in about fifteen to twenty minutes after birth.

5. The position of the mother during parturition is the same as in feeding. Parturition apparently does not interfere with the latter process.

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NOTES ON DISTRIBUTION AND HABITS OF SOME OF THE BIRD-FLIES, HIPPOBOSCIDÆ.

By Charles W. Johnson,

Boston Society of Natural History.

The following notes on this interesting group of flies have been brought together in the hope of thereby encouraging ornithologists to observe more closely the occurence of these insects on the various species of birds. While the wide distribution and great diversity of hosts frequented by one species seems somewhat at variance with the distribution of other insects as well as their hosts, it is impossible with the limited material and data at hand to arrive at any other conclusion regarding the species. Highly specialized forms always lose many of the distinguishing specific characters present in the species of the higher groups less restricted in their habits. Living as these flies do under similar and uniform conditions, notwithstanding their wide distribution, they would naturally show but little variation.

The occurence of the same species of fly upon non-migrating birds confined both to the tropical and boreal regions would indicate that they are naturally transmitted from one to the other by the migratory species; and the interesting example of phoresy recorded below shows how the various species of the wingless Mallophaga are also distributed.

One of the peculiar habits of these flies, and one which probably accounts for so few of them being taken by ornithologists, is that they are rarely seen while the bird is warm, but as the dead bird becomes cold they dart from it as if terror-stricken at losing their host, for if another cannot be found soon, it probably means death. If in this quick flight they happen to alight on one's clothes, there is a possibility of capturing them, if caught firmly between the thumb and finger, for their smooth, flattened bodies slip easily through one's fingers and when once they escape they are rarely seen again, as they dart into any little crevice that offers protection.

Their method of reproduction admits of no great increase, producing but one large egg at a time, which develops into a

peculiar larval condition within the parent, and pupating at birth. The decrease in the number of birds will undoubtedly diminish these flies, which deserve a great deal of careful biological study, for our knowledge of the group is still very inadequate.

The following records are in part based upon specimens in the Museum of Comparative Zoölogy, Boston Society of Natural History, and the author's collection.

Ornithoica confluenta (Say).

Ornithomyia confluenta Say, Jour. Acad. Nat. Sci. Phila., III, 103, 1823.
Ornithomyia confluens Wied., Auss. Zw., II, 611, 1830.
Ornithomyia vicina Walker, List Dipt., IV, 1144, 1849.
Ornithoica confluenta Speiser, Ann. Museo. Civ., XX (2d ser.) 558, 1899; Ent News, XVIII, 103, 1907.
Ornithoica confluens Aldrich, Catl., 655, 1905.

Say recorded this species from "*Ardea candidissima*,"—Snowy Heron (*Egretta candidissima*). No locality is given, and it may have been collected in "Pa.," "or west of the Missouri River." Wiedemann gives Pennsylvania. Walker's *O. vicina* was from "Jamaica, on *Ephialtes grammicus*" [Jamaica owl] (Gosse Coll.); also on *Psittacus leucocephalus*. Nothing further regarding the habits of this species appeared until 1878. Osten Sacken in his catalogue of Diptera, page 263, says: "*Ornithomyia confluenta* Say will, I suppose, form a new genus, on account of its peculiar venation. An apparently diffierent species of the same group was found by Mr. Wm. Holden on *Accipiter fuscus* near San José Cal." A study of this specimen in the Museum of Comparative Zoölogy shows no character to separate it from specimens referable to *O. confluenta*. There are also in the above Museum four specimens from Cuba, one collected by Poey and three by Gundlach. There is in the old collection of the Boston Society of Natural History a specimen marked "Mass."

The latest and most interesting capture of this species was that of two specimens by Mr. W. S. Brooks at Wilson Mills, Oxford County, Maine, Nov. 4, 1921, from the Canada Jay

(*Perisoreus canadensis*). It was these specimens from a non-migratory bird of Canadian life-zone that led to a study of this species and the finding of an almost parallel case in the distribution and habits of *Ornithomyia anchineuria*. Some specimens are slightly darker than others and vary from 2 to 2.5 mm. The wing is shown in figure 1, and the following species in figure 2.

Fig. 1. Wing of *Ornithomyia confluenta* at left; of *O. anchineuria* at right.

Ornithomyia anchineuria Speiser.

Ornithomyia pallida Say, 1823, *nec* Latreille, 1811.

Ornithomyia anchineuria Speiser, Zeitschr. f. Hym. u. Dipt., 1905, V, 348.

Say's type was taken on the Bluebird, "*Sylvia sialis*." No locality is mentioned. Wiedemann gives "Pennsylvania," and in Aldrich's Catalogue is "West of the Mo. River." In Smith's Insects of New Jersey, 1899, p. 699, I recorded it from the Bobolink or Reed-bird (*Dolichonyx oryzivorus*) and Red-winged Blackbird (*Agelaius phœniceus*). The specimens were collected by Mr. Charles Liebeck along the Delaware River below Philadelphia, Aug. 19 to Sept. 27, 1892-97. A specimen was taken on a Hermit Thrush (*Hylocichla guttata pallasii*) at Clifton, Pa., Oct. 19, 1897, by Mr. C. A. Voelker. A specimen was also obtained from a Robin (*Planesticus migratorius*) at Southbridge, Mass., Aug. 18, 1914, by Mr. S. W. Bromley, and from a young Junco (*Junco hyemalis*) at Woodstock, Vt., Aug. 1911, by Mr. A. P. Morse. In the Museum of Comparative Zoölogy is a specimen from the Red Crossbill (*Loxia curvirostra minor*) collected at North Bay, Onatrio, Sept. 7, 1896, by G. S. Miller, Jr., and from the Catbird (*Dumetella carolinensis*), at Worthington, Mass. Another specimen in the same Museum was collected by Mr. W. S. Brooks at Ellis Bay, Anticosti Island, Sept. 3, 1919. from a new Jay (*Perisoreus barbouri*) allied to the Canada Jay,

This specimen has attached to it two Mallophaga, one on each side of the abdomen just back of the posterior edge of the first segment; in the dried specimen they extend beyond the end of the fly's abdomen, with the ends of the Mallophaga touching each other. It is an interesting example of phoresy and shows how many of the Mallophaga are probably distributed.[1]

On Aug. 29, 1921, Mr. A. B. Fuller obtained two specimens from the Savannah Sparrow (*Passerculus sandwichensis savanna*) at Essex, Mass. One of the flies had attached to it a pupa, black and polished in appearance, but when enlarged twenty-five diameters it shows an irregular mosaic-like pattern. At one end there is a slight contraction, forming four or five slight nodes. Its length is 2.5 mm., while the total length of the dried fly is 4 mm. In a recent "Annotated List of the Diptera or Oregon," by Cole and Lovett (Proc. Cal. Acad. Sci., 1921, 4th ser., XI, 344), this species is recorded from "Upper Alsea Valley, Benton Co., on Steller's Jay." Coquillett records it from Washington D. C., to California.

Except for size, I see little to separate this species from the European *O. avicularia* Linn., and it is probably what Van der Wulp had before him when he recorded the latter from Wisconsin (Tijdsch. v. Ent., XII, 80, 1869). As Coquillett suggests (Ent. News, XVIII, 290, 1907), it may represent one holarctic species. The *O. avicularia* also frequents many species of birds, including hawks, owls, woodpeckers, herons, ravens, jays, partridges, peacocks, crossbills, sparrows, skylarks etc.

Olfersia albipennis Say.

It is a question whether *O. albipennis* and what we are calling *O. ardeæ* are not one and the same species, but whether it is the same as the European species is still another question. When the light strikes the wings at a certain angle, especially when they overlap each other, they are often decidedly whitish in color, hence Say's name. As it is an older name than *O. ardeæ*,

[1]This specimen was recorded by Nathan Banks in Psyche, Vol. 27, p. 20, 1920, and by W. L. McAtee in Ent. News, Vol. 33, p. 20, 1922. The bird however was not mentioned.

I am using it for the American species. It has been taken from the following species of birds:

Great Blue Heron (*Ardea herodias*) T. Say.

Black-crowned Night Heron (*Nycticorax nycticorax*). Alston, Boston, Mass., Aug. 1, '12; Hampton, N. H., May 13, '17 (S. A. Shaw); Delaware River, below Philadelphia, Oct. 15 '96 (C. Liebeck).

Little Blue Heron (*Florida cærulea*). Bristol Isl., Delaware River (Fowler).

White Heron or Egret (*Herodias egretta*). St. Augustine, Nov. 8,'87.

American Bittern (*Botaurus lentiginosus*). Delaware River below Philadelphia, Sept. 13-Oct. 12,'85 (C. Liebeck).

Least Bittern (*Ixobrychus exilis*). Delaware River below Philadelphia, Sept. 18, (C. Liebeck).

Olfersia americana (Leach)

This species is known to frequent the following birds:

Great Horned Owl (*Bubo virginianus*). Wenham, Mass., Dec. 2,'10 (Dr. J. C. Phillips), Dover, Mass., Dec. 24,'94 (A. P. Morse), San José, Cal. (W. Holden).

Barn Owl (*Aluco pratincola*). San José, Cal. (W. Holden).

Long-eared Owl (*Asio wilsonianus*). Hampton, N. H., Apr. 9, '09 (S. A. Shaw).

Barred Owl (*Strix varia*). Framingham, Mass., Nov. 1,'10 (C. A. Frost).

Screech Owl (*Otus asio floridanus*). St. Augustine, Fla. (C. W.J.)

Western Screech Owl (*Otus mecallii*). Calif. (M. C. Z).

Red-shouldered Hawk (*Buteo lineatus*). Wenham, Mass., Aug. 14,'14 (J.C. Phillips), Sherborn, Sept. 21,'98, (A.P. Morse); Dunmore Lake, Vt. (C. E. Brown).

Red-tailed Hawk (*Buteo borealis*). Illinois (M. C. Z.).

Broad-winged Hawk (*Buteo platypterus*). Texas (G. H. Ragsdale).

Pigeon Hawk (*Falco columbarius*). (B. S. N. H.).

Ruffed Grouse (*Bonassa umbellus*). Liberty Hill, Conn., Oct. 1896 (O. Bangs).

Olfersia sp.

From Chuck-wills-widow (*Antrostomus carolinensis*), St. Augustine, Fla. (C. W. J.).

Ornithoctona erythrocephala (Leach)

This has been found on the following species of birds:

Red-tailed Hawk (*Buteo borealis*). Cuba (M. C. Z.).

Broad-winged Hawk (*Buteo platypterus*). Cuba (M. C. Z.).

Sparrow Hawk (*Falco sparverius*). Porto Rico (Coquillett).

Ruddy Quail-dove (*Geotrygon montana*). Holguin, Cuba (M. C. Z.).

Yellow-crowned Night Heron (*Nyctanassa violacea*). Dominica, May 25,'01 (O. Bangs).

Pigeon Hawk (*Falco columbarius*). Metis, Quebec, collected by L. M. Terrill.

The last record, received through Mr. Albert F. Winn, is especially interesting. Although Osten Sacken recorded this fly from Quebec, this is the first record of a host north of the West Indies. Mr. Terrill captured the hawk on her nest and seven specimens of the fly were taken. Since writing the above Jos. Ouellet informs me that he has taken this species on the American Bittern, near Montreal, Aug. 1902.

Pseudolfersia fumipennis (Sahlberg)
(*P. maculata* Coquillett).

From the Fish Hawk or Osprey (*Pandion haliætus carolinensis*). Cape May, N. J., Aug.; Lahaway, N. J., Apr. 1 (J. T. Brakeley); St. Augustine, Fla. (C. W. J.); Sand Point, La., and Cuba (Mus. Comp. Zool.); Bald Eagle (*Haliaeetus leucocephala*). Hampton, N. H., May 17,'05 (S. A. Shaw); and Loon (*Gavia immer*). Wisconsin (Coquillett).

Pseudofersia spinifer (Leach)

Taken on the Florida Cormorant (*Phalacrocorax auritus floridanus*) at Great Sale Key, Bahams, July 17,'05, by Dr. G. M. Allen. A widely distributed species of the tropics, frequenting the Man-o'-War-Bird (*Fregata aquila*), Gannets and Black Vulture.

NOTES ON NEOTTIGLOSSA TRILINEATA KIRBY (HEMIPTERA, PENTATOMIDÆ)[1]

By Roland F. Hussey

In Richardson's "Fauna Boreali-Americana" (Vol. 4, 1837, p. 276, pl. vi, figs. 6, 6a), W. Kirby described and figured a *Pentatoma trilineata*, from one specimen "taken in the road from New York to Cumberland House" [Saskatchewan], and proposed for it a new subgenus, *Neottiglossa*, which he characterized, in the following words:

"*Nose* shorter than the cheeks. *Bed of the promuscis* elevated on each side at the base.

"In the typical *Pentatomæ*, the part which I regard as analogous to a *nose* is of the same length with the two lateral lobes of the front, and the base of the cavity in which the promuscis reposes when unemployed is not so elevated."

Whatever may be said of this generic diagnosis, whose incompleteness led to the redescription of the genus under different names by Dohrn (1860) and by Fieber (1861), Kirby's description of *Pentatoma trilineata* serves amply for the identification of the species, and it is surprising that it has not been better understood. Dallas (List of Hemip., i, 1851, p. 224) records the species from Hudson's Bay and from Nova Scotia. Uhler (Proc. Bost. Soc. Nat. Hist., xiv, 1871, p. 96) placed *trilineata* as a synonym of *Neottiglossa undata* Say, in which he was followed by Stâl (Enum. Hem., ii, 1872, p. 18). A few years later, Uhler (Bull. U. S. Geol. Geogr. Surv., iii, 1877, p. 401) separated the two species,

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 200.

recording *trilineata* from Dakota, British Columbia, California, Nebraska, Canada, and the region of the Mackenzie River, and stated that *trilineata* differs from *undata* "in being larger and more robust and blunt anteriorly, the head entirely black and more coarsely punctate, the venter more widely black, and the femora much more invaded with black." Forty-five years have elapsed since Uhler published these notes, yet no one has given us any further information regarding Kirby's species.

Among some Hemiptera collected in northern Michigan by Mr. S. Moore of Detroit, recently submitted to me by the Museum of Zoölogy of the University of Michigan, there is one specimen which I refer without hesitation to *Neottiglossa trilineata*. It agrees well with Kirby's original description, differing only in its slightly smaller size (5½ mm. as compared with 3 lines) and in the markings of pronotum and scutellum; but these differences are no greater than may be found in a series of *N. undata*. The specimen before me differs more considerably from Kirby's figures, but these agree neither with each other nor with his description, for in one figure the lateral margins of the pronotum are represented as concavely sinuate, and in the other as straight and concolorous, while the description reads "Prothorax. . with the lateral margin. . white."

Neottiglossa trilineata, as I identify it, differs from *N. undata* in its darker coloration anteriorly, in the more obtuse apex of the head, in the more broadly flattened pronotal margins, in antennal structure, and in the form of the ventral abdominal segments. Since the species has been so little understood by American entomologists, I have thought best to give a full description of the specimen before me, together with figures illustrating some of the characters by which it differs from *N. undata*.

Head, black, a little bronzed, somewhat shining, deeply and closely punctate, the punctures somewhat finer on the base of the vertex. Sides of head subparallel for a short distance before the eyes, thence concavely sinuate to a point beyond the middle of the tylus, thence straight and converging at an angle of about 110°; extreme lateral margin very lightly reflexed; apex

of head slightly but distinctly emarginate. Head, seen in profile (Fig. 1, A), less abruptly deflexed than in *N. undata* (Fig. 1, B), and the apex less acute. Ratio of lengths of antennal segments 19:23:20:35:45 (in *undata* the ratio of segment II to segment III

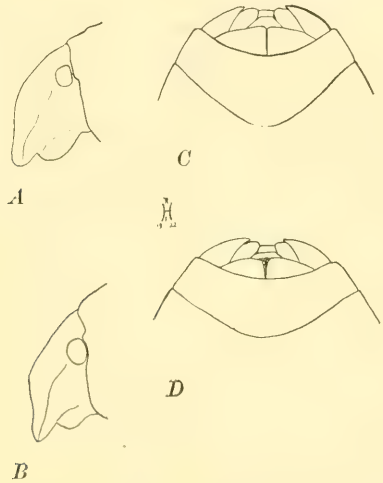

Fig. 1.—A, head of *Neottiglossa trilineata*; B, head of *N. undata*; C, Apical ventral segments of *N. trilineata*; D, ventral segments of *N. undata*.

is 23:17); the three basal segments yellowish, the third darkened toward the apex and on the sides, fourth and fifth segments black. Rostrum nearly reaching the hind coxæ, apical segment piceous.

Pronotum black and closely punctate on the anterior half, obscure testaceous and more sparsely punctate on the posterior half; median line and a small irregular spot behind each callosity yellow. In the specimen before me the median line is obsolete behind the middle of the disc. Lateral margins straight, white, impunctate, broader than in *N. undata*; when viewed from above, there appears to be a narrow black line along the extreme edge, but this is not visible when the pronotum is viewed from the side. Anterior and humeral angles as in *N. undata*; postero-lateral margins a little more oblique and the posterior angles less broadly rounded than in that species.

Scutellum testaceous, sparsely punctate with black, the basal angles impressed, black, the apex with a piceous spot. Median line yellow, extending back from the base for about two-thirds the length of the scutellum, suddenly abbreviated; a transverse yellowish line crosses it at the middle of the scutellum and joins at each side a sublateral line which extends forward to the base of the scutellum; all these lines are faintly margined with piceous, and form a distinct trident-shaped marking. Base of the scutellum between the arms of the trident infuscated or piceous, and more densely punctate than the remainder of the scutellum.

Hemelytra testaceous, sparsely black punctate, with two piceous spots on the apical margin of the corium, one near the inner angle, the other at the end of the cubitus. Membrane white.

Abdomen black above, connexivum white. Beneath bronze-black, closely punctate; coxal cavities and legs yellowish, the femora spotted and lined with black, the tibiæ with short black lines on the distal half of the anterior and posterior faces, the third tarsal segment piceous. Sixth ventral segment more produced anteriorly (♀) (Fig. 1, C) than in *N. undata* (Fig. 1, D).

Length, 5½ mm.

Redescribed from one female taken on the beach of Lake Michigan (in wash-up?) near St. Ignace, Mackinac County, Michigan, May 31, 1921 (S. Moore), and deposited in the Museum of Zoölogy of the University of Michigan.

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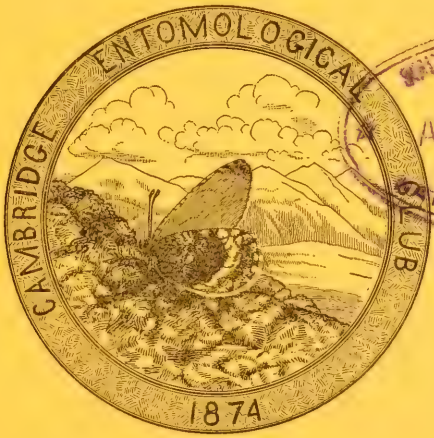

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THE NORTH AMERICAN SPECIES OF *CRYPTOLUCILIA* BRAUER AND BERGENSTAMM (*PSEUDOPYRELLIA* GIRSCHNER) (*DIPTERA, ANTHOMYIDÆ*).

By J. Bequaert.

Some time ago I sent to the eminent French dipterist, Dr. J. Villeneuve, a series of specimens of the common blue-green anthomyid fly which is passing in this country under the name "*Pseudopyrellia cornicina*." Dr. Villeneuve called my attention to the fact that these specimens were not true *cornicina* but belonged to a related species, *cæsarion* (Meigen). On taking the matter up with Dr. J. M. Aldrich and Mr. C. W. Johnson, and on examining a number of public and private collections, it becomes apparent that these two species are generally confused here. Aldrich (Cat. North American Dipt., 1905, p. 524), for instance, treats *cornicina* and *cæsarion* as synonyms. It seems useful therefore to point out the main differences between them, so as to facilitate their identification by local entomologists.

As indicated by Stein (Arch. f. Naturg., 83, Abt. A, Heft 1, 1919, p. 105), the name *Cryptolucilia* Brauer and Bergenstamm (Denkschr. Ak. Wiss. Wien, 60, 1893, pp. 179 and 206; type: *C. asiatica* Brauer and Bergenstamm = *Musca cæsarion* Meigen according to Stein) has priority over *Pseudopyrellia* Girschner (Berlin. Entom. Zeitschr., 38, (1893) 1894, p. 306), since Girschner's paper was not issued until January 1894.

The species of *Cryptolucilia* have long been placed among *Lucilia*, which they resemble in color and general appearance. They are, however, easily separated from the latter genus by the absence of hypopleural bristles and the arrangement 1:2 of the sternopleural bristles. *Cryptolucilia* therefore belongs to the Anthomydiæ as defined by Girschner.

Of the Nearctic anthomyid genera, *Pyrellia* and *Morellia* alone have a similar metallic blue-green color. *Cryptolucilia* can

be distinguished from these by the contour of the fourth longitudinal vein, which in its apical part is bluntly angular and a little sinuate beyond the bend, whereas in *Pyrellia* and *Morellia* the curve of the distal section of the fourth vein is broad and gentle.

1. **Cryptolucilia caesarion** (Meigen) (=*Musca cæsarion* Meigen, Syst. Beschreib. Europ. zweifl. Ins., 5, 1826, p. 57). Thorax with a pair of acrosticals before the transverse suture, usually placed rather irregularly in an oblique line; three posterior dorsocentrals. Front of the male about one-sixth the width of the head; in the female comparatively wide, measuring over one-third of the total width of the head.

This is a common and widely distributed North American species and, as stated above, is labeled "*Pseudopyrellia cornicina*" in American collections. The figures given by Hough (Biol. Bull., 1, 1899, p. 27, fig. 9) for *cornicina* undoubtedly refer to this species. I have seen specimens from the following States: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Maryland, Virginia, North Carolina, Nebraska, Texas, South Dakota, Arizona, California, and Washington; also from Canada (Ontario, Quebec.) In addition, Dr. Aldrich possesses specimens from Kansas, Idaho, Nevada, and New Mexico.

The brilliant blue larva lives in cow manure and the adult flies are commonly found on fresh cow dung. This is evidently the species which was reported by Howard (Proc. Washington Ac. Sci., 2, 1900, p. 579), Brues (Psyche, 9, 1902, p. 354), and F. C. Pratt (Canad. Entom., 44, 1912, p. 181) under the name "*Pseudopyrellia cornicina*" as having been bred in abundance from cow manure. Howard figures the early stages.

Among the very large number of *Cryptoluciliæ* from North America examined, I have found only one in which the anterior acrosticals were lacking, but as this specimen possessed *three* posterior dorsocentrals, I believe it is an abnormal example of *C. cæsarion*.

2. **Cryptolucilia cornicina** (Fabricius) (=*Musca cornicina* Fabricius, Spec. Insect., 2, 1871, p. 438). Thorax without acrosticals before the transverse suture; four posterior dorsocentrals. Front comparatively narrower in both sexes.

This species is thus far unknown from North America. In Europe, however, it is not less common than the foregoing. I have examined a male from Rambouillet, France, kindly sent to me by Dr. Villeneuve.

Stein (Arch. f. Naturg., 83, Abt. A, Heft 1, 1919, p. 105) synonymizes *Pyrellia frontalis* Thomson (Eugenies Resa, 2, Zool., 1, Diptera, 1868, p. 545), from California, with *C. cornicina*. Whether this is based on an examination of Thomson's type specimen is not known, but the description applies equally well to *C. cæsarion*.

The failure of North American entomologists to separate *cæsarion* and *cornicina* is evidently due to the confusion on this subject which has been allowed to prevail until recent years by European dipterists. Even Girschner while establishing his genus *Pseudopyrellia* on "*P. cornicia* Fll." was evidently using specimens of *cæsarion*, since he expressly mentions among the generic characters the presence of a pair of heavy acrosticals. Schnabl and Dziedzicki (Die Anthomyiden. Nov. Acta Ac. Leop. Car. Nat. Cur., 95, 1911, pp. 224 and 229) repeated the same error. The two species, however, have been correctly separated by Stein (Arch. f. Naturg., 81, Abt. A, Heft 10, 1916, p. 18), who has also examined their type specimens.

Considering the constant association of *Cryptolucilia cæsarion* with cattle dung, the question might be raised whether this fly has not been imported from the Old World through the agency of man, at a comparatively recent date. It is, moreover, remarkable that of the two common Palearctic species, only one has thus far established itself in North America.

NOTES ON THE PUFFBALL BEETLE, *CÆNOCARA OCULATA* (SAY)

By Harry B. Weiss, New Brunswick, N. J.

This member of the family *Anobiidæ* was described by Say in 1824 (App. vol. II, Keating's Exp. to source of St. Peters Riv. under Maj. Long, Phila., 1824, p. 273) and has long been known to collectors as being associated with the fungi commonly called puffballs. Blatchley (Col. Ind., 1910, p. 884) records it from Indiana as occurring throughout the state on low vegetation in damp localities and also in small puffballs (Lycoperdon). Smith (Ins. N. J., p. 307) records it as common throughout the state but does not mention any host.

For the past two years it has been noted at Monmouth Junction, N. J., breeding in a species of puffball known as *Scleroderma vulgare* and undoubtedly occurs in many localities where its host grows. Leng (Check List Col. Amer. N. of Mex. p. 244) indicates its wide distribution by the following localities—Ct., Fla., New Eng., Ariz., Ind.

Fungi belonging to the genus *Lycoperdon* are small puffballs with somewhat thickened bases or stalks. When young the interior is soft, white and firm; later it becomes yellowish and finally forms a purplish brown, dusty mass consisting of spores and threadlike filaments. Species of this genus appear in the summer and autumn and are common on the ground or on old stumps, usually in clusters. In the genus *Scleroderma*, the plants are sessile or nearly so. The peridium is thick and leathery and sometimes becomes cracked and ruptured at the apex. *Scleroderma vulgare* in which *Cænocara oculata* was found breeding is about 5 cm., in diameter, subglobular, with a thick, yellowish or pale brown scaly or warty, leathery peridium. The spore mass is purplish black. This species is quite common and occurs in dry places and on hard ground. At Monmouth Junction, N. J., the fructifications were found in the dry parts of a large wooded area.

On September 5, several adults of *Cœnocara oculata* were noted with their bodies projecting slightly from small circular holes in the walls of the fungi. Upon cutting such fungi open, they were found to contain, in addition to the blackish, powdery mass of spores, numerous full grown larvæ some of which had constructed pupal chambers or cells. One puffball contained fully 100 larvæ. Many of the larvæ pupated by September 9 and on September 22 fully colored adults were found in the cells.

When full grown each larva constructs an oval cell in the spore mass. These are about 4 mm., long and 2 mm., wide and many are attached to the inner side of the peridial wall. Pupation takes place in these cells and when the adult is ready to emerge it simply eats through the wall of the fungus. Upon examining these exit holes it will be found that they are shallow and extend in only to the depth of the pupal cell. The larvæ undoubtedly do most if not all of their feeding in the fungus when it is young as at this time, the interior is solid and fleshy. When ripe, the spore mass is dry and powdery.

Larvæ. Length about 4 mm. Width about 1.5 mm. Form subcylindrical, tapering toward head, posterior end rounded, somewhat white grub-like in appearance. Body curved, almost semicircular in outline. White except for brownish mouth parts. Head small, subcircular, bearing minute hairs; collum absent; antennæ single jointed, minute, almost obsolete; ocelli absent; cranial sutures indistinct; gula membraneous; ventral mouth parts fleshy. Clypeus and labrum distinct, former transverse, latter small, semicircular bearing several minute hairs on anterior edge. Mandibles comparatively large, heavy, broad across base, narrowing toward tip which is strongly bifid. Lacinia and galea distinct, well separated, each bearing chitinous hairs; maxillary palpi two-jointed, second joint tapering and twice as long as the first; labium with mentum and submentum indistinct; labial palpi two-jointed. Body segmentation indistinct; body bearing numerous minute hairs and irregular transverse rows of larger hairs on raised dorsal folds of thoracic and ab-

dominal segments. Anal end of body and anal area bearing numerous longer hairs. True legs absent, indicated by ambulatory tubercles.

Pupa. Length about 3 mm. Width about 1.8 mm. White; oval; posterior end of abdomen terminated by a pair of tubercles each bearing a short, weak spine; remainder of body surface devoid of spines or hairs.

Adult. Reference to the place of original description has already been made and Blatchley's description (Col. Ind. p. 884) is available if the original is not. The adult is interesting on account of its ability to pack itself up into a little globe or ball. The legs shut together; a cavity on the breast receives the antennæ and large mouth parts and the head is folded down over the chest closing this cavity. In such a closely packed condition, the insect resembles a small seed. When disturbed, it immediately folds up.

RECORDS OF HYMENOPTEROUS PARASITES IN PENNSYLVANIA

By A. B. Champlain.

Bureau of Plant Industry, Harrisburg, Pa.

Definite breeding records of Hymenopterous parasites are always valuable contributions to our knowledge of this order of insects. The following collection of fragmentary records of parasitic Hymenoptera and their hosts are from rearings by the author, and from notes in the file of the Bureau of Plant Industry, extending over a period of years. Due credit for the records obtained appears throughout the paper.

The recorded species which are in the collection of the Pennsylvania Bureau of Plant Industry were all identified or verified by leading authorities on Hymenoptera,—S. A. Rohwer and R. A. Cushman of the U. S. National Museum, and some by H. L. Viereck of the U. S. Bureau of Biological Survey. The abbreviations—Det. Roh., Det. Cush., Det. Vier.—designate the species identified by each.

Evaniidæ

Hemistephanus sp. (Det. Cush.). Hummelstown, Pa., Rockville, Pa., Magnolia, Md., is a parasite of *Dicerca divaricata* in *Betula lenta* and of unknown borers in *Quercus bicolor* and *Quercus* sp. Notes by H. B. Kirk and J. N. Knull.

Oleisoprister abbotii Westw., Hummelstown, Pa., reared from *Liriodendron tulipifera* infested by *Leptura mutabilis.*

Odontaulacus bilobatus (Prov.), (Det. Roh.) Mt. Holly, Pa., June 14, 1921—Knull and Champlain. Adults were flying around and alighting on dying hemlock *Tsuga canadensis.* Upon cutting into the bark a heavy infestation of *Melanophila fulvoguttata* was found in adult and pupal stages. In some cells adults and pupæ (one to a cell) of *O. bilobatus* were found with remnants of the host.

Odontaulacus rugitarsis Cress. (Det. Cush.) New Bloomfield, Pa., June 16. Adults were plentiful flying around and alighting on cut white pine (*Pinus strobus*) infested by Scolytoids and Cerambycids.

Pammegischia burquei Prov. (Det. Cush.), Harrisburg, Pa. A parasite of *Xiphidria champlaini* Roh. in dead branches of *Carpinus caroliniana*; *X. attenuata* Nort. in dead branches of *Tilia americana* and of *X. maculata* in dead *Acer rubrum*. Adults fly during May.

Braconidæ

Macrocentrus delicatus Cress. (Det. Vier.). Willow Street, Pa. Reared from pupæ of *Mineola indiginella*.

Helconidea ligator Say (Det. Cush.), Hummelstown, Pa., Jan. 23. Reared from oak (*Quercus bicolor*) infested by *Purpuricenus axilaris*. J. N. Knull; West Chester, Pa. Reared from dead *Morus* sp. infested by borers, Camp Hill, Pa., from dead *Robinia pseudacacia*, infested by *Neoclytus erythrocephalus*, F. M. Trimble.

Helconidea borealis Cress. (Det. Roh.), Harrisburg, Pa. Parasite on Cerambycid larva in dead *Rhus toxicodendron*, H. B. Kirk, Hummelstown, Pa. Parasite of Cerambycid larvæ in dead mulberry (*Morus rubra*) branches,—J. N. Knull.

Helcon pedalis Cress. (Det. Roh.), Hummelstown, Pa. Parasite on *Xylotrechus* larvæ in dead hemlock (*Tsuga canadensis*), —J. N. Knull.

Ichneumonidæ

Nemeritis canescens (Grav.) (Det. Cush.), Butler, Pa., IX. 25. In flour mills. A parasite of Mediterranean flour moth.

Orthopelma luteolata (Grav.) (Det. Cush.), Chester, Pa. VI-27. Reared from Cynip galls on wild rose.

Cremastus gracilipes Cush. (Det. Cush.), Rockville, Pa. Reared from cat tail rush infested by *Dicymolomia julianalis*; Collins, Pa. Lepidopterous larvæ infesting "cat-tails" growing along canal, caged IX-22, indoors—Nov. 23 to next April, many moths and ichneumonid parasites emerged—A. F. Satterthwait." Identified same as above.

Labena apicalis Cress. (Det. Cush.), Rockville, Pa. Parasite of *Stenosphenus notatus* in Hicoria sp., I-II,—J. N. Knull.

Xorides calidus (Prov.) (Det. Roh.), Harrisburg, Pa. Parasite of *Phloeotrya 4—maculata* in dead sumac (*Rhus typhina*).

Odontomerus canadensis Prov. (Det. Cush.), Hummelstown, Pa., V-18. Parasite of Cerambycid in sumac (*Rhus* sp.), Knull.

Glypta simplicipes Cress. (Det. Cush.), Philadelphia, Pa., V-20. Reared from larva of leaf tyer on *Azalea* sp.,—J. K. Primm.

Scambus (*Epiurus*) *tecumseh* Vier. (Det. Cush.). Host—*Dicymolomia julianalis* Walsh, in cat-tail rush, Rockville, Pa., VI-6 to 19.

Tromatobia rufopectus Cress. (Det. Cush.). "Harrisburg, Pa., collected egg mass of garden spider from shrub. On opening egg cocoon found that eggs had been parasitized by an Ichneumonid, and the case contained a dozen or more whitish cocoons matted together. Upon opening one of these cocoons found the parasite in mature larval stage. Material caged. March 22 the parasites had emerged. There were twelve females and one male,—J. R. Stear."

Scambus indigator Walsh (Det. Vier.), Willow Street, Pa. Reared from pupa of *Mineola indiginella* Zell.

Perithous pleuralis Cress. (Det. Cush.), Hummelstown, Pa. Cocoons found in old (borer?) burrows in *Platanus occidentalis*, II-17—Knull.

Ephialtes aequalis (Prov.) (Det.Cush), Ledy, Pa., from Codling moth puparia.

Ichneumon irritator Fab., New Cumberland, Pa. Host—*Cyllene pictus*. Hummelstown, Pa., parasite of *Chrybothris* sp. larvæ found in sapwood of dead *Cercis canadensis*,—Kirk and Knull.

Ichneumon comstocki Cress. (Det. Vier.), Rockville, Pa. Reared from *Evetria comstockiana*,—V. A. E. Dæcke.

Rhyssa lineolata Kirby (Det. Cush.), Mt. Holly, Pa., June 14. Adult female ovipositing in dead hemlock infested by *Urocerus albicornis*.

Urocerus albicornis Fab., New Bloomfield, Pa. This horntail infested hemlock stumps, trees cut one year ago. At this time (Aug. 1) adult females are flying. Cutting into infested stumps we found pupæ of males and females, also mature larvæ, small larvæ and apparently newly hatched larvæ, as well as parasites.

Among the parasites, *R. lineolata* was common. Adults were collected from July 10 to 30 at various localities. On Aug. 1, at New Bloomfield, pupæ and newly transformed adults were chopped from the *Urocerus* cells. Observation by Knull and Champlain.

Rhysella humida Say (Det. Cush.), Rockville, Pa. A parasite of *Xiphidria champlaini* Roh. in dead *Carpinus caroliniana*.

Megarhyssa nortoni (Cress.), New Bloomfield, Pa., July 21 and August 1. Adults ovipositing in stumps infested by *Urocerus albicornis*,—Knull and Champlain.

Arotes formosus (Cress.) (Det. Cush.), Dauphin, Pa., Clarks Valley, VI-5. Parasite of *Bellamira scalaris* in dead river birch (*Betula nigra*),—Kirk and Champlain.

Gelis bruesi (Strickl.) (Det. Cush.), Rockville, Pa. Parasite on the eggs of Drassid spider. The spider egg cases were collected from the under side of stones. The cocoon of the parasite was in the space originally occupied by the spider egg mass.

Gelis obscurus (Cress.) (Det. Cush.), Rockville, Pa. Parasite on the eggs of Drassid spider. Both winged and wingless forms were reared.

Acroricnus junceus Cress. (Det. Vier.), Conewago, Pa., V-7. Reared from nest of solitary wasp on *Juniperus.* Also reared from nest of *Odynerus tigris*,—V. A. E. Daecke.

Itamoplex vinctus (Say). (Det. Cush.), Chambersburg, Pa., Reared from cocoons of peach tree borer (*Synanthedon exitosa*),—E. M. Craighead.

Agrothereutes nuncius Say (Det. Vier.), Harrisburg, Pa. Very common parasites in the cocoons of *Callosamia promethea.*

Lagarotis diprioni Roh. (Det. Cush.), Wyomissing, Pa. Reared from the cocoons of *Diprion lecontei.*

Chromocryptus nebraskensis Ashm. (Det. Cush.), Obelisk, Pa., XI-18. Reared IV-21, from the cocoon of *Tolype velleda.*

Amblyteles. Many species of this genus overwinter in the adult stage in cracks in bark, in old borer cells in logs and beneath stones. During the winter months they may be found packed closely together in cells in logs, six to a dozen specimens, sometimes one species, often a number of species together. Many of the records show that they are primary parasites of Lepidoptera, and usually emerge after the host has entered the pupal stage.

Amblyteles malacus Say (Det. Cush.), Harrisburg, Pa. Emerged IV-18 from Arctiid pupa from beneath bark in old willow log. Linglestown, Rockville, Harrisburg, Pa. Reared from Arctiid pupæ,—Kirk and Champlain.

Amblyteles cincticornis (Cress.) (Det. Vier.), Enid, Pa. Reared from moth pupa on cabbage. Adults collected in hibernation.

Amblyteles subcyaneus Cress. (Det. Vier.), Harrisburg, Pa. Reared from *Arctiid* pupæ from under bark of willow log,—A. F. Satterthwait & W. S. Fisher.

Amblyteles extrematatis (Cress.) (Det. Vier.). (Det. Cush.), Penbrook, Pa. Reared from pupa of Arctiid (*Gaberasa ambigualis*), D. K. McMillan. Also reared from Arctiid pupæ from other localities in Pennsylvania.

Amblyteles unifasciatorius (Say) (Det. Cush.), Harrisburg, Pa. Reared from Lepidopterous pupa.

Amblyteles paratus Say (Det. Cush.), Linglestown, Pa. Reared from small moth pupa,—Kirk and Champlain.

Amblyteles rufiventris Brullé (Det. Cush). From pupa of *Vanessa huntera*,—D. K. McMillan & W. S. Fisher.

(Det. Vier.). Emerged from pupa of *Vanessa cardui*,—P. R. Myers.

Amblyteles duplicatus Say (Det. Cush.), Enola, Pa. Reared from pupæ of *Eudamus tityrus*,—Kirk and Champlain.

Amblyteles cæruleus Cress. (Det. Cush.), Harrisburg, Pa. Reared from moth pupa,—Kirk and Knull.

Amblyteles sp. near *signatipes* (Cress.) (Det. Cush.). Reared from moth pupa collected beneath bark, Harrisburg, Pa., II-24,—P. R. Myers.

Vanhorniidæ

Vanhornia eucnemidarum Cwfd. Parasite of *Tharops ruficornis* in dead maple, Hummelstown, Pa.,—Knull and Champlain.

Ibaliidæ

Ibalia ensiger Norton, (Verified Roh.) New Bloomfield, Pa., —VIII. Ovipositing in hemlock, August 1, pupæ and adults from cells of *Urocerus albicornis* in stumps of hemlock,—Knull and Champlain.

Ibalia maculipennis Haldeman. (Det. Champlain). Very common in the vicinity of Harrisburg where it is a parasite of *Tremex columba* in hickory.

ON THE HYMENOPTEROUS GENUS HARPAGOCRYPTUS AND ITS ALLIES.[1]

By Charles T. Brues.

In the October issue of the Proceedings of the Hawaiian Entomological Society for 1908 Bridwell ('08) described a peculiar genus of Hymenoptera from Queensland, which he named Harpagocryptus and placed in the Family Dryinidæ. Harpagocryptus differs from all other genera of Dryinidæ except *Dryinopsis* Brues ('10)[2] in having the antennæ of the female 12-jointed, but Bridwell was influenced in placing the genus in this family by the habits of the larva which forms a sac on the side of the abdomen of crickets after the fashion of certain well known Dryinids.

About a year later ('10) the present writer described the genus Algoa, based on an anomalous insect from Cape Colony which he was unable to place with certainty in any family. At the time I did not compare it with Bridwell's description of Harpagocryptus, as I did not think the South African insect could be a member of the Dryinidæ. The two are, however, closely related, and I regarded them as synomous until recently, when Mr. Nathan Banks of the Museum of Comparative Zoölogy, gave me a specimen of a subapterous Hymenopteron from Long Island, New York, belonging to the same group. After a careful comparison of the two species before me with Bridwell's description, I have come to the conclusion that three closely related genera are concerned. I find also that I have a male of *Algoa heterodoxa* which is entirely wingless and distinguishable from the female only by the presence of two spines at the apex of the abdomen, and of thirteen antennal joints, while the femora are much more slender than those of the female.

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 205.

[2]This genus is similar in many respects to Methoca and apparently still more like Andreus Ashm. (03b), although I know the latter only from the description. Unfortunately the male is unknown and may or may not prove to be of the Thynnid type. Inasmuch as the systematic position of Methoca itself must still be considered as somewhat doubtful, I am unable to form a satisfactory opinion concerning the affinities of Dryinopsis.

Still a fourth member of this group is Olixon Cameron ('87) described from Panama and later redescribed by Kieffer ('11) from Mexico, as Saphobethylus. Turner and Waterston ('17) have shown these two genera to be complete synonyms as the type species of both are identical. Cameron regarded Olixon as an anomalous Braconid, but thought that it showed resemblance to certain Bethylids, particularly on account of its greatly thickened fore legs. Kieffer placed Saphobethylus in the Bethylidæ without question, but Turner and Waterston have referred the insect to the Rhopalosomatidæ.

All four genera are closely related, but are, I think, undoubtedly separable on good characters. They may be distinguished by means of the following key, which is based solely on the females, except in the case of Olixon.

1. Second segment of abdomen much the longest.....2
   Second segment of abdomen only a little longer than third, head transverse, vestigial wings present, reaching to base of abdomen, but without nervure; tarsal claws with a small subapical tooth...**Olixon** Cameron.
2. Tegulæ well developed; anterior wings present, but reduced in size and reaching to the tip of the propodeum; antennæ much longer than the head and thorax together, slender.....3
   Tegulæ and wings absent; antennæ stout, barely as long as the head and thorax.....**Algoa** Brues
3. Mandible with a long apical tooth and with three minute subapical teeth on the inner edge; head seen from above transverse....**Harpagocryptus** Bridwell
   Mandible with a long apical tooth, the inner teeth large and well-developed; head seen from above as long as broad.....**Nealgoa** gen. nov.

Of the three genera, Algoa and Nealgoa are distinguished by a number of characters which are indicated in the generic diagnoses that follow; likewise Algoa and Harpagocryptus are separable by several clear-cut structural differences. Harpa-

gocryptus and Nealgoa are evidently more closely similar, although many characters which might be useful are not given by Bridwell, and were it not for the great geographical separation, I should hesitate to propose a new genus for the North American species.

The characters which appear useful in differentiating the four genera follow.

Olixon Cameron.

Biol. Centr.-Americana, Hymenoptera, vol. 1, p. 412 (1887)
Kieffer. Bull. Soc. Sci. Bruxelles, vol. 35, p. 216 (1911) (*Saphobethylus*)

♂. Head transverse, wider than the thorax. Antennæ a little shorter than the body; first joint of flagellum one-half longer than second, all flagellar joints long, at least four times as long as thick; antennæ inserted below the lower margin of the eyes; malar space with a black carina connecting the eye and mandible; cheeks half as long as the eye. Mandibles curved, pointed and without tooth. Eyes almost attaining the posterior margin of the head. Prothorax a little longer than wide, bulging laterally in front. Anterior wing reaching to the base of the abdomen, without venation or stigma. Propodeum as long as the prothorax, its hind angles acutely toothed. Tarsal claws with a small tooth near tip. Third segment of abdomen a little shorter than the first. External genitalia consisting of a median stylet between a pair of parallel, upturned, filiform projections.

Harpagocryptus Bridwell.

Proc. Hawaiian Entom. Soc., vol. 2, pp. 34 (1908).

♀. Head transverse, wider than the thorax, occiput arcuately emarginate. Antennæ elongate, slender, much longer than the head and thorax together; second and following joints of antennæ subequally elongate, many times as long as thick; first joint shorter than second; pedicel very short, but evidently longer than wide. Mandibles with a long apical tooth and three

minute subapical teeth on the edge. Prothorax large and long, narrowed posteriorly; tegulæ present; fore wings strap-like, reaching to the posterior face of the propodeum; propodeum very long, its superior angles produced into a strong acute tooth on each side.

Algoa Brues.

Journ. New York Entom. Soc., vol. 18, p. 18 (1910)

♀. Head quadrate, not broader than long, occiput faintly emarginate. Antennæ short, barely as long as the head and thorax together; first flagellar joint longer than the second; second and following barely three times as long as thick; pedicel twice as long as thick and more than half as long as the first flagellar joint; antennæ inserted just above the level of the lower margin of the eyes. Malar space with a sharp furrow, shorter than the basal width of the mandible. Mandible with a long apical tooth and three minute subapical teeth on the edge. Eye separated by its own width from the hind margin of the head. Prothorax one-half longer than wide, obliquely narrowed posteriorly. Wings absent, tegulæ obsolete. Propodeum almost as long as the pronotum, much wider behind than in front, its hind angles slightly acute, but not toothed.

♂. Antennæ 13-jointed, longer and more slender than those of the female; pedicel nearly as long as the first flagellar joint; second and following flagellar joints subequal, each three times as long as thick. Ocelli obsolete as in the female. Front femora greatly thickened, the other legs slender, especially the hind ones; all tarsi long and slender, their joints all cylindrical, none flattened nor emarginate at tips. Abdomen armed with two slender, upturned spines at apex.

The male is so similar to the female, except for the additional antennal joint, more slender legs and small spines at the apex of the abdomen that I did not recognize its sex at the time the species was described. It measures 2.5 mm. in length, while the females I have seen range from 4 to 5.2 mm. The antennæ of the male are only slightly lighter basally while in the female the first three joints are honey-yellow.

Nealgoa gen. nov.

♀. Small, 5-6 mm. in length. Head, seen from above as long as broad, produced medially in front, truncate behind, the eyes approaching close to the occipital margin; malar space long, greatly exceeding the basal width of the mandible and equalling the length of the scape, malar furrow wanting; ocelli obsolete. Antennæ 12-jointed, long and slender, slightly attenuate at tips, much longer than the head and thorax together; scape two and one-half times as long as thick; pedicel half as long as the first flagellar joint; all flagellar joints long. Palpi as in Algoa and Harpagocryptus. Pronotum as long as broad, almost as wide as the head, strongly narrowed behind, from just before the middle; mesonotum short, twice as broad as long, tegulæ well developed. Fore wing paddle-shaped, reaching slightly beyond the tip of the propodeum, with a strong costal vein extending almost to the tip, and with two pale, oblique discal veins, evidently the vestiges of the radius and submedius; hind wing absent. Propodeum a little longer and narrower than pronotum, very slightly widened posteriorly, the superior angles prolonged into acute teeth; posterior face concave, almost vertical. First segment of abdomen more or less campanulate, separated from the second, both above and below, by a strong constriction; anterior face separated from the dorsal face by an arcuate carina which gives off a short median ridge behind; spiracle at the lateral margin just behind the carina. Second segment the longest and widest, three times as long as the first, longer than wide and broadest near the tip; apical margin emarginate medially; third to sixth segments subequal, narrowing to the acute tip of the abdomen, each one-third as long as the second, with straight posterior margins. Legs long, the anterior femora thickened, about one third as broad as long, middle and hind femora stout, but neither are noticeably thickened; fourth joint of all tarsi thickened and emarginate at tip, very deeply so on the front pair; claws acute, simple; tibial spurs 1, 2, 2; front and middle tarsi much longer than their tibiæ, posterior ones twice as long.

Type: *N. banksii* sp. nov.

Nealgoa differs from Algoa in its more slender middle legs, longer, unfurrowed malar space, eyes set close to the occipital margin, long slender antennæ, well developed tegulæ and short wings.

Nealgoa banksii sp. nov.

♀. Length 6 mm. Bright fulvo-ferruginous; antennæ infuscated beyond the third joint; middle femora and tibiæ weakly infuscated apically; hind femora strongly so; hind tibiæ fuscous, internally at base and apex pale golden, due to a coating of pale glistening pubescence; pulvilli black. Entire body without distinct sculpture although microscopically punctulate; surface subshining and clothed everywhere with dense, but extremely minute pale hair. Palpi pale yellow, teeth of mandibles black. Wings brownish, costal vein dark brown, discal veins weak, pale brown, margin minutely fringed. Second and third joints of antennal flagellum the longest, subequal, each five times as long as thick; first joint distinctly shorter, twice as long as the pedicel; apical joints of flagellum gradually shorter and more slender, none less than five times as long as thick. Tarsi densely pubescent beneath, each joint with a distinct spine at each outer angle; longer spur of hind tibia half as long as the metatarsus.

Type in the Museum of Comparative Zoölogy, from Sea Cliff, Long Island, New York (Collection N. Banks).

As has been stated above, the four genera referred to are very closely related, but they form an extremely aberrant group and are not readily placed in any family. In 1910, I located Algoa in the Embolemínæ, which is generally considered as a part of the Bethylidæ, and pointed out that it was in many respects similar to the genera with multiarticulate antennæ which form the subfamily Sclerogibbinæ. These resemblances are mainly in the form of the head, pro- and mesothorax, thickened fore legs and abdomen. Pedinomma, also placed in the Embolemínæ by Ashmead and others (*v.* Brues '22) shows many resemblances and is likewise widely distributed, although differing in the number of antennal joints. Recently Turner and Waterston ('17) have referred Olixon to the Rhopalosomatidæ

on the basis of the similarity of the genitalia of the male and the number of antennal joints in the two sexes which is the same as that prevailing in Rhopalosoma and most aculeate Hymenoptera. There is also a curious similarity in the habits of Rhopalosoma and Harpagocryptus. Hood ('13) has shown that the larva of the former lives as an external parasite on the jumping tree cricket, Orocharis, while Bridwell's Harpagocryptus was reared from an Australian cricket of the family Trigonidiidæ on which the larva forms a sac like that of certain Dryinidæ.[1] This habit would, however, not give any reason to associate Harpagocryptus with Rhopalosoma rather than with the Drynidæ.

I am unable to reconcile the differences between Rhopalosoma and the genera here discussed sufficiently to assign them to the same family. The head in both sexes of Rhopalosoma is thin and strongly transverse, the eyes and ocelli very large and the front is not produced anteriorly. The thorax has the pronotum very short and collar-like and absolutely different from that of Algoa, *et al.* The propodeum is elongate-oval, not truncate nor sharply declivous behind; the abdomen has an extremely long petiole; the femora are only slightly thickened and the middle coxæ are approximate (widely separated by the mesosternum in Algoa). Such divergence, particularly in the form of the prothorax, head and propodeum is certainly of great importance, although the reduction of the eyes, mesothorax and scutellum is usually encountered in wingless or subapterous Hymenoptera.

Ampulicimorpha Ashmead, referred by him to the Embolemínæ does not show any great similarity to Algoa except in the general form of the head and thorax and the external male genitalia which resemble those of Olixon as described by Kieffer. On the other hand, the peculiar genus Sierolomorpha (placed by Ashmead ('03) in the family Cosilidæ), resembles Algoa quite closely in abdominal structure, in the general form of the thorax and head, thickened legs and antennæ (♂ 13-jointed, ♀ 12 jointed)[1].

[1]This insect is evidently the undescribed Embolemid mentioned by Perkins '05 (footnote, p. 27) as having been reared from "small cricketes of the genus Trogonidium or allied forms."

[1]Ashmead knew only the male, but several years later (Brues '05) the present writer found the female of this interesting insect).

The male of Algoa differs strikingly from all of the foregoing by the bispinose armature at the apex of the abdomen, which recalls that of the otherwise very different Mutillidæ. The male of Sierolomorpha has no spines that project beyond the tip of the abdomen. In Algoa I cannot find the "stylet" described by Kieffer for Olixon, which is evidently retracted in my specimen of Algoa, although the male of Ampulicimorpha bears a pair of spatulate claspers that project beyond the tip of the abdomen on each side of a median stylet.

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A BIBLIOGRAPHICAL NOTICE ON THE REDUVIID GENUS TRIATOMA (HEMIP.) [1]

By Roland F. Hussey.

The genus *Triatoma* has received much attention during recent years, both from the entomological and from the medical viewpoints. Chagas' discovery that these insects may serve as intermediate hosts in the transmission of trypanosomal diseases of the American tropics awakened an active interest in this genus among Brazilian and Argentine workers, and as a result numerous papers have been published on the biology and taxonomy of the group. Among these are two very important contributions—summaries, in fact, of our knowledge of the genus *Triatoma*—which may be called to the attention of entomologists in general.

The first of these is the "Revisão do genero Triatoma Lap.," by Dr. Arthur Neiva, of Rio de Janeiro. During the years 1910 to 1914, Dr. Neiva published a series of thirteen papers on this genus, some dealing with the biology of the Brazilian species, some with the medical aspects of their ecology, and some with their taxonomy. After studying the collections of the principal museums in Europe and in North and South America, he des-

[1]Contributions from the Entomological Laboratories of the Bussey Institution, Harvard University, No. 204.

cribed as new some thirteen species, six of which are from North American localities, one from Mexico, one from Cuba, three from South America, and two from tropical Africa. The descriptions, with few exceptions, appeared first in "O Brazil-Medico," a periodical published in Rio de Janeiro, and inaccessible to the great majority of entomologists in this country; but they are transcribed in full in Neiva's "Revisão." A copy of this work has recently come into my hands, and I shall review it here.

After a brief discussion of the general habits of the Reduviidæ, and of the hæmatophagous forms in particular, Dr. Neiva takes up the affinities of the genus *Triatoma*. He finds that the species of this genus, as it was formerly understood, intergrade with those of the genus *Lamus* Stal, and therefore places the latter as a synonym of *Triatoma*. He also found, on examining Stal's type of *Belminus rugulosus*, that it has ocelli, so he likewise reduces *Belminus* to a synonym, saying that this genus was founded on the lack of ocelli: but he makes no mention of the other (and equally important) characters on which Stal based the genus, and I feel that, despite Neiva's opinion, *Belminus* and *Triatoma* must be kept distinct for the present. *Panstrongylus guentheri* Berg is, according to Neiva, very closely allied to the African species of Triatoma that he had described a few years before; and therefore *Panstrongylus* too is dropped from the list of valid genera. Neiva's remarks on the genus *Eratyrus* Stal are very indefinite, and lead me to believe that he was doubtful as to its status.

Some twelve pages are then devoted to the biology of the forms which have been studied. Neiva concludes that the species of *Triatoma* are strictly hæmatophagous, and take their food either directly from some warm-blooded host or from other ectoparasites, such as the bedbug or other Reduviidæ, which have fed recently. Oviposition begins within thirty days after mating; a single female lays from 160 to 220 eggs, which are deposited in small masses containing from 1 to 45 ova. The eggs hatch in from 8 to 16 days, and the nymphs begin to feed three or four days later. The length of the life-cycle varies in the different

forms: in *T. rubrofasciata* it covers 210 days, in *T. megista* 260 days, and in *T. infestans* and *T. sordida* the period is intermediate between these two extremes. Thus there is probably but one brood each year.

Many species have become "domesticated," and some are strictly confined to houses and to outbuildings about farms: such species are *T. megista*, *T. sordida*, *T. sanguisuga*, *T. infestans*, *T. rubrofasciata*, *T. maculata*, and *T. rubrovaria*. Neiva believes that this adaptation is of comparatively recent date, and has been acquired since the discovery of America, since, he says, even to-day the Indian villages are not infested with these insects. The primitive habitats of the species of *Triatoma* are probably nests of various mammals: thus *T. geniculata* occurs in nests of the armadillo *Dasypus noremcinctus* L., while the North American *T. neotomæ* has been taken only in nests of the wood-rat *Neotoma*, and the South American *T. brasiliensis*, though now domesticated, is frequently found in nests of the rodent *Cerodon rupestris* Wied. The domesticated species have received many vernacular names, of which Neiva lists some twenty-five.

The genus is then considered from the taxonomic aspect. Laporte's original description is quoted in full. Then follow twelve pages devoted to the type species, *Triatoma rubrofasciata* (DeGeer), with quotations from Wolff, Latreille, Burmeister, Amyot et Serville, Blanchard, Herrich-Schäffer, Stal, and Walker, and with a very brief and unsatisfactory redescription of DeGeer's type, which is to be found in the Stockholm Museum. Neiva believes that this species is a native of India, and that it was introduced into America and elsewhere through the medium of commerce. This opinion, which is diametrically opposed to that of Kirkaldy[1], is based on the wide-spread distribution of this form in the Old World and on the fact that in America it is confined strictly to the coastal region.

An annotated list of thirty-six species then follows. *Panstrongylus guentheri*, though previously mentioned as being a

[1]Can. Ent., xxxix, 1907, p. 247; Faun. Hawaii, ii, 1910, p. 550.

Triatoma, is omitted here. The original descriptions of Neiva's own species are transcribed in full, and bibliographic references to the others are given. These descriptions, which deal almost entirely with color characters and mention scarcely any structural details, are utterly worthless for the satisfactory identification of the species, and it will be necessary to examine the types in order definitely to fix the forms. This work is soon to be undertaken by Mr. H. G. Barber and myself, and will be reported later.

A bibliography containing 97 titles is appended to the "Revisão."

The other paper, which Mr. Barber has very kindly brought to my attention is the "Contribución al estudio del gen. Triatoma Lap." by Eduardo del Ponte, published in Vol. II of the "Revista del Instituto Bacteriológico del Departamento Nacional de Higiene, Buenos Aires," and dated March 1921. The first part of this work, dealing with the anatomy of the Triatomas, is original; the chapters dealing with the biology and the systematics of the group are frankly based on Neiva's "Revisão," yet contain much additional material. Of particular interest is the account of the so-called *xenodiagnosis* (Brumpt), which affords an infallible method of diagnosing the early stages of suspected trypanosomal diseases, when the trypanosomes are too few to be detected readily by ordinary methods. Xenodiagnosis consists essentially in allowing an uninfected *Triatoma* nymph to bite the patient and to take up a considerable quantity of blood, after which the insect is placed in an incubator at 30° C. If trypanosomes were present in the patient, and were ingested by the Triatoma, they multiply rapidly in the insect and may readily be found.

In his systematic treatment of the genus, Del Ponte has made a very creditable effort to supply the deficiencies in Neiva's "Revisão." He gives good figures and full descriptions of the half-dozen species known to him (*T. circummaculata*, *T. infestans*, *T. platensis*, *T. rubrovaria*, *T. sordida*, and *T. vitticeps*; and description only of *T. megista*). In addition, he gives a full translation of the best description available (usually that of

Stal) for each of the species, with very few exceptions. Unfortunately his translations are often marred by minor inaccuracies. He has also drawn up a tentative synopsis of 35 species, calling it an "Ensayo de una clave teórica para el gen. Triatoma Lap." (p. 161), and states frankly that it is based very largely on descriptions and hence must be revised by comparison of actual specimens of the various forms. By some oversight, *T. venosa* (Stal) was omitted from his treatment of genus.

The species of *Triatoma*, as given by Neiva and Del Ponte, are listed below. The synonymies and distributions are taken directly from Neiva's "Revisão," and any additions or comments that I have made are enclosed in square brackets.

Genus TRIATOMA Laporte.

1832, Essai Class. Syst. Hémip., p. 11.

Orthotype *Reduvius gigas* Fabr.=*Cimex rubrofasciatus* DeGeer.

Conorhinus Laporte, 1832, op. cit., p. 77.
[?]*Belminus* Stal, 1859, Berlin. Ent. Zeitschr., iii, p. 102.
?*Eratyrus* Stal, 1859, op. cit., p. 103.
Lamus Stal, 1859, op. cit., p. 115.
Panstrongylus Berg, 1879, Hem. Argent., p. 167.
[?*Marlianus* Distant, 1902, Ann. Mag. Nat. Hist. (7), x, p. 191 (haplotype *Conorhinus diminutus* Walk.=*Belminus rugulosus* Stal).]

1. **africana** (Triatoma) Neiva, 1911, Proc. Ent. Soc. Wash., xiii, p. 239, and 1914, Revis. Triatoma, p. 32; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 168.

   Locality: Tropical Africa. Type in Kgl. Zool. Museum, Berlin.

2. **arenaria** (Conorhinus) Walker, 1873, Cat. Heter., viii, p. 18; Neiva, 1914, Revis. Triatoma, p. 33; Del Ponte, 1921, op. cit., p. 169.

   Locality: Brazil (Pará). A doubtful species: not recognized.

3. **brasiliensis** (Triatoma) Neiva, 1911, Brazil-Medico, xxv, p. 461, and 1914, Revis. Triatoma, p. 33; Del Ponte, 1921, op. cit., p. 169.

Locality: Brazil (Rio Grande do Norte: Caicó). Habitat, in nests of the Mocó (*Cerodon rupestris* Wied; Rodentia). Type in Instituto Oswaldo Cruz.

4. **chagasi** (Triatoma) Brumpt & Gomez, 1914, Ann. Paul. Med. Cirurg., iii, No. 4, p. 75; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 169.

Locality: Brazil (Minas Geraes: Serra de Cabral, near Lassance). Habitat, in nests of *Cerodon rupestris* Wied.

5. **circummaculata** (Conorhinus) Stal, 1859, Berl. Ent. Ztschr., iii, p. 114; Neiva, 1914, Revis. Triatoma, p. 35; Del Ponte, 1921, op. cit., pp. 163, 170, fig.

Localities: Uruguay; Argentina.

6. **dimidiata** (Reduvius) Latreille, 1811, in Rec. d'Observ. Zool., Voy. Humboldt et Bonpland, p. 223, pl. xv, fig. 11; Neiva, 1914, Revis. Triatoma, p. 36; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 171.

6a. **dimidiata maculipennis** (Conorhinus) Stal, 1859, Berl. Ent. Ztschr., iii, p. 111; Champion, 1899, Biol. Centr.-Amer., Rhynch.-Het., ii, p. 207, pl. xii, fig. 21 (Conorhinus); Neiva, 1914, Revis. Triatoma, p. 36; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 172.

Localities: Mexico; Honduras; Costa Rica; Guatemala; Nicaragua; Panama; Venezuela; Ecuador; Peru.

7. **flavida** (Triatoma) Neiva, 1911, Brazil-Medico, xxv, No. 44, p. , and 1914, Revis. Triatoma, p. 38; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 172.

Locality: Cuba. Type in U. S. National Museum.

8. **geniculata** (Reduvius) Latreille, 1811, in Rec. d'Obs. Zool., Voy. Humb. et Bonpl., i, p. 225 [Neiva says p. 151], pl. xv, fig. 12; Stal, 1859, Berl. Ent. Ztschr., iii, p. 116 (Lamus); Neiva, 1914, Revis. Triatoma, p. 39; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 173.

   lutulentus (Conorhinus) Erichson, 1848, in Schomberg, Versuch Faun. Flor. Brit. Guiana, iii, p. 614.

   corticalis (Conorhinus) Walker, 1873, Cat. Heter., viii, p. 17.

   Localities: Peru; Venezuela; French Guiana; Brazil; Paraguay. Primitive habitat, nests of *Dasypus novemcinctus* L. (Edentata).

9. **gerstaeckeri** (Conorhinus) Stal, 1859, Berl. Ent. Ztschr., iii, p. 111; Neiva, 1914, Revis. Triatoma, p. 40; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 174.

   Localities: Southern United States; Mexico.

10. **guentheri** (Panstrongylus) Berg, 1879, Hem. Argent., p. 168; Neiva, 1914, Revis. Triatoma, p. 6, in text [not treated in list of species].

    Locality: Argentina.

11. **heidemanni** (Triatoma) Neiva, 1911, Brazil-Medico, xxv, No. 44, p. , and 1914, Revis. Triatoma, p. 41; Del Ponte, 1921, Rev. Inst. Bact. B. A., ii, No. 6, p. 175.

    Localities: Pennsylvania; Tennessee; Illinois; Texas. Type in U. S. National Museum.

12. **howardi** (Triatoma) Neiva, 1911, Proc. Ent. Soc. Wash., xiii, p. 240, and 1914, Revis. Triatoma, p. 43; Del Ponte, 1921, op. cit., p. 175.

    Locality: Tropical Africa. Type in Kgl. Zool. Museum, Berlin.

13. **indictiva** (Triatoma) Neiva, 1912, Brazil-Medico, xxvi, No. 3, p. , and 1914, Revis. Triatoma, p. 44; Del Ponte, 1921, op. cit., p. 175.

Localities: Arizona (Kerville); Texas. Type in U. S. National Museum.

14. **infestans** (Reduvius) Klug, 1834, in Meyen's Reise um die Erde, i, p. 412; Neiva, 1914, Revis. Triatoma, p. 45; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, pp. 164, 176, fig.

renggeri (Conorhinus) Herrich-Schäffer, 1848, Wanz. Ins., viii, p. 71, fig. 838.

sextuberculatus (Conorhinus) Spinola, 1852, in Gay's Hist. Chile, vii, p. 218.

octotuberculatus (Conorhinus) Philippi, 1860, Reis. Atacama, p. 173 (nymph).

paulseni (Conorhinus) Philippi, 1860, op. cit., p. 174. (Nymph.)

gracilipes (Conorhinus) Philippi, 1860, op. cit. p. 174. (Nymph.)

gigas (Conorhinus) Burmeister, 1861 (nec Fabricius), Reise La Plata Staat., i, p. 167.

Localities: Brazil; Bolivia; Paraguay; Uruguay; Argentina; Chile.

15. **lignaria** (Conorhinus) Walker, 1873, Cat. Heter., viii, p. 17; Lethierry et Severin, 1896, Cat. Gén. Hém., iii, p. 117 (Eratyrus); Distant, 1902, Ann. Mag. Nat. Hist. (7), x, p. 192 (Lamus); Neiva 1914, Revis. Triatoma, p. 46; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 177.

Locality: Guiana. [Locality omitted by Neiva, 1914, op. cit.]

16. **maculata** (Conorhinus) Erichson, 1848, in Schomberg, Versuch. Faun. Flor. Brit. Guiana, iii, p. 614; Stal, 1859, Berl. Ent. Ztschr., iii, p. 108 (Conorhinus; as new); Neiva, 1914, Revis. Triatoma, p. 47; Del Ponte, 1921, op. cit., p. 177.

?*nigromaculata* (Conorhinus) Stal, 1872, Enum. Hem., ii, p. 111.

Localities: Venezuela; British Guiana; Brazil.

17. **maxima** (Conorhinus) Uhler, 1894, Proc. Calif. Acad. Sci. (2), iv, p. 286; Neiva, 1914, Revis. Triatoma, p. 48; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 178.

Localities: California; Lower California.

18. **megista** (Conorhinus) Burmeister, 1835, Handb. d. Ent., ii, pt. 1, p. 246; Stal, 1859, Berl. Ent. Ztschr., iii, p. 115 (Lamus); Neiva, 1914, Revis. Triatoma, p. 48; Del Ponte, 1921, op. cit., pp. 165, 179.

porrigens (Conorhinus) Walker, 1873, Cat. Heter., viii, p. 19.

Localities: British Guiana; Brazil.

19. **mexicana** (Triatoma) Neiva, 1912, Brazil-Medico, xxvi, No. 3, p. , and 1914, Revis. Triatoma, p. 50; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 180. [Not *Conorhinus mexicanus* Herrich-Schäffer, 1848, Wanz. Ins., viii, p. 71, figs. 839, 840,=*Meccus mexicanus* (H. S.) Stal, 1859, Berl. Ent. Ztschr., iii, p. 105.]

rubrofasciata (Conorhinus) Champion, 1899 (nec DeGeer), Biol. Centr.-Amer. Rhynch.-Het., ii, p. 208, pl. xii, fig. 22.

Locality: Mexico.

20. **migrans** (Triatoma) Breddin, 1903, Sitz.-Ber. Ges. Naturf. Freunde Berlin, p. 11; Neiva, 1914, Revis. Triatoma, p. 52; Del Ponte, 1921, op. cit., p. 181.

?*phyllosoma* (Conorhinus) Herrich-Schäffer, 1848, Wanz. Ins., viii, p. 70, fig. 837. (Name preoccupied: Burmeister, 1835.)

Locality: Java.

21. **neotomae** (Triatoma) Neiva, 1911, Brazil-Medico, xxv, p. , and 1914, Revis. Triatoma, p. 53; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 181; Schwarz, 1901, Proc. Ent. Soc. Wash., iv, p. 398 (without name).

Localities: Texas; Arizona. Habitat, in nests of *Neotoma albigula* Hardl. and *N. micropus* Baird (Rodentia). Type in U. S. National Museum. [Neiva also gives New Mexico and California; but the data for this species and for *T. uhleri* appear to have been confused.]

22. **nigromaculata** (Conorhinus) Stal, 1872, Enum. Hem., ii, p. 111; Neiva, 1914, Revis. Triatoma, p. 55; Del Ponte, 1921, op. cit., p. 182.

variegata (Conorhinus) Stal, 1859 (nec Drury), Berl. Ent. Ztschr., iii, p. 113; Walker, 1873, Cat. Heter., viii, p. 18

?=*maculata* Erichson 1848.

Locality: Venezuela. Type specimen not found.

23. **occulta** (Triatoma) Neiva, 1911, Brazil-Medico, xxv, p. , and 1914, Revis. Triatoma, p. 56; Del Ponte, 1921, op. cit., p. 182.

discipennis (Conorhinus) Stal, MS. (Berlin Museum.)

Locality: Texas. Type in Kgl. Zool. Museum, Berlin.

24. **ocellata** (Triatoma) Neiva, 1914, Revis. Triatoma, p. 55; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 182.

Locality: Arizona (Mohave). Type in U. S. National Museum.

25. **platensis** (Triatoma) Neiva, 1913, Anal. Mus. Nac. Buenos Aires, xxiv, p. 197, and 1914, Revis. Triatoma, p. 57; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, pp. 165, 183, fig.

Locality: Argentina (Pampa central). Type in Museo Nacional de Buenos Aires.

26. **protracta** (Conorhinus) Uhler, 1894, Proc. Calif. Acad. Sci. (2), iv, p. 284; Neiva, 1914, Revis. Triatoma, p. 58; Del Ponte, 1921, op. cit., p. 183.

Localities: Utah; California; Lower California.

27. **recurva** (Conorhinus) Stal, 1868, Hem. Fabr., i, p. 124; Neiva, 1914, Revis. Triatoma, p. 59; Del Ponte, 1921, op. cit., p. 184.

Locality: Brazil.

28. **rubida** (Conorhinus) Uhler, 1894, Proc. Calif. Acad. Sci. (2), iv, p. 285; Neiva, 1914, Revis. Triatoma, p. 59; Del Ponte, 1921, op. cit., p. 184.

Locality: Lower California.

29. **rubrofasciata** (Cimex) DeGeer, 1773, Mém. Hist. Ins., iii, p. 349, pl. xxxv, fig. 12; Neiva, 1914, Revis. Triatoma, pp. 20-32; Del Ponte, 1921, op. cit., p. 162.

gigas (Reduvius) Fabricius, 1775, Syst. Ent., p. 729.

erythrozonias (Cimex) Gmelin, 1788, Syst. Nat. Edn. 13, i, pt. 4, p. 2181.

?*phyllosoma* (Conorhinus) Herrich-Schäffer, 1848, Wanz. Ins., viii, p. 70, fig. 837. (Name preoccupied, Burmeister, 1835.)

stalii (Conorhinus) Signoret, 1861, Ann. Soc. Ent. France (3), viii, p. 967.

rubrovarius (Conorhinus) Stal, 1868, *partim*, Hem. Fabr., i, p. 124.

[*rufofasciata* (Triatoma) Van Duzee, 1916, Check-List Hem. N. Amer., p. 29, No. 742; and 1917, Cat. Hem. N. Amer., p. 248. 742.]

Localities: China; Formosa; Philippines; Borneo; New Guinea; Tonga; Java; Sumatra; Singapore; Malay Peninsula; Indo-China; India; Andaman Islands; Ceylon; Seychelles; Mauritius; Madagascar; Zanzibar; Angola; Sierra Leone; Azores; Haiti; St. Thomas; French Guiana; Brazil; Argentina; Hawaii. [Not United States!]

30. **rubrovaria** (Conorhinus) Blanchard, 1843, in D'Orbigny, Voy. dans l'Amér. mérid., vi, pt. 2, p. 219, pl. xxix, fig. 7; Stal, 1868, Hem. Fabr., i, p. 124

(*partim*) (Conorhinus); Neiva, 1914, Revis. Triatoma, p. 60; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, pp. 166, 185, fig.

rubroniger (Conorhinus) Stal, 1872, Enum. Hem., ii, p. 112.

Localities: Brazil; Uruguay. (Not Java!)

31. **rufotuberculatus** (Lamus) Champion, 1899, Biol. Centr.-Amer., Rhynch.- Het., ii, p. 210, pl. xii, figs. 27, 27a; Neiva, 1914, Revis. Triatoma, p. 61; Del Ponte, 1921, op. cit., p. 186.

Locality: Panama.

32. **rugulosa** (Belminus) Stal, 1859, Berl. Ent. Ztschr., iii, p. 102; Neiva, 1913, Mem. Inst. Osw. Cruz, v, p. 74 (Triatoma), and 1914, Revis. Triatoma, p. 62; Del Ponte, 1921, op. cit., p. 187.

diminutus (Conorhinus) Walker, 1873, Cat. Heter., viii, p. 19; Distant, 1902, Ann. Mag. Nat. Hist. (7), x, p. 191 (Marlianus).

Localities: Costa Rica; Colombia; Venezuela.

33. **sanguisuga** (Conorhinus) Leconte, 1855, Proc. Acad. Nat. Sci. Phila., vii, p. 404; Neiva, 1914, Revis. Triatoma, p. 63; Del Ponte, 1921, op. cit. p. 188.

lateralis (Conorhinus) Stal, 1859, Berl. Ent. Ztschr., iii, p. 107.3.

lecticularius (Conorhinus) Stal, 1859, op. cit., 107.2.

lenticularius (Conorhinus) Stal, 1868, Hem. Fabr., i, p. 124.

variegatus (Conorhinus) Stal, 1872 (nec Drury), Enum. Hem., ii, p. 111; Uhler, 1876, Bull. U. S. Geol. Geogr. Surv., i, p. 331; and other North American authors.

ambigua (Triatoma) Neiva, 1911, Brazil-Medico, xxv, p. 422 (as variety of *sanguisuga*).

Localities: Maryland; Florida; Texas; Argentina (Misiones, in coll. Berg, Mus. La Plata).

34. **sordida** (Conorhinus) Stal, 1859, Berlin. Ent. Ztschr., iii, p. 108; Neiva, 1914, Revis. Triatoma, p. 66; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, pp. 167, 188, fig.

Localities: Brazil; Bolivia; Uruguay; Argentina.

35. **tennuis**[1] (Triatoma) Neiva, 1914, Mem. Inst. Osw. Cruz, vi, fasc. 1, p. 35; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, p. 189.

Locality: Brazil (Bahia).

36. **uhleri** (Triatoma) Neiva, 1911, Brazil-Medico, xxv, p. , and 1914, Revis. Triatoma, p. 66; Del Ponte, 1921, op. cit., p. 190.

Localities: Texas; New Mexico; Arizona; California. Type in U. S. National Museum.

37. **variegata** (Cimex) Drury, 1770, Illustr. Exot. Entom., i, p. 109, pl. xlv, fig. 5; Neiva, 1914, Revis. Triatoma, p. 68; Del Ponte, 1921, op. cit., p. 190.
?*claviger* (Cimex) Gmelin, 1788, Syst. Nat. Edn. 13, i, pt. 4, p. 2179.

Locality: Antigua. (An unrecognized species, possibly synonymous with *T. rubrofasciata.*)

38. **venosa** (Conorhinus) Stal, 1872, Enum. Hem., ii, p. 111; Neiva, 1914, Revis. Triatoma, p. 70. [Omitted by Del Ponte.]

Localities: Costa Rica; Panama; Colombia.

39. **vitticeps** (Conorhinus) Stal, 1859, Berl. Ent. Ztschr., iii, p. 109; Neiva, 1914, Revis. Triatoma, p. 71; Del Ponte, 1921, Rev. Inst. Bact. Bs. Aires, ii, No. 6, pp. 168, 191, fig.

Locality: Brazil (Rio de Janeiro).

[1]So written by Del Ponte. The Zoological Record for 1914 writes *T. tenuis.*

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PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

At the meeting of October 11, 1920, Prof. W. M. Wheeler read a paper by himself and Mr. L. H. Taylor on parasitism of *Vespa arctica* upon *Vespa diabolica* which was published in December 1921. A discussion followed on parasitism in general and especially the habits of *Stylops* in *Andrena*, *Halictus* and other Hymenoptera.

Dr. R. Heber Howe showed remains of beetles from peat deposits at Eastham, Cape Cod, Mass., between layers of glacial till and too far away from present outcrops to be of recent origin.

At the meeting November 8, Mr. L. B. Uichanco read a paper on the development of certain unicellular organisms which live symbiotically in the bodies of Aphids. These are found in the ovaries and enter the eggs at an early stage. Later

they increase in number in a mass of cells in the middle of the embryo which becomes divided in two and in the newly hatched Aphid forms a pair of conspicuous organs. The paper was illustrated by numerous drawings.

Mr. Roland Hussey showed specimens of *Scaptocoris castaneus* from Venezuela belonging to a tropical group of the Hemipterous family Cydnidæ in which the hind tibia is swollen and truncate and the tarsus absent while the front tibia is prolonged by the fusion of the apical spines much beyond the insertion of the tarsus and the latter is much reduced in size.

Mr. F. W. Dodge showed 125 species of the coleopterous family Meoidæ, part of the collection of the late Mr. Fuchs of California.

At the meeting of December 13, Prof. C. T. Brues showed several rare wingless Hymenoptera of unknown habits, one a species of Pedinomma Westw. and another of the genus Algoa.

J. H. Emerton exhibited his portable collection of two hundred species of native spiders illustrated by charts, drawings and photographs of cobwebs.

Mr. F. W. Dodge exhibited a collection of beetles of the family Coccinellidæ.

The annual meeting was held January 10, 1922. The Secretary's report shows than ten meetings were held during the past year with average attendance of nineteen persons. Four new members were elected and the present membership numbers sixty-nine. The following officers for 1922 were elected: President, Wm. M. Wheeler; Vice president, L. R. Reynolds; Secretary, J. H. Emerton; Treasurer, Fred H. Walker; Editor, C. T. Brues; Executive committee, Nathan Banks, S. W. Denton, L. W. Swett.

Mr. Nathan Banks in retiring from the presidency addressed the Club on the value of field observation and the importance of careful records and prompt publication. He thought much valuable work was lost through failure to appreciate its importance, and through timidity in failing to publish what had been discovered. Observers should not be tempted to wait too long for perfection, as completion of their investigations in such things

are of necessity imperfect and must be revised and republished as knowledge improves.

Mr. R. Heber Howe spoke of the genus Gompus in New England. There are 22 species but only two, *exilis* and *spicatus*, are common. Other species, usually rare, occur at some seasons in great abundance owing perhaps to the period of two or three years passed in development.

Mr. J. H. Emerton gave a short account of the meetings of the American Association for the Advancement of the Science at Toronto during Christmas week.

At the meeting of February 14 Mr. O. E. Plath continued his account of the habits of Bombus begun at the September meeting, by reading a paper on the genus Psithyrus and its habits in the Bombus nests which he had under observation the past summer.

The accepted design for a Club Seal was shown and now appears on the cover of Psyche.

CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p. m. at the Bussey Institution, Forest Hills, Boston. The Bussey Institution is one block from the Forest Hills station of both the elevated street cars and the N. Y., N. H. & H. R. R. Entomologists visiting Boston are cordially invited to attend.

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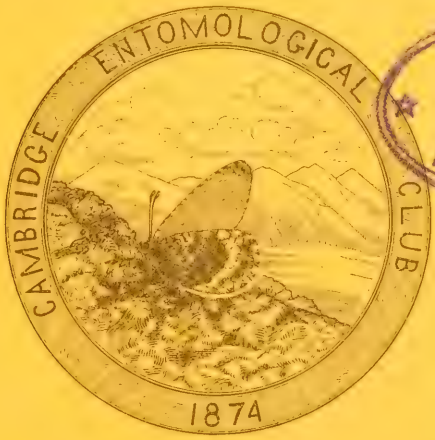

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POSSIBLE PEDOGENESIS IN THE BLOW-FLY, *Calliphora erythrocephala* MEIGEN.

By G. H. Parker.

Zoölogical Laboratory, Harvard University.

In the early autumn of 1918 I prepared a number of cultures of larvae of the common blow-fly, *Calliphora erythrocephala*, and in several of these cultures the numbers of maggots seemed to exceed considerably the numbers of eggs that had been introduced. This aroused the suspicion that some unusual form of multiplication such as polyembryony or pedogenesis was occuring and to test this definite experiments were attempted.

On November 25, 1918, thirty bottles closed with aluminum caps through each of which a minute hole had been punched, were supplied with small pieces of fish-meat carefully inspected to see that they carried no fly eggs. In each of twenty of these bottles a single blow-fly egg was placed, ten bottles having been retained as checks. On December 9, 1918, all these bottles were carefully examined. Seven of the infected bottles contained no maggots, ten contained each one maggot, one contained two maggots, another three, and a third four. One of the check bottles, however, contained nine small maggots showing that the procedure that had been followed was defective. Either unseen eggs had been accidentally introduced with the meat, or flies had slipped eggs into the bottle through the small hole in the cap. Hence the increased numbers in several of the infected bottles could not be said to be due to multiplication within the bottle itself and this type of test was, therefore, abandoned.

In the spring of 1919, with the return of the flies, a new procedure was employed. Fifty clean quart jars were prepared by pouring into them enough coarse sand to cover their bottoms. This sand had previously been sterilized by baking. Into each

jar was then introduced a small glass beaker containing a bit of carefully inspected fish meat. The jar was then closed by having mosquito netting tied over its open end and by setting in place on this netting the glass cover of the jar without, however, clamping it down. Thus it was believed that the jars were effectively protected against the introduction of eggs from the outside and that the gases generated by the decomposing meat within could escape. Fluid could be introduced into the jar by removing the glass top and pouring it in through the meshes of the netting without, however, allowing the accidental entrance or escape of flies should there be any at hand. The fish-meat in the jars was not sterilized by cooking, for it was found to decompose much more freely and satisfactorily when uncooked.

The fifty jars thus prepared were set aside April 2, 1919, and allowed to stand twenty days. After this period a searching inspection showed that none of them contained maggots. These would surely have been seen had they been introduced by accident with the meat. On April 23 twenty-five jars were infected each with a single fly egg and the remaining twenty-five were held unchanged as checks. From time to time during the next few weeks a small amount of distilled water was poured into each jar but otherwise the jars remained closed for this period. On May 14 the contents of the jars were examined. The twenty-five jars used as checks contained no evidence of flies. In the twenty-five infected jars seven were without maggots or pupæ and eighteen contained each a single pupa. Thus there was no evidence of increase. A second trial carried out in the same way in May and June yielded similar results.

In the autumn of 1919 tests were resumed. These were of two kinds, one to ascertain what hatched from an individual egg and the other to find out what came from the larva. To determine what came from a single egg, twenty eggs on October 29 were put with a few drops of water each into a separate Syracuse watch-glass. Twelve of these had hatched by October 30 and each produced a single larva. Eight failed to hatch probably because of mechanical injury. Between October and the end of

December, 1919, 502 eggs were hatched in this way and in no instance did an egg produce more than a single larva. It was therefore concluded that Calliphora gave no evidence of polyembryony such as has been found so abundantly in certain hymenopters.

To test again the possible production of maggots from other maggots, the experimental procedure of April 2, 1919, was repeated. On October 2, fifty jars were set up with fish-meat. They were examined on October 28 and were found to contain no maggots. On the next day into each of twenty-five of these jars a single newly hatched maggot was introduced and the remaining twenty-five were kept as checks. On November 10 an examination of the jars showed no maggots in the twenty-five check jars, no maggots in three of the infected jars, probably because of accidental death, one maggot each in twenty of the infected jars, eight in one infected jar, and twenty-one in another. The maggots in the last two jars were carried on to pupation and hatched. All proved to be Calliphora erythrocephala. Of the eight in the first jar, five were males and three were females. Of the twenty-one in the second jar, five failed to hatch, nine emerged as males and seven as females.

On October 18, a second set of fifty jars was started in the same way as in the preceding test. On November 15 these jars were examined and found to contain no maggots showing that they had not been accidentally infected. Into each of twenty-five of them a single newly hatched maggot was introduced and the jar closed. On November 26 pupation was completed and an examination of the set showed that the twenty-five check jars were without pupæ as well as six of the infected jars; eighteen of the infected jars contained each a pupa, and one contained seven. These seven were subsequently hatched and all proved to be *Calliphora erythrocephala,* four females and three males.

The tests of October 2 and October 18 were carried out with such precautions that it seems impossible that the results could be due to accident. The increases observed have always occured in the autumn and never in the spring and I am, therefore, led to believe that in October and November or even later

Calliphora erythrocephala occasionally multiplies in an unusual way, and that this way is not polyembryony but pedogenesis.

At the appropriate season it is planned to conduct an investigation of the maggots of Calliphora to ascertain whether they contain parthenogenetic eggs or young. If they do, the blow-fly will constitute another instance among insects of pedogenesis. The original and best known case of this kind is that of the fly Miastor and its allies discovered by Wagner (1862, 1865) and studied by Kahle (1908) and by Felt (1911). Less clear is the case of Chironomus reported by Grimm (1870) and of its near ally Tanytarsus observed by Johannsen (1910). All these are Dipterans but within a few years Barber (1913a, 1913b) has claimed an instance, Micromalthus, among the beetles. The wingless female aphids must also be regarded as pedogenetic. Possibly this form of reproduction is more generally spread among insects than was originally supposed.

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ON SOME TROPHOBIOTIC COCCIDÆ FROM BRITISH GUIANA.[1 2]

By Harold Morrison.

Bureau of Entomology, Washington, D. C.

Representatives of all of the species of Coccidæ discussed in the following pages were collected by Dr. W. M. Wheeler of Bussey Institution, Harvard University, in the course of his investigatoins at the Tropical Research Station of the New York Zoological Society in British Guiana and were recently submitted to the writer for determination. Critical study of the material available for examination in the National Collection of Coccidæ has shown that two of these species have also been collected in certain of the West Indian islands by the writer and others, and this opportunity has been taken to add these records to those from British Guiana.

SUBFAMILY MARGARODINÆ

GENUS STIGMACOCCUS HEMPEL.

Stigmacoccus asper (Hempel)

A number of specimens of this species were received with the following note by Dr. Wheeler:

"No. 757. Kartabo, B. G. Sept 5, 1920. Taken from a huge colony of *Crematogaster* sp. (near *acuta* Fabr.) nesting under bark of a large standing tree. The nest covered an area of more than 12 square feet and contained several hundred coccids enveloped in black carton. The young coccids were golden yellow, the older darker."

[1]Published with the permission of the Secretary, U. S. Department of Agriculture.

[2]—The intimate relations described—as existing between ants on the one hand and the various Homoptera—on the other hand—have a common peculiarity. In all of these cases the ants are supplied with food in the form of an excretion or secretion elaborated from the juices of the plants. Wasmann has therefore designated these relationships as *trophobiosis* to distinguish them from the cases of myrmecophily proper—." (Wheeler, Ants, etc. New York, Columbia Univ. Press, 1013, p. 360).

Only preadult specimens and one partially molted adult could be located in the material submitted, and mounts of such specimens have been carefully compared with the corresponding stages from cotype material received by the Bureau of Entomomology from Prof. Adolph Hempel, the describer of the species. Some slight differences in the length and stoutness of the heavy spines crowding the derm of the preadult have been observed, but no other morphological characters that even suggest that the specimens from British Guiana represent another species than *S. asper*. In the absence of other stages, as larvae and well developed females and males, in which specific differences might appear, it seems best to regard the specimens from British Guiana as Hempel's species.

SUBFAMILY DACTYLOPIINÆ

GENUS PSEUDOCOCCUS WESTWOOD

Pseudococcus bromeliae (Bouché)

References.—Ferris, Journ. Econ. Ent. vol. 12. no. 4, Aug. 1919, p. 196—Morrison, Phil. Journ. Sci. vol. 17, no. 2, Aug. 1920, p. 173.—Cockerell, Science n.s. vol. 55, no. 1492, 1922, p. 351.

After extended critical study the writer has placed as this species the material from Dr. Wheeler's collections listed below together with his notes on the same.

"No. 116. Kartabo, B. G. July 17, 1920. In the cavities of the stems of a seedling *Cecropia* (*angulata* I. W. Bailey). The ants belonged to a black species of *Azteca* not yet identified."

"No. 247. Kartabo, B. G. July 23, 1920. The coccids were in the hollow bases of the leaf-petioles of a *Tachigalia paniculata* Aublet with a black species of *Azteca* (*Azteca foveiceps* Wheeler)."

"No. 367. Kartabo, B. G. Aug. 3, 1920. In node-like stem swellings of *Cordia nodosa* Lani. var. *hispidissima* Freser, with the ant *Brachymyrmex* sp. (probably *heeri* Forel)."

No number. "Kartabo, July-Aug. 1920. In the swellings

of the stems of *Cordia nodosa* Lani. var. *hispidissima* Freser, with *Allomerus octoarticulatus* Mayr, the typical ant of this myrmecophyte."

Nos. 209 and 175 have previously been identified in connection with Dr. Wheeler's extended account of the curious social beetles which he found in this region.

An exmination of these specimens in comparison with an extensive series of individuals from many other tropical and subtropical areas has indicated that this species is subject to a certain degree of variation in respect to the structural characters that are at present regarded as of taxonomic value, this variation occuring particularly in the number of spines in the different marginal cerarii, the shape of the ventral chitinized area at the caudal apex of the body, and the number of antennal segments.

In the specimens collected by Dr. Wheeler the cerarian spines average slightly more numerous for corresponding cerarii than in typical forms from pineapple, that is, for example, in the same cerarius in ten specimens instead of, say, four having four spines and the other six, three spines each, the proportions may be six with four spines and four with three spines to each. The chitinized ventral thickening in nearly all of the specimens from pineapple is irregularly quadrate, at most only slightly longer than wide, but in the specimens from Dr. Wheeler, while the variation is marked, the average shape of each thickening is distinctly elongate, in this respect more nearly resembling the shape as figured by Ferris (ref. cited) for the species than the usual shape in the specimens from pineapple. The accompanying figure indicates this variation quite clearly. Finally, *P. bromeliæ* normally has 8-segmented antennæ, while in a majority of the specimens sent by Dr. Wheeler these are 7-segmented; however, since these specimens show a range of from six to eight segments there seems no ground for attaching any taxonomic significance to the presence of one less segment in the majority of the antennæ examined.

Prof. Cockerell (ref. cited) has recently called attention to the fact that the identification by modern coccidologists of the mealybug commonly occuring on pineapple as the "Coccus

bromeliæ" of Bouché rests on a very unstable basis due to the ambiguity of the original description. As a matter of fact, it appears to be entirely impossible to determine positively what species was described by Bouché under this name, and our present notion of the species really dates from Signoret's redescription in 1875. As Prof. Cockerell suggests, his "*Dactylopius brevipes*" described from Jamaica on pineapple is identical with the species at present recognized as *P. bromeliæ*, but as *Pseudococcus brevipes* has never attained any standing among coccid workers, while several at present recognize and identify a certain mealybug as *P. bromeliæ*, the writer has preferred to retain the older name regardless of the uncertainty as to what was actually described by Bouché, at least until his species is clearly shown to be something other than the one at present given the name *bromeliæ*.

Pseudococcus rotundus sp. nov.

Occuring in cavities in stems of the host, attended by ants.

Adult Female.—All specimens available preserved in liquid, so nothing regarding normal external appearance can be given; maximum length as mounted 3 mm., maximum width 2.75 mm., specimens in preservative proportionately somewhat more elongate, flattened beneath but strongly convex above; derm clearing completely on treating with potassium hydroxide, except for the appendages and the ventral chitinized areas; antennae normally 8-segmented, not unusual, the range of measurements in microns of segments in four individuals as follows: I, 72-79; II, 68-79; III, 54-64; IV, 36-46; V. 46-54; VI, 43-57; VII, 50-54; VIII, 107-114; legs normal, stout, hind femur and tibia with numerous tiny pores, those on femur frequently clustered, digitules probably normal, but all injured, claw stout, without denticle; beak elongate triangular, with a narrow basal collar and two much larger, distinct segments; with the usual two pairs of dorsal ostioles; normally with 17 pairs of cerarii each composed of spines with accessory setæ and a cluster

of triangular pores, but some of those on the thorax often greatly reduced or entirely wanting; the numbers of spines in the different cerarii showing the following range in four specimens: I (anterior), 3-4; II, 3-4; III, 2-3; IV, O-3; V, 1-3; VI, O-2; VII, 1-5; VIII, O-2,; IX, 2-4; X, 2-4; XI, 3-4; XII, 2-4; XIII, 2-4; XIV, 4-5; XV, 4-5; XVI, 6-9; XVII (anal lobe), 11-22; in mounted specimens, with the posterior two or three cerarii on each side dorsal and the remainder ventral; apex of abdomen not produced into lobes; ventral chitinous thickening elongate, bearing several setæ; apical setæ about 145μ long; longest and anal ring seta about 93μ long; anal ring of normal form and construction, with inner and outer rows of pores but with the setæ more numerous than in other species of the genus, there being three larger primary setæ and from five to ten smaller supplementary setæ on each half of the ring,the smaller setæ about half the length of the larger; dorsally with small triangular pores only, these scattered rather uniformly over the surface except along the body margin and at the cerarii where they are more numerous; ventrally with the triangular pores over most of the surface, with a few large, circular, multilocular disk pores around the genital opening, with two median transverse rows of tiny tubular ducts just anterior to these, and with a very few disk pores at the spiracular openings; cerarian spines conical, varying greatly in size; body with numerous, but scattered, slender setæ, these averaging larger dorsally and most abundant along the body margin; with a single, large, quadrate median ventral cicatrix posterior to the hind legs.

Immature Stages.—None available for examination.

This species has been described from five specimens with the following data, according to Dr. Wheeler's notes:

"No. 87. Barakara, B. G. July 15, 1920. In the cavities of the stems of *Cecropia angulata* I. W. Bailey. The ants in this *Cecropia* were a species of *Azteca* not yet identified." (Holotype).

"No. 89. Barakara, B. G. July 15, 1920. In the cavities of

the stems of *Cecropia angulata* I. W. Bailey. The ants belonged to a species of *Azteca* not yet identified." (Paratypes).

No number. "Kartabo, B. G. August 1920. In stems of *Cecropia* with *Azteca* sp. (Paratypes).

The types are in the U. S. National Collection of Coccidæ.

The proliferation of the anal ring setæ in this species is a marked digression from the normal condition in the genus *Pseudococcus* and might be regarded as of sufficient importance to justify the separation of the species from that genus. However, most, if not all, of the other structural characters of the species appear to be characteristic of *Pseudococcus* and it has therefore been placed in that genus.

Genus **Farinococcus,** gen. nov.

A member of the group of which *Pseudococcus* is the typical genus; body oval, antennæ 8-segmented, legs normal, without tiny pores, claw without denticle, beak short triangular, 2-segmented, spiracles stout with large opening and numerous disk pores near mouth, two pairs of dorsal ostioles, cerarii very large, composed of many lanceolate spines, setæ and pores and joined into a continuous band anteriorly; anal lobes not developed, with ventral chitinized thickening and apical seta, anal ring normal, with pores and six setæ, derm with triangular pores dorsally and ventrally and many multilocular disk pores ventrally in genital region, no other pore types, derm with slender setæ dorsally and ventrally, with a single median ventral cicatrix. *Genotype.—Farinoccusus multispinosus, sp. nov.*

This genus diverges from the normal Pseudococcine type most conspicuously in the marked development of the cerarii and the great increase in the number of ventral disk pores, and, to some extent, in the enlargement of the spiracles.

Farinococcus multispinosus sp. nov.

Occuring in cavities in the stems of the host.attended by ants.

Adult female.—Preserved in liquid, so nothing regarding the normal external appearance can be given; color of alcoholic

specimens mostly a light yellow brown; body elongate oval, tapering somewhat behind the middle; average length 3.5 mm., width 2.25 mm; uniformly elongate oval when flattened on a slide; clearing completely, except for appendages and ventral chitinized thickenings, on treating with potassium hydroxide; antennæ normally 8-segmented, not unusual, the range of measurements in microns of the different segments as follows: I, 68-78; II, 64-71; III, 46-53; IV, 28; V, 43-57; VI, 43; VII, 46; VIII, 110-118; legs fairly large, stout, the claw without denticle, the digitules normal, those of claw slightly knobbed at tip, all the legs without tiny pores, but all the coxæ with large distinct basal aerolations, and the femora and tibiæ with similar, but quite indistinct, very large aerolations on the upper halves of each; beak short and stout triangular, two segmented; spiracles large and stout, with a number of disk pores near mouth; with two pairs of heavy, thick-lipped dorsal ostioles, cerarii very strongly developed, those on the posterior abdominal segments narrowly but distinctly isolated from each other, those on the anterior portion of the body united to form a narrow continuous submarginal band made up of hundreds of closely crowded lanceolate spines and triangular pores flanked within by dozens of slender setæ aggregated to form more or less distinct groups; posterior cerarii made up of numerous lanceolate spines (apical about 70, preapical about 85, antepenultimate about 80, fourth from last about 70, next about 65, next about 55) and within each of these ventrally a triangular cluster of setæ and in and around both spine and setæ clusters numerous triangular pores; anal lobes not developed, ventral chitinous thickening heavily chitinized, irregular in shape, enclosing three or four setæ; apical setæ set off just outside the ventral thickening, large and stout as compared with the anal ring setæ, perhaps three times the length of these (broken); anal ring placed dorsally well anterior to the body apex, small, of normal structure, with double pore row and six setæ, the derm on each side of the ring protruding and overlapping to form two longitudinal folds covering the ring, except for a linear or oval median slit; derm dorsally with numerous, uniformly distributed,

triangular pores, ventrally with these pores less numerous, but also uniformly distributed, except at and near the body margin, where they are closely crowded, with numerous large circular multilocular disk pores in a heavy collar around the genital opening and in transverse bands on three segments anterior to genital collar, and quinquelocular disk pores of approximately the same size as the genital pores in numbers at the spiracles; no other pore sorts located: dorsally and ventrally with numbers of scattered, slender, faintly lanceolate setæ: with a single large quadrate median ventral cicatrix posterior to the hind legs.

Preadult female.—In general resembling the adult quite closely, differing in the smaller size, the 7-segmented antennæ, the smaller and less developed spiracles, the reduced numbers of spines, setæ and pores in the cerarii and the very great reduction in the number of ventral disk pores.

No other stages have been available for examination.

This species has been described from four mounted and a few unmounted specimens received from Dr. Wheeler with the following note:

"In the cavities of the stems of *Triplaris surinamensis* Chanc. with *Pseudomyrma* sp. nov. (allied to *Ps. triplaridis* Forel.)"

The types are in the U. S. National Collection of Coccidæ.

GENUS RIPERSIA SIGNORET

This genus is at present merely a convenient dumping ground for those species of mealybugs having the number of antennal segments reduced and the cerarii usually much reduced in number or even wanting. Until the genera of the true mealybugs are based on an adequate morphological foundation, little else can be done with apparently new species than to place them in some such convenient genus as this one, and it is on this basis that the two species described below have been assigned to a position here.

Ripersia petiolicola sp. nov.

Occuring in the hollow bases of the leaf petioles of the host, attended by ants.

Adult Female.—Preserved in liquid leaving none of the secretionary covering available for examination, average length as mounted, 1.3 mm., width 0.875 mm; clearing completely on treating with potassium hydroxide, except for the appendages; antennæ small, placed fairly close together at anterior apex of head, not unusual, normally 6-segmented, but frequently 5 and rarely 4-segmented, the normal measurements in microns ranging as follows: I, 33-39. II, 29-36; III, 36-43; IV, 18-25, V, 18-25; VI, 50-61; legs normal, fairly stout, claw without denticle, hind femur and tibia each with a number of pores; beak triangular, with an incomplete basal collar and two distinct segments; with the usual two pairs of dorsal ostioles; only the two anterior and the two posterior cerarii developed to a definitely recognizable state, the anal pairs with relatively large conical spines, several triangular pores and four to six accessory setæ, the spines in the other recognizable cerarii slender, lanceolate, setalike, the pores less numerous and the accessory setæ fewer or wanting; probably with a more or less complete series of cerarii around the body margin, but these not definitely recognizable, due to the separation of the component parts; anterior cerarii with three spines in each, all others with two; anal lobes slightly indicated, with the apical cerarii underlaid by a faint suggestion of chitinization, with a small, irregular, elongate ventral thickening and an apical seta about 100μ long; largest anal ring seta about 78μ; anal ring normal with the usual pores and six setæ; body, as far as noted, with only two sorts of derm pores, a few multilocular disk pores around the genital opening and smaller triangular pores scattered rather uniformly over the surface, but more numerous along the margin and in the cerarii; body dorsally with some scattered, slender, lanceolate setæ and ventrally with even fewer, distinctly longer and more slender, hair-like setæ; with a single, indistinct, transverse oval ventral cicatrix posterior to the hind legs.

Immature stages.—None available for examination.

This species has been described from three specimens having the following collection data according to Dr. Wheeler's notes:

"No. 247. Kartabo, B. G. July 23, 1920. The coccids were in the hollow bases of the leaf-petioles of a *Tachigalia paniculata* Aublet with a black species of *Azteca* (*Azteca foveiceps* Wheeler.)"

The types are in the U. S. National Collection of Coccidæ.

Ripersia subcorticis sp nov.

Occuring under the bark of the host, attended by ants.

Adult Female.—Preserved in fluid, so nothing regarding the normal external appearance can be given; color of alcoholic specimens ranging from yellow brown to dull purple, but usually with a purple tinge; stout oval, flattened beneath, fairly convex above, average length of mounted specimens 2 mm., width 1.5 mm; clearing completely, except for appendages, on treating with potassium hydroxide; antennæ not unusual, normally 7-segmented, but frequently with six, the range of measurements in microns of those available for examination as follows: I, 47-54; II, 39-50; III, 25-35; IV, 22-32; (III and IV where combined, 57-61), V, 22-29; VI, 28-32; VIII, 71-82; legs normal, the claw without denticle, the hind coxa, but not the femur and tibia, with a number of pores; beak elongate triangular, with an obscure basal collar and two distinct segments; with the usual two pairs of dorsal ostioles; cerarii, as such, not distinctly developed, but with loose marginal or ventral submarginal clusters of slender, conical to slightly lanceolate spines, accompanied by a closer grouping of the small triangular pores, these clusters distinctly isolated on the posterior abdominal segments, but forming an almost continuous but inconspicuous band around the anterior margin of the body; anal lobes barely indicated, the apical seta immediately adjacent to the posterior cluster of spines, length not certain, probably about one and a half times that of the anal ring setæ, without any trace of ventral chitinous thickenings; derm dorsally with only the small tri-

angular disk pores, these scattered rather uniformly over the body surface; ventrally with these pores distributed uniformly except at margin close to and in the "cerarii," with some large circular, multilocular disk pores around the genital opening and in narrow transverse rows on the two segments anterior to this, with a very few, tiny tubular ducts near the genital opening and with much larger, short tubular ducts in clusters just within the "cerarii" on the last five or six abdominal segments, these ranging from four to eight in number in the three clusters anterior to the apical but with only one or rarely two in the one or two anterior groups, the apical group median, usually with about twelve pores in it; derm dorsally with fairly uniformly scattered, very slender, lanceolate setæ, ventrally with longer, slender hair-like setæ; anal ring of normal form, with inner and outer rows of pores and with three primary and usually four smaller, secondary setæ on each half, longest anal ring seta about 110μ; with a single median quadrate ventral cicatrix posterior to the hind legs.

Immature stages.—None available for examination.

This species has been described from four mounted and a few unmounted specimens collected by Dr. Wheeler with the following note:

"No. 79. Barakara, B. G. July 15, 1920. Taken in a large colony of the ant *Tranopelta gilva* Mayr, under the bark of a living tree. The white coccids were present in great numbers over the whole surface of the wood. The ant is usually subterranean, its nest under bark being very exceptional."

The types are in the U. S. National Collection of Coccidæ.

In the multiplication of the anal ring setæ is found a condition exactly comparable to that in *Pseudococcus rotundus*, just described, and it is also similar to the structural modifications of the anal ring in certain other related forms known to be protected and attended by ants, such as *Lachnodiella cecropiæ*, suggesting the possibility that the relationship between the ant and mealybug may have had some influence on the modification in structure.

SUBFAMILY COCCINÆ.

GENUS AKERMES COCKERELL

Following Prof. Newstead's lead, the two species discussed below are continued in the genus *Akermes*, although a comparison of the two with the genotype raises a very serious question as to the correctness of such generic association.

Akermes quinquepori (Newstead)

Reference.—Newstead Bull. Ent. Res. vol. 7, 1917, p. 349.

This species is represented in the material submitted by Dr. Wheeler by three lots of specimens. Dr. Wheeler's notes in regard to these are as follows:

"No. 76. Barakara, B. G. July 15, 1920. Found in a large colony of ants (*Camponotus novogrenadensis* Mayr) which had their nest within that of *Hamitermes excellens* Emerson (MS.) in the bark of a large standing tree. The galleries of the ants interdigitated but did not communicate with those of the termites. The coccids were in the ant galleries and attached in great numbers and in all stages to the surface of the tree itself. It was difficult to remove them without breaking them. A large piece of the inner bark with the coccids was removed with large coccids attached to it. The insects were seen to exude copious drops of clear honeydew from the brown anus on the dorsal surface."

"No. 87. Barakara, B. G. July 15, 1920. In the cavities of a stem of a *Cecropia angulata* I. W. Bailey. The ants in this *Cecropia* were a species of *Azteca* not yet identified."

"No. 164. Kartabo, B. G. July 17, 1920. In the cavities of the stems of a seedling *Cecropia* (name to be supplied later). The ants belonged to a black species of Azteca not yet identified."

Through the kindness of Mr. G. E. Bodkin in locating the same, the writer was given the opportunity of collecting specimens of Prof. Newstead's species from the same tree and the same ant nest that produced the individuals described by him

(Collection Nos. A-733 and A-761), and Dr. Wheeler's specimens have been compared directly with these. The specimens from lots No. 76 and No. 164 are entirely comparable with the topotype specimens except for their slightly larger size. The specimens from lot No. 87 average smaller in size and tend more towards a circular shape. The morphological characters, with the exception of some minor differences in the shape and extent of the various chitinized areas, as the collar surrounding the anal plates, appear to be identical within the limits set by a slight allowance for individual variation, in all the specimens examined.

In addition to the British Guiana records, the writer has collected this species in the grounds of the Department of Agriculture, St. Clair, Port-of-Spain, Trinidad, Nov. 23, 1918 beneath the bark of *Ficus (ulmifolia?)* (A-1046), inside the hollowed-out twigs of a large tree of *Pithecolobium saman* (A-1047), and finally on an unknown tree (A-1059), in each case attended by ants.

Some additions to Prof. Newstead's original description may be noted to advantage as aids to the recognition of the species: The claw digitules are present, thread-like, curved, not quite reaching the tip of the claw: the heavy collar at the marginal end of the spiracular complex normally bears two stout, tapering, blunt-tipped, widely separated spines of small size on the outer margin, but these are frequently broken off and the spine base is so placed as to make its recognition very difficult when the spine is missing: the marginal spines are fairly stout, tapering, faintly lanceolate; each anal plate bears from 10 to 15 setæ dorsally, one apical, two subapical, and the remainder scattered over the surface; there are four ventral ridge and four fringe setæ, the latter in two pairs on the edge of the membranous fold beneath the plates; all setæ of the anal plates are slender and of moderate length; anal ring small, with a few large pores and ten setæ; the ventral multilocular disk pores are quite numerous beneath and behind the anal plates and over the posterior portion of the ventral surface, especially near, but not quite at, the body margin, up to the posterior spiracles, but any transverse rows across the middle of the abdominal segments

anterior to the anal plates are very incomplete or wanting; the "submarginal compound pores" are as described by Newstead, but those just in front of the anterior spiracles are perhaps one-third as large as the two anterior to the posterior spiracles; ventrally there are tiny simple pores in addition to the multilocular disk sort; dorsally there are large, circular, faintly multilocular disk pores, much smaller, circular, heavy-walled simple disk pores and, occasionally, from two to five such pores grouped in a solid heavily chitinized plate.

The larva of this species differs from that of the new species described below most obviously in the length of the hairs in the ventral abdominal rows these in the present species being very minute, while in the new species they are much longer and more conspicuous.

Akermes secretus sp. nov.

Reference.—Coccus sp., van Zwaluwenburg, Jour. Econ. Ent., vol. 10, 1917, p. 515.

Occuring in cavities in the stems or beneath the bark of the host, attended by ants.

Adult female.—Color in life different shades of light reddish or yellowish brown often varying to a hint of lavender or purple brown; color of alcoholic specimens dorsally very pale grayish brown, with more or less distinct linear transverse mottling of dark brown, tiny blackish flecks along margin, a brown area around anal plates and small white spots at the spiracular openings, ventrally with a marginal band of dull brown, the anterior two-thirds of the surface yellow cream, shading off to brown at edges, the ventral abdominal segments about the same color as the dorsum, the whole venter variously mottled and flecked with dark color; maximum length mounted on slide 5.5 mm., width 4 mm.; convexity apparently varying with the development of the ovaries, never strongly convex, shape irregularly oval, body only lightly chitinized, clearing almost completely on treating with potassium hydroxide, but showing faint Saissetia-like areolations in the derm in fully matured

specimens, only the anal plate region and the spiracular areas retaining any marked color; antennæ reduced to short stubs, very indistinctly 4-segmented, bearing a few short slender setæ and several stout blunted setæ at apex; legs also greatly reduced, the different parts not distinguishable, claw present, the claw digitules present, threadlike, curved, extending slightly beyond the apex of the claw; spiracular grooves distinctly deeper than in *quinquepori*, the heavy collar at the inner end perhaps one-third to one-half as wide as in that species and the spiracle itself placed almost immediately below and just inside of the collar rather than at the inner end of a distinct membranous tube as in *quinquepori*; no spiracular spines observed; marginal setæ stout, spinelike, tapering, with swollen bases and acutely pointed tips; beak small and short, apparently 1-segmented; dorsally with an occasional relatively large, circular, apparently very faintly multilocular, disk pore, with much more numerous, smaller circular pores with bilocular centers, scattered uniformly over the surface, and with considerably smaller, simple pores, probably in the aggregate more numerous than the second sort, but tending to cluster into groups of four or more, with wide intervals between clusters; ventrally with multilocular disk pores beneath and around in at least three distinct arches anterior to the anal plates, these normally with eight loculi and somehwat larger than the largest dorsal pore, and with much smaller, apparently simple, circular pores with oval centers, these arranged irregularly in distinctly segmental bands across the middle portion of the abdominal segments, but more numerous and less definitely arranged towards the body margin; no dorsal setæ observed except at body margin and a scattered cluster just inside the opening of each spiracular collar; ventral setæ present, not especially numerous or conspicuous, scattered, except for some indefinite segmental rows anterior to the anal plates, and most abundant on that portion of the ventral surface behind the posterior spiracles; no submarginal tubercles, such as may be found in some genera in this subfamily; the "submarginal compound pores" of *quinquepori* not in evidence; anal plates surrounded by a heavily chitinized

collar, the usual shape of the plates, from above, half ovate, but varying quite a little according to the pressure on the plate; each plate quite deep, with about 15 to 17 scattered setæ dorsally and apically, these frequently broken off, an indeterminate number, apparently three, of ventral ridge setæ, two fringe setæ placed close together at center of fold in membrane, and three to five hypopygial setæ along middle of membrane beneath fringe setæ; anal ring small, oval, with ten small setæ and some large pores.

Larva.—Stout oval, flat, average length 821μ, average width 571μ; antennæ slender, elongate, 6-segmented, the third very long; legs slender, claw without denticle, digitules slender, those of claw slightly knobbed, those of tarsus hair-like; spiracular spines occuring singly, stout, somewhat tapering; on abdomen, at least, with two dorsal rows of minute pores on each side of the body; ventrally with a submarginal row of relatively long hairs and a similar parallel row some distance in from the margin; anal plates elongate, each with a long apical seta, two small subapical setæ and a subbasal seta; with one pair of fringe setæ.

This species has been described from the following lots of specimens: In branches of *Inga laurina*, Mayaguez, Porto Rico, March, 1915, collected by R. H. Van Zwaluwenburg (holotype and paratypes); on "guama", San-Juan, P. R., Nov. 1912, collected by W. V. Tower (paratypes); beneath bark of *Hematoxylon campechianum* (logwood), Botanic Garden, St. George, Grenada, Nov. 13, 1918 (A-971) and Nov. 19, 1918 (A-1021), Friendship Estate, Tobago Island, Nov. 7, 1918 (A-912), and on the Savanna, Port-of-Spain, Trinidad, Nov. 23, 1918, all collected by Harold Morrison (paratypes), and in the cavities of the stems of *Triplaris surinamensis* Chamc. with *Pseudomyrma* sp. nov. (allied to *Ps. triplaridis* Forel), collected by Dr. W. M. Wheeler at Camaria, British Guiana (paratypes). In all instances where information is available, the species is reported as receiving the attention of some species of ant.

The types are in the U. S. National Collection of Coccidæ.

Aside from the very obvious difference in the presence or absence of the "submarginal compound pores," the two preceding species may be separated very easily by a comparison of a number of other structural characters, as the shape and size of the marginal setæ, the distribution of the ventral disk pores, the character of the dorsal pores in the adult female, and the conspicuous difference in the lengths of the submarginal setæ in the larvæ.

Under the name *Pseudophilippia iniquilina*, Prof. Newstead has described[3] from Jamaica a coccid which quite obviously has little or no relationship with the genotype of *Pseudophillipa*, and equally obviously is closely related to the two preceding species. So far as can be ascertained from the figures and the somewhat incomplete description of this species, it stands in an intermediate position between *quinquepori* and *secretus*.

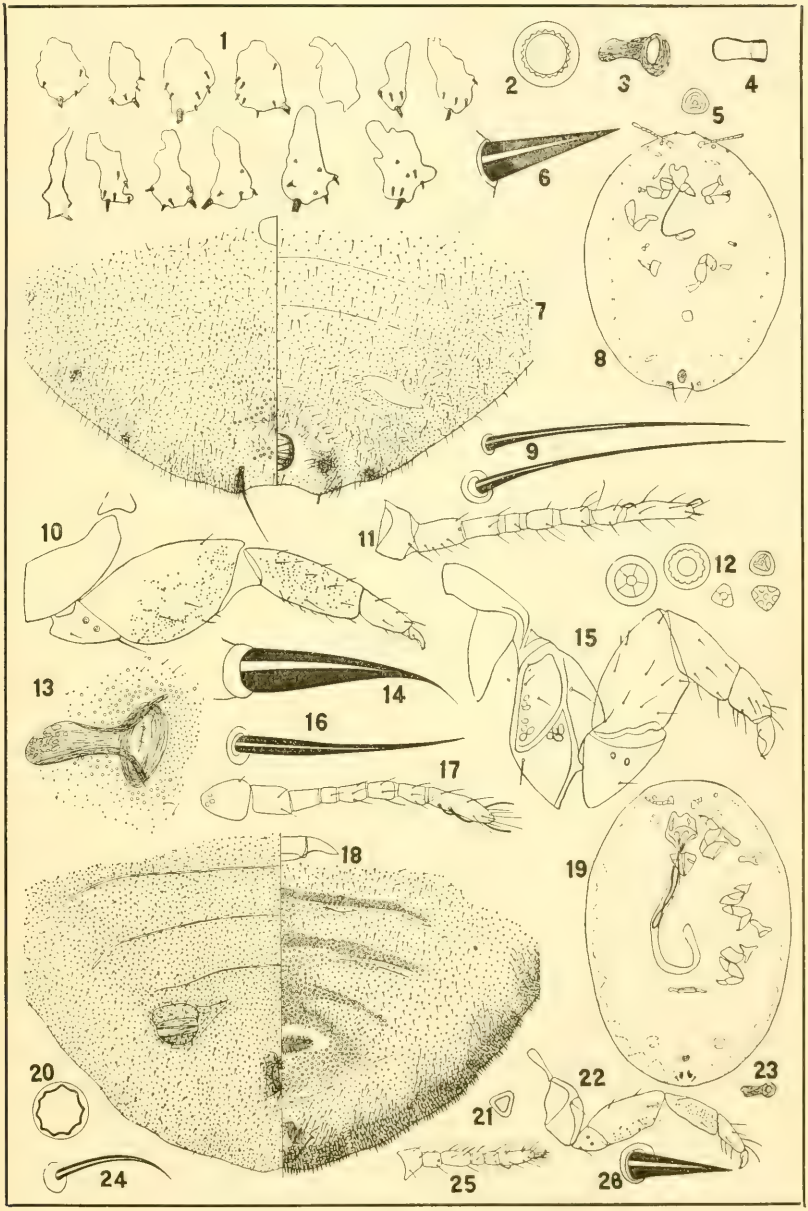
Explanation of Plates.

Plate V.

Fig. 1. *Pseudococcus bromeliæ* (Bouché). Variation in shape of ventral chitinized area of anal lobes, all XI53; top, from left to right, from pineapple, Georgetown, British Guiana (H. Morrison, No. A-703) (2); from Kartabo, B. G. (Wheeler No. 209); from Kartabo, B. G., in leaf petioles of *Tachigalia paniculata* (Wheeler No. 247)(2); from Kartabo, B. G. in stem swellings of Cordia nodosa (Wheeler No. 367) (2); bottom, from left to right, first two same as last two of top row; remainder from Kartabo, B. G. in stems of red Cecropia (Wheeler No. 116).

Fig. 2-11, *Pseudococcus rotundus*, new species, all adult female. Fig. 2, ventral disk pore, XI000; Fig. 3, spiracle, X80; Fig. 4, tubular duct, XI000; Fig. 5. triangular pore, XI000; Fig. 6, cerarian spine, XI000; Fig. 7. apex of abdomen, X40; Fig. 8. outline from below showing position of parts, XII. 6;

[3]Bull. Ent. Research, vol. X, 1920, p. 181, fig. 5.



MORRISON:—COCCIDAE

Fig. 9. dorsal (above) and ventral (below) setæ, XI000; Fig. 10. posterior leg, X80; Fig. 11. antenna, X80.

Fig. 12-19, *Farinococcus multispinosus*, gen. et sp. nov., all adult female. Fig. 12. spiracular, multilocular disk and triangular (three views) body pores, XI000; Fig. 13. anterior spiracle, X80; Fig. 14. cerarian spine, XI000; Fig. 15. posterior leg, X-80; Fig. 16. body seta, XI000; Fig. 17. antenna, X80; Fig. 18. apex of abdomen, X40: Fig. 19. outline of body from below, showing location of parts, extent of spine and seta clusters shown by dotted line at margin, X8;

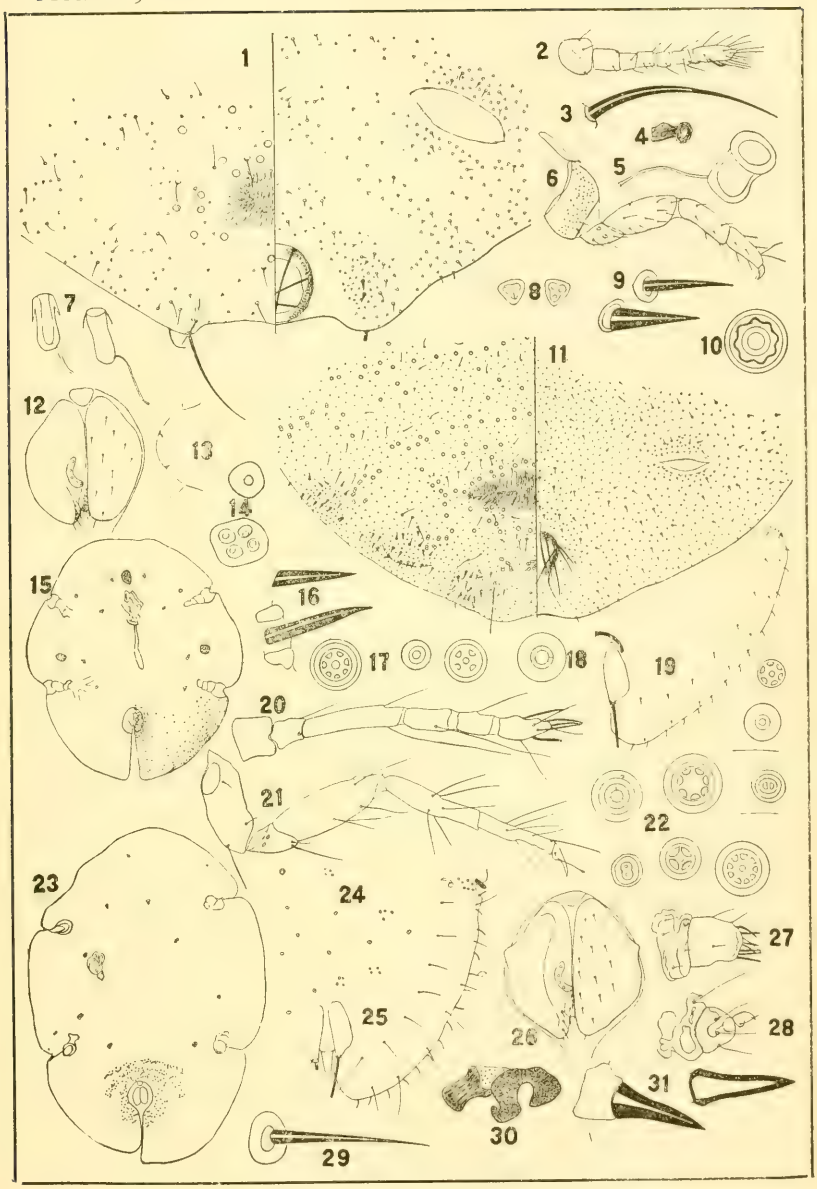
Fig. 20-26, *Ripersia petiolicola*, sp. nov., all adult female. Fig. 20. ventral multilocular disk pore, XI000; Fig. 21. triangular pore, XI000; Fig. 22. posterior leg, X80; Fig. 23. spiracle, X80; Fig. 24. ventral seta, XI000; Fig. 25. antenna X80; Fig. 26. cerarian spine XI000.

Plate VI.

Fig. 1. *Ripersia petiolicola*, sp. nov., adult female, apex of abdomen, XI53.

Fig. 2-11. *Ripersia subcorticis*, new species, all adult female. Fig. 2. antenna, X80; Fig. 3. ventral seta, XI000; Fig. 4. spiracle, X80; Fig. 5. larve ventral tubular duct, XI000; Fig. 6. posterior leg, X80; Fig. 7. small ventral tubular ducts, XI000; Fig. 8. triangular pore, XI000; Fig. 9. dorsal seta (above) and cerarian spine (below), XI000; Fig. 10. ventral multilocular disk pore, XI000; Fig. 11. apex of abdomen, X80.

Fig. 12-19, *Akermes quinquepori* Newst., all adult female except last. Fig. 12. anal plates, X80; Fig. 13. margin of spiracular thickening showing spines, X80; Fig. 14. dorsal simple pores, singly and in cluster, XI000; Fig. 15. outline of body, optical section, showing particularly the five dorsal "cribriform plates" and the arrangement of the ventral disk pores, X8; Fig. 16. marginal spines XI000; Fig. 17. ventral multilocular disk and simple pores, XI000; Fig. 18. Dorsal multilocular disk pore, XI000; Fig. 19. margin of abdomen of larva showing short ventral setæ, X80.



MORRISON:—COCCIDAE

Fig. 20-31. *Akermes secretus,* sp. nov., all adult female except first two and figure twenty-five. Fig. 20, antenna of larva, X153; Fig. 21. leg of larva, X153; Fig. 22. adult female, group of derm pore sorts, XI000; Fig. 23. outline in optical section, showing parts, and arrangement of ventral multilocular disk pores, X8: Fig. 24. section of dorsal derm in abdominal region, showing tendency of small simple pores to group in clusters of four, X40; Fig. 25. larva, margin of abdomen showing long slender ventral setæ, X80; Fig. 26. adult female, anal plates, X80; Fig. 27. antenna, X153; Fig. 28. legs X153; Fig. 29. ventral seta, XI000; Fig. 30. spiracle, X40; Fig. 31. marginal spines, XI000.

CONOAXIMA, A NEW GENUS OF THE HYMENOPTEROUS FAMILY EURYTOMIDÆ, WITH A DESCRIPTION OF ITS LARVA AND PUPA.

By Charles T. Brues[1]

During the course of his investigations on myrmecophilous plants in British Guiana, Professor I. W. Bailey obtained specimens of a remarkable Hymenopterous insect parasitic on ant-queens.

The following notes on its habits have been furnished by Professor Bailey.

"The colonies of *Azteca constructor* Emery and of *A. alfaroi* Emery which inhabit the fistulose stems of *Cecropia angulata* I. W. Bailey, the common myrmecophytic Cecropia of the Kartabo Region of British Guiana, are initiated by young fecundated queens in juvenile plants. The queens enter the internodal chambers through circular perforations cut in groove-like depressions (Prostomata) in the sides of the stem. These entrance apertures are covered with triturated pith on their central sides and ultimately become occluded by callus, which seals the queens within the 'primordial chambers.'

"Although many of the successive internodal cavities of each young plant become inhabited, few of the queens succeed in raising a brood. When the stems are cut open, most of the chambers are found to contain dead queens. I was unable to account for this high mortality until I discovered the presence of a small scar in the callus which fills the entrance aperture. This scar within a scar indicated, of course, that some insect had emerged since the queen became sealed within her domatium. Following up this clue, I soon found chambers—with modified callus in the apertures—which contained, in addition to the dead and frequently dismembered queen, the larva, pupa or imago of a Hymenopterous parasite. The evidence at hand seems to indicate that the queens are parasitized before they enter their dwellings."

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 209.

The parasite proves to represent an undescribed genus which may be characterized as follows:

Conoaxima gen. nov.

Similar to Axima Walker. Head strongly transverse, deeply emarginate behind, with an erect spine or tooth in front of each lateral ocellus, cheeks and temples separated from head behind by a strong ridge or carina; ocelli in a curved line, the lateral one close to the eye; antennæ inserted at the middle of the face, 11-jointed, with one ring-joint; front with a deep groove that receives the two antennal scapes; eyes oval, bare, one-third longer than the malar space; anterior orbits divergent below, the head in front not conspicuously narrowed toward the mouth; temples rounded behind the eyes. Pronotum as long as the mesonotum, with a strong, tooth-like or sharply rounded projection medially in front; scapulæ separated behind by half the length of the mesonotum. Scutellum conical, twice as long as the mesonotum, its tip extending well over the propodeum. Abdomen long, compressed, petiole about half the length of the hind femur; fifth segment the longest; sixth and seventh also much lengthened, stigmal and postmarginal veins of equal length, each half as long as the marginal. Head and thorax deeply, coarsely punctate; black.

Type species: *C. aztecicida* sp. nov.

This genus is very similar to Axima, but differs in several important characters. The scutellum is conical in form, not rounded, the abdominal petiole is very much shorter and the marginal vein only about twice as long as the stigmal. The spines on the vertex in the two genera are similar, but there is no ridge between them in Conoaxima. The large conical scutellum which projects over the propodeum, with its upper surface in the same plane as the mesonotum give the insect the appearance of an Eucharid.

In addition to the species taken by Professor Bailey in British Guiana, I have a second one obtained by Professor W. M. Wheeler some years ago at Quirigua, Quatemala, also from a

nest of Azteca. Without doubt, the Central American species is also a parasite of these ants.

The two species may be distinguished as follows:

Frontal projections spiniform, acute, much longer than broad at base; median projection of pronotum acute; scape of antennæ black or piceous; .....*C. aztecidida* sp. nov.

Frontal projections triangular, as high as broad at base; median projection of pronotum rounded; scape of antennæ more or less ferruginous, especially toward base ..*C. affinis* sp. nov.

Conoaxima aztecicida sp. nov.

♀. Length 4.2 mm. Black; abdomen obscurely stained with rufous at the sides of the sixth and base of the seventh segment; antennal scape entirely, pedicel, except above; knees, tibiæ and tarsi of front legs; knees and apices of tibiæ of four posterior legs, yellow; middle and hind tarsi, except tips, white. Body clothed with white, bristly hairs, one arising from each puncture on the thoracic nota, with a denser patch on the metanotum and hind coxa below; tip of abdomen also white haired; legs clothed with white hairs which form quite a distinct fringe on the hind femora beneath. Head closely and densely punctate, each puncture about half as wide as the diameter of the scape and almost everywhere so close together that the space between them forms an irregularly hexagonal reticulum. Lateral ocelli much closer to the eye than to the median ocellus, the lateral ones oval, separated by their own width from the eye; frontal spine just in front and slightly toward the median line from the lateral ocellus; head seen from above two and one half times as broad as thick, with the eyes extending almost to the front and to the temples. Antennal scape extending to the median ocellus, less than half as long as the flagellum; pedicel narrower than, and only half as long as the first funicular joint; one ring-joint; the five funicle joints growing thicker and slightly shorter, first one oval, twice as long as thick, fifth but little longer than thick; club composed of three distinct joints, as long as the two preceding funicular joints together, entire

flagellum clothed with long, sparse white hairs. Pronotum one-third as long as wide, very slightly and broadly emarginate medially behind; punctation like that of the head, forming about seven irregular transverse rows; mesonotum and scutellum sculptured like the pronotum; scapulæ less clearly separated behind where they are separated by about one-fourth the width of the thorax; a very deep transverse impression between the median lobe of mesonotum and the scutellum; the latter sharply upturned at the tip, and with a broad shallow shagreened impression basally at the sides, the centre of the impression with a tuft of white hairs. Propodeum with a large shield-shaped shagreened areola extending from base to apex and a lateral transversely reticulate areola on each side, the carinæ very strong. Pleuræ opaque, almost entirely without large punctures except on the densely hairy metapleuræ; mesopleura with a few oblique lines. Hind coxæ granulate, densely hairy externally. Petiole with a median furrow above and an incomplete lateral one; second to fourth segments short, subequal, together distinctly shorter than the fifth, which is by far the longest segment, sixth and seventh of about equal length, each on the dorsum two-thirds as long as the fifth, the sixth with a small round, very distinct spiracle near the base, the seventh with a larger one toward tip; eighth barely extruded; gaster in profile lanceolate, one-third as high as long, highest at the base of the fifth segment. Wings hyaline, venation pale; rather densely hairy, but without noticeably marginal fringe; hind wing with three frenulum hooks.

Type from Kartabo, British Guiana (I. W. Bailey, collected as described on a previous page of this journal (Psyche, vol. 29, p. 153.

Conoaxima affinis sp. nov.

♀. Length 3.7 mm. Very similar to *C. aztecicida*, but differing most distinctly as indicated in the table above. The thorax is also more coarsely punctate, especially the scutellum where about eight punctures form a longitudinal line.

Type from Quirigua, Guatemala, January 14, 1912. (W. M. Wheeler). This species undoubtedly attacks Azteca also, as Professor Wheeler took the specimen from the hollow thorn of an Acacia when collecting nests of Azteca at a place where these ants were abundant.

The anatomical similarities between Conoaxima and Axima are interesting on account of the habits of the two genera. The first account of the habits of Axima was given by Howard[1] who cites a number of instances in which *Axima zabriskei* Howard has been reared from small bees under conditions that allow of little doubt that the Axima is a primary parasite. On three occasions the Rev. J. L. Zabriskie bred examples from nests of *Ceratina dupla* in stems of sumac at different localities in New York State. Howard found also in the Museum of Comparative Zoölogy at Cambridge specimens presumably bred by Mr. H. G. Hubbard from larvæ found in burrows of a small blue bee at Fresh Pond in Cambridge, and further specimens in the Cornell University collection bred from a bee supposed to be *Ceratina dupla*. There can be no doubt therefore, that *A. zabriskei* attacks Ceratina and it is very probable that the other members of the genus parasitize small bees of some kind.

Professor Bailey obtained also a single larva and pupa of Conoaxima. The larva probably full-grown is of quite unique form, due to the presence of a dorsal series of large, unpaired tubercles. The first of these is on the metathorax and each of the four following segments bears another one; those of the abdomen are larger than the metathoracic one and of about equal size. From the wrinkled appearance of the thin integument that covers the tubercles, it seems evident they are capable of considerable distension during life. After preservation in alcohol, the larger tubercles project for a distance of about one fourth the dorso-ventral thickness of the body and are more than half the width of the body segments to which they are attached. Following these there is a much smaller projection at the tip of the sixth segment and a minute one at the tip of the seventh. From the position of the head and the curvature

[1]Insect Life, vol. 2, pp. 365-367, 3 figs. "A North American Axima and its Habits" (1890)

of the body it is clearly evident that these appendages are dorsal and not ventral as one might naturally suppose from analogy with other insect larvæ. Laterally nine small circular spiracles form a continuous series from the mesothorax to the seventh abdominal segment. Scattered over the body are a number of very minute spiniform black tubercles from the apex of some of which there projects a hyaline seta. Most likely all the spines bear setæ in perfect specimens; they are arranged as follows: prothorax with a transverse ring of twelve; meso and metathorax with a ring of ten, interrupted above; first abdominal segment with one above the spiracle and a series of three below; second to sixth with one above and two below; seventh and eighth with only two on each side although the eighth bears several other round chitinized dots; apical segment with a ring of about ten. In addition the head bears a seta, without tubercle, at each side of the front and one on each cheek.

The pupa is similar in general form to the imago and the body, including the head, bears a few scattered long bristly hairs. It is nowhere noticeably tuberculate except that behind each antenna there is a lanceolate projection that represents in exaggerated form the carina behind the eye of the adult. Above, the head is bilobed, due to a deep median impression, but the surface of each lobe is evenly convex and shows no trace of the spiniform porcesses of the imago. The anterior margin of the pronotum has a median tubercle which is crowned at apex with a tuft of sparse, short bristly hairs. This no doubt is a functional pupal organ, the vestige of which persists in the imago as the median pronotal projection or tooth described on a previous page. Seven pairs of abdominal spiracles are visible, each deeply pigmented, entering the tracheal trunks by more weakly pigmented funnels.

So far as I can ascertain, the only reference to any larva similar to the one just described, relates to Axima which is said by Howard (*loc. cit.*) to have "six or more strong dorsal tubercles." According to the same author the pupa of Axima has the head strongly tuberculate which is not the case in Conoaxima, except for the lamelliform projections on the temples.

SYNOPSIS OF PANURGIDÆ (*HYMENOPTERA*).

By Charles Robertson.

Carlinville, Illinois.

My synopses of local bees are intended to show how I distinguish them. It is assumed that the student has only the local species and all of them. Nothing follows from such a statement as that *Chloralictus nymphalis* runs to *C. testaceus* in my table of Halictinæ. If it had been one of the local species, it would not have run to that name.

The differences between the Panurgidæ and Dufoureidæ are partly mentioned in the "Synopsis of Anthophila", Can. Ent. *36*: 42, 1904. The local species mix the pollen with honey, but *Panurgus* evidently does not. It has a large scopa which is not necessary in those which stick the pollen with honey.

Often the two cubital cells are not homologous, so that the bees are referred here on account of other resemblances. In Perditinæ the cubital cells are the first and third, the second being obliterated by coalescence of the first and second transverse cubital nervures. The "first transverse cubital" is a compound vein, and the "second" is really the third. Usually in the rest of the Panurgidæ the true second transverse cubital vein is wanting and the one called "second" is the third. The "second cubital cell" is composed of the second and the third united. I have a specimen of *Pseudopanurgus compositarum* with three cubital cells. In true *Panurginus* I think the first and second cubital cells are united and that the venation is not homologous with that of American species which have been referred to that genus. I have seen *P. albopilosus* and *montanus*, determined by Friese. These have an independent origin from forms having three cubital cells.

Abbreviations.—1p 1 = basal joint of labial palp; 1p 4:2 = length of first and second joints as 4 to 2; Ma, Mas = long-tongued bee flowers; Mi, Mis = short-tongued bee flowers; mp 6 = maxillary palps six-jointed; oligolege = bee collecting pollen

from related flowers; Pol = polytropic flowers, adapted to various short-tongued insects; R = Red, all dark colors; social flowers = flowers crowded so that insects pass from one to another without taking wing or climbing; W = white; Y = yellow, greenish to orange,

Females.

1. Marginal cell about as long as stigma; cubital cell 1 about twice as long as 2; recurrent veins about opposite transverse cubitals; discoidal part of basal vein about twice as long as cubital part; lower border of discoidal cell 3 shorter than that of 1; middle spur about half as long as planta; face with colored marks; scopa simple, pollen on front of tibia; glossa linear; 1p 1 flat, longer than 2-4; head and thorax greenish, abdomen black or brown, **Perditinae.**
2. Marginal cell longer than stigma; cubital cells usually subequal; recurrent vein 1 beyond transverse cubital 1, 2 usually before 2; discoidal part of basal vein more than twice as long as cubital part; middle spur more than half as long as planta; mp 6; black, 3.
3. Stigma middle-sized; recurrent veins about equally distant from transverse cubitals; face with yellowish marks; scopa simple, pollen mainly on front of tibia but also around planta; glossa filiform; 1p 1 flat, at least longer than 2-4, **Calliopsinae.**

a. Stigma large; recurrent vein 1 usually remote from transverse cubital 1, 2 near or opposite 2; lower border of discoidal cell 3 shorter than that of 1; face without marks; pollen on front of tibia, **Anthemurginae.**

Males.

4. Venation as in 1 **Perditinae.**
   Venation as in 2, mp 6 5.
5. Venation as in 3, **Calliopsinae.**
   Venation as in 3a **Anthemurginae.**

PERDITINÆ

Females.

Claws simple; clypeus, interrupted basal fasciæ on segments 2-3, wings and veins, whitish; border of stigma and of marginal cell fuscous; mp 6, short; 1p 5: 1; 4mm; oligolege of *Boltonia asteroides*; Sept. 3; *boltoniæ* in, **Perditella.**

Claws with an inner tooth, 1.

1. Veins fuscous; claw tooth subapical; five marks on face, base of mandibles, two spots on collar, tubercles, anterior tibiæ in front, middle knees, and oblique basal fasciæ on sides of segments 1-4, whitish; mp 6, long; 1p 6: 1; 6-7mm; oligolege of Astereæ and Heliantheæ; Aug. 17-Sept. 20; *octomaculata* in **Perdita.**

Veins black; claw tooth median; mandibles, anterior tibiæ in front, and tarsi, yellowish; usually a dot on each side of segment 3, and often on 4; middle tibiæ more or less yellowish; mesonotum purplish; metathorax bluish; mp short, joints indistinct; 1p 9: 2; 5-7mm; oligolege of *Physalis*; July 7-Sept. 3; *maura* in, **Zaperdita.**

Males.

Cheek with a distinct process; subdiscoidal and recurrent vein 2 obsolete; mandibles, clypeus, anterior tibiæ in front, middle knees and tarsi, whitish; 4-5mm; Aug. 30-Sept. 8;*boltoniæ* in, **Perditella.**

Cheek simple; veins ordinary; at least the mandibles, labrum, clypeus, sides of face, scape, flagellum beneath, anterior and middle tibiæ in front, front and middle tarsi, and hind knees, yellow 1.

1. Face of about equal width below; cheeks narrow; coxæ trochanters, anterior and middle femora and tibiæ in front, and spots on segments 1-4, yellow; hind tarsi dark; 5-6mm; Aug. 13-Sept. 24; *octomaculata* in, **Perdita.**

Face broader below; cheeks broad; coxæ, trochanters, femora except tips, and abdomen, black; front and middle tibiæ almost entirely yellow; posterior orbits yellow below; hind tarsi yellow; 5mm; July 17-Aug. 1; *maura* in, **Zaperdita.**

CALLIOPSINÆ

Females.

Front tarsi simple; disc of metathorax short, rugose; abdomen finely punctured, rather opaque; veins dark; cubital cell 2 narrowed about one-half above; ornaments luteous, at least the clypeus in part, spot above, sides of face, two lines on collar, and front and middle knees; flagellum testaceous beneath; 1p 7: 1, **Calliopsis.**

Front tarsi with curled spines; disc of metathorax smooth, shining, foveate; abdomen sparsely punctured, shining; wings hyaline, veins pale; cubital cell 2 narrowed less than one-half above; apex of labrum and of clypeus, triangular mark on each side of face, base of mandibles, and front knees, whitish; mp and galea 5: 14; 1p 13: 1; 7-8mm; oligolege of *Verbena*; June 28-Sept. 10; *verbenæ* in **Verbenapsis.**

Males.

Disc of metathorax shining, foveate; wings hyaline, veins pale; cubital cell 2 narrowed less than one-half above; front tarsi pale, with long hair; base of mandibles, middle of labrum, sides of face, clypeus except sides of base, front and middle knees, and line on front tibia, whitish; 6-7mm; July 2-Sept. 1; *verbenæ* in, **Verbenapsis.**

Disc of metathorax opaque, rugose; wings a little dusky, veins dark; cubital cell 2 narrowed about one-half above; front tarsi with short hair; at least the mandibles, labrum, face below antennæ, two lines on collar, tarsi, and tibiæ in front, yellow, **Calliopsis.**

CALLIOPSIS

Females.

Clypeus black, with a median stripe, 3 spots above; lateral face marks subquadrate, not extending above antennæ; spot on tubercles; rarely a dot on tegulæ; labrum dark; mp and galea subequal; 6-8mm; polylege; May 30-Oct. 14, **andreniformis.**

Clypeus luteous, with two black stripes, 1 spot above; lateral face marks pointed above antennæ; tubercles black; dot on tegulæ; mp shorter than galea; 7mm; oligolege of Heliantheæ and Astereæ; Aug. 20-Sept. 19, **coloradensis.**

Males.

Tubercles, legs, antennæ except flagellum at base above, yellow; tegulæ usually dark; 5-6mm; May 30-Sept. 19 **andreniformis.**

Tubercles, coxæ, trochanters, femora except tips, tibiæ behind, and apical joints of tarsi more or less, black; dot on tegulæ; line on scape in front; flagellum testaceous beneath; 6-7mm; Aug.21—Sept. 24, **coloradensis.**

ANTHEMURGINÆ.

Females.

Scopa plumose; glossa linear, acuminate; 1p 1 elongate, flat; mp not longer than galea; tegulæ and front and middle knees testaceous, **Pseudopanurgus.**

Scopa simple; mp longer than galea, 1.

1. Lp 4: 1½, 1 flat; glossa lance-linear, acuminate; nearly bare, finely and densely punctured, opaque; middle spur sparsely pectinate, about as long as planta; tegulæ and front and middle knees testaceous; 5-6mm; polylege; May 28—Oct. 23; *parvus* in, **Heterosarus.**

Lp 2:2, 1 simple, incrassate; glossa lanceolate, shorter than mentum; middle spur finely pectinate, two-thirds as long as planta; finely punctured, shining, head more coarsely punctured and opaque; knees black; apical half of wings clouded; 7-8mm; oligolege of *Passiflora lutea*; July 21—Sept. 9; *passifloræ* in **Anthemurgus.**

Males.

Clypeus and sides of face with yellow stripes; black, mandibles, tarsi, anterior tibiæ in front, and sometimes middle ones, testaceous; apical half of wings clouded; 7-8mm; July 21—Aug. 30; *passifloræ* in **Anthemurgus.**

Clypeus entirely and sides of face yellowish or whitish, 1.

1. Lateral face marks hardly extending above clypeus; mandibles, middle of labrum, clypeus and face marks, whitish; flagellum beneath, tubercles, tegulæ, knees, tarsi, and anterior tibiæ in front, testaceous; 5-6mm; May 28—June 15; *parvus* in **Heterosarus.**

Lateral face marks extending above clypeus; at least the clypeus, sides of face, tarsi, anterior tibiæ in front, and bases of middle and hind tibiæ, yellow, **Pseudopanurgus.**

PSEUDOPANURGUS

Females.

Mesonotum rugose, with coarse confluent punctures; enclosure of labrum subquadrate; a supraorbital tubercle; wings clouded beyond middle; recurrent vein 1 remote from transverse cubital 1, 2 near transverse cubital 2; mp shorter than galea; 1p 10: 2; 7-8mm; oligolege of Helianthea; Aug. 2—Oct. 1, **rugosus.**

Mesonotum more finely punctured, 1.

1. Enclosure of labrum subquadrate, 3.

Enclosure of labrum rugose, strongly narrowed apically; middle of flagellum beneath testaceous; mp a little shorter than galea, 2.

2. Metathorax shining, impunctate; tubercles yellow: head and mesonotum more sparsely punctured; veins darker; 1p 7: 2; 6-7mm; oligolege of Heliantheæ; Aug. 3—Sept. 28, **labrosus.**

   Metathorax opaque, punctate behind; tubercles dark; head and mesonotum more closely and coarsely punctured; veins paler; 1p 6½: 3; 5-6mm; oligolege of Heliantheæ; Aug. 15—Sept. 25 **labrosiformis.**

3. Hind tarsi not yellow; 6-7mm, 5.

   Hind tarsi yellow; mp shorter than galea 4.

4. Scutel shining, almost impunctate; mesonotum not trisulcate; enclosure of labrum more narrowed apically; wing clear hyaline; veins pale; scopa with long, long-barbed hairs; 1p 8: 3; 6-7mm; oligolege of Heliantheæ; May 29—Sept. 5, **albitarsis.**

   Scutel more opaque, closely punctured; mesonotum trisulcate; enclosure of labrum less narrowed apically; wing less hyaline; scopa with short, short-barbed hairs; 1p 7: 3; 5-7mm; oligolege of Astereæ and Heliantheæ; Aug. 11—Oct. 4, **solidaginis.**

5. Mesonotum nearly bare; shining, rather finely and closely punctured; scopa rather short; mp about equaling galea; 1p 4: 1; oligolege of Astereæ and Heliantheæ; Aug.23--Oct. 23 **asteris.**

   Mesonotum distinctly pubescent, 6.

6. Mesonotum entirely pubescent, opaque, with large shallow dense punctures; scopa rather short; mp about equaling galea; 1p 4: 1½; oligolege of Astereæ; Sept. 6—Oct. 29, **compositarum.**

   Mesonotum pubescent in front, shining, minutely and sparsely punctured; scopa long and thin; mp a little shorter than galea; 1p 4½:2; oligolege of Heliantheæ; Aug. 1—Sept. 12, **rudbeckiae.**

Males.

Mandibles and labrum yellow, 2.
Mandibles and labrum black; apical joints of tarsi blackish; 6-7mm 1.

1. Mesonotum coarsely reticulated; wings clouded beyond middle; broad bases of middle and hind tibiæ yellow; July 29—Aug. 22, **rugosus.**
Mesonotum shining, sparsely punctured; wings hyaline; middle and hind knees yellow; June 11—Sept. 8, **albitarsis.**

2. Enclosure of labrum slightly narrowed towards apex, 4.
Enclosure of labrum strongly narrowed and subbidentate at apex; middle joints of flagellum fulvous beneath, 3.

3. Metathorax shining, impunctate; tubercles yellow; hind tibiæ broadly yellow at base; 5-6mm; Aug. 1-30 **labrosus.**
Metathorax punctured behind; tubercles black; hind knees yellow; 4-5mm; Aug. 3—Sept. 8, **labrosiformis.**

4. Middle of clypeus concave, impunctate; tubercles and middle and hind knees yellow; 5-7mm; Aug. 3—Sept.7, **rudbeckiae.**
Middle of clypeus convex, punctate, 5.

5. Mesonotum opaque, with large dense shallow punctures, closely pubescent; antennæ long; face below antennæ, and tibiæ, except spot beneath, yellow; 5-6mm; Aug—28—Oct. 4, **compositarum.**
Mesonotum more shining, the pubescence short or sparse, 6.

6. Hind tibiæ yellow at least on basal third; tubercles yellow; mesonotum finely punctured, not trisulcate; 5-6mm; Aug. 23—Oct. 21, **asteris.**
Hind tibiæ yellow at extreme base; tubercles black; mesonotum coarsely punctured, trisulcate; 4-6mm; Aug. 12—Sept. 7, **solidaginis.**

PHENOLOGY.—Of the dominant families of bees the Panurgidæ have the most definite phenological position. They fly from May 28 to October 29, all of them together August 30—September 3.

Phenologically the sexes begin and end as follows:

Begin			End		
♂ first	♂ ♀ together	♀ first	♀ last	♂ ♀ together	♂ last
37.5	25.0	37.5	75.0	....	25.0

The males which are first precede by 6.1 days and the females which are last are later by 29.2 days. It is probable that all of the species are proterandrous, but the males precede by so few days and are so much harder to observe that it is not easy to prove the proterandry. My dates give the earliest ever observed and it is probable that, in the year in which the earliest date for the female was recorded, the male really preceded. The records show 124 flower visits for the females and 92 for the males, which indicates how much more likely the flight of the female is to be correctly made out.

Taking the cases in which the males were first and the females last as normal examples we have for the average number of days:

	♂ precedes	♀ follows	♂	♀	Species
4 normal	7.2	27.5	32.5	52.7	59.5
12 others	....	....	46.0	66.3	68.6
Total	....	....	42.6	62.9	66.3

The oligoleges are 85.5 per cent. of the species. They average 55.3 days, while the two polyleges average 143.5 days.

FLOWER VISITS.—In the following lists the pollen visits of the female (♀c) are separated from the nectar visits (♀s). The pollen visits do not exclude nectar visits to the same flowers. Visits of the male (♂s) not made by the female also are in italics. Visits to Compositæ are distributed under Anthemideæ, Astereæ, Eupatorieæ, and Heliantheæ.

ANTHEMURGUS PASSIFLORÆ.—♀ c (1): *Passifloraceæ*: Passiflora, type July 31.

♂ s (1): *Passifloraceæ*: Passiflora lutea, *type* July 31.

CALLIOPSIS ANDRENIFORMIS (51).—♀ c (19): *Astereæ*: Aster ericoides villosus; *Helianthea*: Verbesina helianthoides; *Labiatæ*: Lycopus sinuatus, Pycnanthemum pilosum; *Leguminosæ*: Desmodium marilandicum, D. paniculatum, Melilotus alba, Psoralea onobrychis, Trifolium repens, T. pratense; *Lythraceæ*: Lythrum alatum; *Malvaceæ*: Malva rotundifolia; *Oxalidaceæ*: Oxalis stricta; *Polygalaceæ*: Polygala sanguinea; *Rubiaceæ*: Houstonia purpurea; *Scrophulariaceæ*: Gerardia tenuifolia; *Verbenaceæ*: Lippia lanceolata, Verbena hastata, V. urticifolia.

♀ s (23): *Acanthaceæ*: Dianthera americana; *Helianthea*: Bidens aristosa, Coreopsis palmata; *Labiatæ*: Blephilia ciliata, Hedeoma pulegioides, Nepeta cataria, Prunella vulgaris, Pycnanthemum flexuosum, P. virginianum; *Leguminosæ*: Amorpha canescens, Lespedeza procumbens, L. reticulata, Strophostyles pauciflora, Stylosanthes biflora, Trifolium hybridum; *Lythraceæ*: Ammannia coccinea; *Orchidaceæ*: Spiranthes gracilis; *Polygonaceæ*: Polygonum pennsylvanicum; *Portulacaceæ*: Portulaca oleracea; *Scrophulariaceæ*: Ilysanthes riparia; *Umbelliferæ*: Eryngium yuccæfolium; *Verbenaceæ*: Verbena bracteosa, V. stricta.

♂ s (29:9): *Acanthaceæ*: Dianthera americana; *Anthemideæ*: *Chrysanthemum leucanthemum*; *Helianthea*: Coreopsis palmata, *Rudbeckia triloba*; *Labiatæ*: Blephilia ciliata, Hedeoma pulegioides, Pycnanthemum pilosum, P. virginianum, *Stachys palustris*; *Leguminosæ*: *Lespedeza capitata*, L. procumbens, L. reticulata, Melilotus alba, Psoralea onobrychis, Trifolium hybridum, T. repens; *Malvaceæ*: Malva rotundifolia; *Polygonaceæ*: Polygonum pennsylvanicum; *Polygalaceæ*: Polygala sanguinea; *Rhamnaceæ*: *Ceanothus americanus*; *Rosaceæ*: *Geum album, Gillenia stipulacea, Potentilla monspeliensis*; *Rubiaceæ*: Houstonia purpurea; *Scrophulariaceæ*: Gerardia tenuifolia; *Umbelliferæ*: *Cryptotænia canadensis*, Eryngium yuccæfolium; *Verbenaceæ*: Lippia lanceolata, Verbena urticifolia.

♂ ♀ in copula (1): Psoralea onobrychis, June 26; several other cases not recorded.

CALLIOPSIS COLORADENSIS (5).—♀ c (5): *Astereæ* Boltonia asteroides, Solidago canadensis; *Heliantheæ*: Bidens aristosa, Coreopsis tripteris, Rudbeckia triloba.

♂ s (4) *Astereæ*: Boltonia asteroides, Solidago canadensis; *Heliantheæ*: Bidens aristosa, Rudbeckia triloba.

♂ ♀ in copula (7): Bidens aristosa, Aug. 31; Boltonia asteroides, Aug. 29, Sept 1; 12, two pairs; Solidago canadensis, Aug. 23, Sept. 12.

HETEROSARUS PARVUS (8).—♀ c (7): *Astereæ*: Aster ericoides villosus, Solidago canadensis, S. ulmifolia; *Geraniaceæ*: Geranium carolinianum; *Labiatæ*: Monarda bradburiana, *type* May 28; *Rosaceæ*: Gillenia stipulacea; *Umbelliferæ*: Eulophus americanus.

♀ s (1): *Umbelliferæ*: Thaspium aureum trifoliatum.

♂ s (1): *Rosaceæ*: Gillenia stipulacea.

PERDITA OCTOMACULATA (7).—♀ c (5): *Astereæ*: Aster ericoides villosus, Boltonia asteroides, Solidago canadensis, S. ulmifolia; *Heliantheæ*: Bidens aristosa.

♀ s (1) : *Labiatæ*: Lycopus sinuatus.

♂ s (5:1): *Astereæ*: Boltonia asteroides, Solidago canadensis; *Eupatoricæ*: *Eupatorium altissimum*; *Heliantheæ*: Bidens aristosa; *Labiatæ*: Lycopus sinuatus.

♂ ♀ in copula (3): Bidens aristosa, Sept. 4; Lycopus sinuatus, Sept. 5; Solidago canadensis, Aug. 17.

PERDITELLA BOLTONIÆ (1).—♀ c (1): *Astereæ*: Boltonia asteroides, *type* Sept. 3.

♂ s (1): *Astereæ*: Boltonia asteroides, *type* Sept. 3.

PSEUDOPANURGUS ALBITARSIS (11).—♀ c (8); *Heliantheæ*: Brauneria pallida, B. purpurea, Helianthus divaricatus, H. mollis, Rudbeckia hirta, R. laciniata, R. subtomentosa, Verbesina helianthoides.

♀ s (2): *Heliantheæ*: Coreopsis palmata, Lepachys pinnata.

♂ s (8:1) : *Astereæ*: *Aster ericoides villosus*; *Heliantheæ*: Brauneria pallida, Coreopsis palmata, Helianthus divaricatus, H. mollis, Rudbeckia hirta, R. laciniata, Verbesina helianthoides.

♂ ♀ in copula (5) : Helianthus mollis, Aug. 23; Rudbeckia hirta, June 18; 23, two pairs; 26.

PSEUDOPANURGUS ASTERIS (8).— ♀ c (8): *Astereæ*: Aster ericoides villosus, A. lateriflorus, A. sagittifolius, Solidago canadensis, S. nemoralis, S. serotina, S. ulmifolia; *Heliantheæ*: Rudbeckia triloba.

♂ s (4): *Astereæ*: Aster ericoides villosus, A. sagittifolius, Solidago canadensis, S. ulmifolia.

♂ ♀ in copula (5): Aster ericoides villosus, Sept. 14, 1893, *type*; Sept. 14, 1896; 20; A. sagittifolius, Aug. 30; Solidago canadensis, Sept. 1.

PSEUDOPANURGUS COMPOSITARUM (12).— ♀ c (7) *Astereæ*: Aster ericoides villosus, A. lateriflorus, A. multiflorus, A. novæ angliæ, A. paniculatus, Boltonia asteroides, *type* Sept. 20, Solidago ulmifolia.

♀ s (3): *Astereæ*: Aster salicifolius, Solidago nemoralis; *Polygonaceæ*: Polygonum dumetorum.

♂ s (6:2): *Astereæ*: Aster ericoides villosus, A. lateriflorus, Boltonia asteroides, *type* Aug. 28; *Heliantheæ*; *Bidens aristosa*, *Rudbeckia triloba*; *Polygonaceæ*: Polygonum dumetorum.

PSEUDOPANURGUS LABROSIFORMIS (11).— ♀ c (7): *Helianthea*: Actinomeris alternifolia, Bidens aristosa, Helianthus divaricatus, H. tuberosus, Heliopsis helianthoides, Rudbeckia laciniata, R. triloba.

♀ s (2): *Heliantheæ*: Coreopsis tripteris, *type* Aug. 24, Helianthus strumosus.

♂ s (7:2): *Astereæ*: *Solidago canadensis*; *Heliantheæ*: Coreopsis tripteris, *type* Aug. 24, Helianthus divaricatus, H. tuberosus, Heliopsis helianthoides, Rudbeckia laciniata, *Silphium perfoliatum*.

Stylopized: Aug. 3.

PSEUDOPANURGUS LABROSUS (4).— ♀ c (3) : *Helianthea*: Helianthus divaricatus, H. tuberosus, Rudbeckia triloba.

♀ s (1): *Heliantheæ*: Rudbeckia laciniata.

♂ s (3): *Heliantheæ*: Helianthus divaricatus, H. tuberosus, Rudbeckia triloba.

♂ ♀ in copula (1): Helianthus tuberosus, Aug. 14, *type*.

Stylopized: July 3, type of Crawfordia labrosi Pierce.

PSEUDOPANURGUS RUDBECKIÆ (6).— ♀ c (5): *Helianthea*: Bidens aristosa, Rudbeckia hirta, R. laciniata, R. subtomentosa, R. triloba.

♂s (6:1) : *Heliantheæ*: Bidens aristosa, *Helianthus divaricatus*, Rudbeckia hirta, R. laciniata, R. subtomentosa, R. triloba.

♂ ♀ in copula (4): Rudbeckia triloba, Aug. 3, 21, three pairs, *type*.

Stylopized: Aug. 1; 3, ♂ of copulating pair; 29, type of Crawfordia rudbeckiæ Pierce.

PSEUDOPANURGUS RUGOSUS (7).— ♀ c (5): *Helianthea*: Bidens aristosa, Helianthus divaricatus, H. mollis, H. tuberosus, *type* Aug. 22, Rudbeckia triloba.

♀ s (1) : *Heliantheæ*: Silphium perfoliatum.

♂ s (6:1): *Heliantheæ*: Helianthus divaricatus, H. mollis, H. tuberosus, *type* Aug. 22, *Heliopsis helianthoides*, Rudbeckia triloba, Silphium perfoliatum.

PSEUDOPANURGUS SOLIDAGINIS (7).— ♀ c (4): *Astereæ*: Boltonia asteroides, Solidago canadensis, *type* Sept. 18; *Helianthea*: Helianthus grosseserratus, Rudbeckia subtomentosa.

♂ s (6:3): *Astereæ*: Solidago canadensis; *Helianthea*: *Bidens aristosa*, *Coreopsis tripteris*, Helianthus grosseserratus, *H. tuberosus*, *type* Aug. 22, Rudbeckia subtomentosa.

Stylopized: Aug. 11, 12.

VERBENAPIS VERBENÆ (3).— ♀ c (3): *Verbenaceæ*: Verbena hastata, V. stricta, V. urticifolia. The concealed

pollen is drawn from the narrow tubes by inserting the front tarsi with their curled spines.

♂ s (3): *Verbenaceæ*: Verbena hastata, V. stricta, V. urticifolia.

♂ ♀ in copula (4): Verbena stricta, July 11, 21; V. urticifolia, July 15, 17.

ZAPERDITA MAURA (2).—♀ c (1): *Solanaceæ*: Physalis lanceolata.

♀ s (1) : *Solanaceæ*: Physalis virginiana.

♂ s (2) : *Solanaceæ*: Physalis lanceolata, P. virginiana.

PAIRING HABITS.—Both sexes of all of the species were found. Thirty pairs belonging to eight species were taken in copula. The differences are remarkable. Of eight species no pairs were seen together, while of *Calliopsis coloradensis*, which flies only 36 days and visits only five flowers, seven pairs were taken together, forming a majority of the specimens.

VISITS TO FLOWER CLASSES.—The table shows 144 visits to 85 flowers. Mas shows 37.6 per cent. of the flowers visited and 45.1 per cent. of the visits. Red shows 35.2 per cent. of the flowers visited, while yellow shows 49.3 per cent. of the visits. *Calliopsis andreniformis*, with 35.4 per cent. of the total visits, shows 29.4 to Mas and 43.1 to red. Separating this species the remaining 15 show for Mas 51.1 per cent. of the flowers and 53.7 per cent. of the visits, and for yellow 53.3 per cent. of the flowers and 67.7 per cent. of the visits. Seven species, *C. coloradensis*-*P. solidaginis*, show 78.4 per cent. of their visits to Mas and 90.1 to yellow. The last five show 63.8 per cent. under Mis and 44.4 under white. As a rule the visits of the males do not differ much from those of the females, but in *Calliopsis andreniformis* the male shows 5.8 less in percentage of visits to Mas, 11.0 less red and 14.9 more to white.

TABLE I.

	Non-social		Social			Total	Colors		
	Ma	Mi	Mas	Mis	Pol		R	W	Y
Flowers observed	30.1	24.2	18.8	21.5	5.2	441	30.3	38.7	30.8
Anthemurgus passiflorae	..	1	..	..	..	1	..	1	..
Zaperdita maura	..	2	..	..	..	2	..	..	2
Verbenapis verbenae	..	.	2	1	..	3	2	1	..
Calliopsis andreniformis	12	9	15	10	5	51	22	21	8
coloradensis	..	.	3	2	..	5	..	1	4
Pseudopanurgus albitarsis	..	..	8	3	..	11	2	1	8
labrosiformis	..	..	10	1	..	11	..	..	11
labrosus	..	..	4	..	..	4	..	..	4
rudbeckiae	..	..	4	2	..	6	..	..	6
rugosus	..	..	7	..	..	7	..	..	7
solidaginis	..	..	4	3	.	7	..	1	6
asteris	..	..	3	5	..	8	1	2	5
compositarum	..	..	4	8	..	12	2	6	4
Perdita octomaculata	..	..	1	5	1	7	..	4	3
Perditella boltoniae	..	..	..	1	..	1	..	1	..
Heterosarus parvus	2	1	..	4	1	8	2	3	3
Total visits	14	13	65	45	7	144	31	42	71
Flowers visited	15.2	15.2	37.6	25.8	5.8	85	35.2	31.7	32.9
Visits	9.7	9.0	45.1	31.2	4.8	144	21.5	29.1	49.3
Calliopsis andreniformis	23.5	17.6	29.4	19.6	9.8	51	43.1	41.1	15.6
Others: Flowers visited	4.4	8.8	51.1	31.1	4.4	45	20.0	26.6	53.3
Others: Visits	2.1	4.3	73.7	37.6	2.1	93	9.6	22.5	67.7
C. col.—P. sol. 7	..	..	78.4	21.5	..	51	3.9	5.8	90.1
P. ast.—Heterosarus 5	5.5	2.7	22.2	63.8	5.5	36	13.8	44.4	41.6
C. andreniformis ♀	21.4	16.6	33.3	21.4	7.1	42	52.3	33.3	14.2
C. andreniformis ♂	20.6	17.2	27.5	20.6	13.7	29	41.3	48.2	10.3

ANTS OF THE GENUS FORMICA IN THE TROPICS

By William Morton Wheeler.

The genus Formica belongs to the northern hemisphere and is best represented in the north temperate or subboreal zone, from which the number of species dimishes rapidly towards the pole and towards the equator. One species, *Formica fusca,* is so eurythermal that it and its many varieties may be said to be nearly coextensive in range with all the remaining species of the genus. Certain data recently accumulated show that through commerce a few of the species have succeeded in establishing themselves in the tropics. These data and the original distribution of the genus are briefly considered in the following paragraphs.

A map of the distribution of the genus Formica shows that it covers nearly the whole of Europe as far north as North Cape, where Sparre-Schneider (1909) has taken it between latitude 69° to 70° N., that is within the arctic circle. In Asia the range is even wider, since it probably reaches the same high latitude and extends as far south as Soochow, China and the Himalayas (28° to 30° N.). A corresponding southward distribution in Europe is, of course, precluded by the Mediterranean. In the New World Formica covers most of the Nearctic Realm. I have shown (1913) that in Alaska *F. fusca* and its varieties *marcida* Wheeler and *neorufibarbis* Emery range at least as far north as 64° to 67°, that is up to Fort Yukon, on the arctic circle. Eastward *F. fusca* occurs on the coast of Labrador, but no Formicidæ are known to exist in Greenland and Iceland, according to Pjetum and Lundhein, cited by Forel (1910). Prof. Pilsud, Director of the Danish Biological Laboratory on Disko Island, on the west coast of Greenland, has recently confirmed this statement in my hearing. The southern range of Formica in North America seems to stop at about 30° in the United States. I have seen no specimens from Florida, but have taken a couple of species near San Antonio, Texas and several along the Mexican border in western Texas, New Mexico,

Arizona and California. Some of these together with a few allied species occur also in Mexico, but apparently only at elevations of about 8000 ft., as far south as Hidalgo in the state of Guerrero (lat. 18°). In all probability the same Formicas inhabit the mountains of the state of Oaxaca and therefore extend the range of the genus to the southern limits of the Nearctic Realm, that is to the Isthmus of Tehuantepec.

Although there would seem to have been every opportunity both in Asia and Mexico for the spread of the species of Formica into the tropics, the only recorded instances of its occurrence are the following:

(1) Bingham in 1903 cites the taking of three workers and a female of the common European *F. rufibarbis* Fabr. by W. L. Distant in Pretoria, South Africa, only a short distance from the tropic of Capricorn (26° S.). This seems to be the only record of the genus occuring in the southern hemisphere. There would seem to be little doubt that the species was imported directly from Europe.

(2) According to Emery *F. fusca* var. *glebaria*, a common ant in central and southern Europe, has been imported into the gardens of Algiers. He calls attention to the fact that this insect does not occur in Crete nor on the smaller islands of the Mediterranean.

(3) In 1913 Forel described a var. *formosae* of *F. picea* Nyl. from Taihorin, Formosa, which is on the tropic of Cancer. *F. picea* is a boreal European ant, usually found in peat-bogs. Forel's variety may perhaps occur at a considerable elevation in the mountains, which in Formosa rise to an altitude of 9000 to 14,000 ft. In this case, therefore, we may be dealing with a relict instead of a recent importation like the two previous cases. Emery believes that the *F. fusca* var. *filchneri* described by Forel from China is really *F. picea*.

I was astonished to find among a fine collection of ants made for me by Dr. J. W. Chapman at Dumaguete, on the island of Negros Oriental, Philippines, several specimens of two species of Formica. One of them, represented by a number of workers, agrees in all respects with European and North American

specimens of the typical *F. fusca*, while the other, represented by four workers, is undoubtedly our common North American *F.* (*Proformica*) *neogagates* Emery subsp. *lasioides* Emery, or rather a slightly darker form approaching the var. *vetula* Wheeler. It seems probable that both these Formicas reached Dumaguete (lat. 9° 30′ N.) from the United States, in merchandise imported for the Silliman Institute, at which Dr. Chapman and several other Americans are teaching.

The actual occurrence of Formica species among the tropical ant fauna is of interest in connection with the composition of certain fossil faunas like that of the Baltic Amber, which is of Lower Oligocene Tertiary age. This fauna consisted to a considerable extent of tropical genera like Tetraponera, Iridomyrmex, Oecophylla, Dimorphomyrmex, Gesomyrmex, Pseudolasius, etc., but, as I have shown (1914), it also comprised several species of Formica and notably one, *F. flori* Mayr, which is very closely related to the existing *F. fusca*. It seemed to me that in the ancient Samland these Formicas must have lived at a greater elevation than the tropical genera, but the existence of Formicas at sea-level in the Philippines seems to indicate that even during lower Oligocene times what is now a north temperate ant-genus may have shared the same habitat as the various tropical forms.

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A NEW JAVAN CHILOPOD OF THE GENUS MECISTOCEPHALUS.

By Ralph V. Chamberlin.

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At Honolulu, Hawaii, a number of millipeds and centipeds were taken on Mar. 8, 1922, from soil of a shipment of plants from the Botanical Gardens of Buitenzorg, Java. Among these specimens, which were submitted to the writer for identification, were numerous specimens, mostly young, of the new species of Mecistocephalus described below. This form belongs to the lesser group of species in which the sternal impressions are not furcate anteriorly, and apparently has its nearest relatives in *M. apator* Chamberlin and *M. monticolens* Chamberlin, previously described from the same region. Two other chilopods were in the collection, *Otostigmus feæ* Pocock being represented by one specimen, and a species of *Lamyctes*, not in identifiable condition, by another. Two diplopods were represented, *Trigoniulus lumbricinus* (Gerstæcker) and *Oxidus gracilis* (Koch), the latter being a species long ago introduced into this country and Europe and often known as "the hot-house milliped."

Mecistocephalus tridens sp. nov.

Head and prehensorial segment chestnut, the remaining parts yellow.

Head wider than long in the ratio 14:9. Widest anteriorly and narrowing caudad, more abruptly so over caudal fourth of length, the general narrowing less marked than in *apator*. Anterior margin nearly straight, much as in *apator*.

Clypeal region with no anterior, non-areolated areas. With six principal setæ arranged as in *monticolens*, the sublateral teeth being also nearly of same from as in that species.

General outline of labrum as in *monticolens*, but the median piece narrower and about as wide behind as in front with the

sides a little concave. Caudal end of median piece straight and weakly tridentate. Anterior margins of lateral pieces concave, bending more strongly forward toward mesal ends. Caudomesal angles of lateral pieces a little produced, their apices on a level with caudal end of median piece.

Prosternal teeth small and acute. The usual teeth present on joints of prehensors, the distal one of femuroid being largest; all oblique and rather slender though distally rounded.

Sternal impressions not furcate anteriorly.

Ventral plate of pregenital segment strongly narrowed caudad, trapeziform. Coxal pores on each side small, moderate in number.

Pairs of legs, 49.

Length, 20 mm.

Cotypes in Museum of Comparative Zoology and in collection of The Federal Horticultural Board.

A UNIQUE METHOD OF DEFENSE OF *BREMUS* (*BOMBUS*) *FERVIDUS* FABRICIUS.[1]

By O. E. Plath,

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It is a well-known fact that bumblebees, especially the more ferocious species, are quick to attack with sting and mandibles if any vertebrate ventures too close to their nests. Similar punishment is meted out by many species if their nests are invaded by bees which do not belong to the colony, *e. g.* Psithyrus.[2] In this case the fate of the intruder may be shown by describing briefly the behavior of a fair-sized colony of *Bremus impatiens* Cresson when a queen of *Psithyrus laboriosus* Fabricius enters, or is placed in, its nest. As soon as the stranger is detected on or near the comb, a general uproar arises in the colony. The intruder is seized immediately by numerous workers, stung to death, and thrown out of the nest. This, in general, seems to be the behavior of a large number of Bremus species whose habits have been studied. But, as we shall see presently, one of our most common New England bumblebees, *Bremus fervidus* Fabricius, behaves very differently under these conditions.

During the summer of 1921, the writer had under observation 13 colonies of bumblebees belonging to the following species: *Bremus affinis* Cresson, *Bremus bimaculatus* Cresson, *Bremus fervidus* Fabricius, *Bremus impatiens* Cresson, and *Bremus vagans* Smith. Each colony was kept in a glass-covered box which was provided with a flight-hole so that the life of the colony could go on unhindered. On July 24th, the writer noticed a disheveled *Psithyrus laboriosus* queen crawling out from the nest material of colony No. 7 (*B. fervidus*) and removed her to a separate box. She was wet all over, her pile being matted against the integument by a sticky liquid. On the same day a worker of colony No. 8 (*B. impatiens*) which had been placed near

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 206.

[2]A genus of bumblebees whose members are social parasites on various species of the genus Bremus, the industrious branch of the bumblebee family (Bremidae).

colony No. 7 (*B. fervidus*) the preceeding evening, was found sitting near the entrance of her nest and, like the Psithyrus queen, was completely covered with a sticky liquid. Whenever this worker attempted to enter the nest, she was immediately attacked by her sisters and driven back. The reason for this strange behavior and the source of the sticky liquid, which the writer at first was unable to account for, were disclosed several days later.

On July 27th a captured *Psithyrus laboriosus* queen was placed in a *Bremus fervidus* nest and the writer was surprised to find that the workers, instead of creating a furore and killing the Psithyrus, as do the workers of *Bremus impatiens*, remained calm and resorted to a more peaceful, but equally effective, method of expelling the intruder. About a dozen workers gathered about the Psithyrus queen, and, after stealthily approaching a little closer, each one placed a small drop of liquid on the intruder with her mouth. The Psithyrus queen did not seem to relish this performance and slowly left the comb, apparently seeking to hide herself. A number of workers followed her and from time to time added more liquid until she was as wet as the Psithyrus queen and Bremus worker referred to above. The experiment was repeated with other *fervidus* colonies and was later (September 13th) demonstrated before the Cambridge Entomological Club. The members of the club were also shown the very different behavior of a *Bremus impatiens* colony under these conditions.

From July 27th to September 24th a large number of other experiments were carried out in order to determine how colonies of *Bremus fervidus* react to other intruders. These experiments may be summed up briefly as follows:

Experiment 1. Introduced: Young queen of *Psithyrus ashtoni* Cresson.

Result: Daubed with liquid like *Psithyrus laboriosus.* No attempts to sting her.

Experiments 2, 3, 4 and 5. Introduced (separately):

Workers of *Bremus affinis, bimaculatus, impatiens,* and *vagans.*

Result: Same as in experiment 1.[3]

Experiment 6. Introduced: Worker from another *fervidus* colony.

Result: Attacked with legs and mandibles. No attempt at daubing.[4]

Experiments 7, 8 and 9. Introduced (separately): Worker honeybee (*Apis mellifica*), male of *Bremus impatiens,* and male of *Polistes pallipes* Lepeletier.

Result: All stung to death and thrown out of the nest. No attempts at daubing.

Experiments 10, 11, 12, 13 and 14. Introduced (separately): Blue bottle fly (*Calliphora vomitoria*), drone fly (*Eristalis tenax*), dragon fly (*Sympetrum rubicundulum*), small cricket (*Nemobius sp.*), and gypsy moth (*Porthetria dispar*).

Result: Same as in experiments 7, 8, and 9.

Experiment 15. Introduced: Katydid (*Conocephalus sp.*).

Result: Stung to death, but also daubed.

Experiments 16, 17, and 18. Introduced (separately): Earth worm (*Lumbricus sp.*), young frog (*Rana sp.*), and mouse (*Mus musculus*).

Result: All stung to death. No attempts at daubing.

From these experiments it will be seen that the workers of a *Bremus fervidus* colony, at least when dealing with insects, vary their method of attack with the nature of the intruder. If stingless, or comparatively weak (*e. g.*, the honeybee), the intruder is seized immediately and stung to death, while daubing is invariably resorted to if the intruder possesses superior fighting ability. What enables *Bremus fervidus* to make these distinctions, it is difficult to say. In this connection it must be stated that

[3]In connection with experiment 4 it may be stated that a worker of *Bremus impatiens,* an exceedingly pugnacious species, sometimes attacks a *fervidus* worker, and may then be stung to death by one or more workers of the latter species, though other members of the colony, even during the struggle, continue to daub the intruder.

[4]Similar results obtain if two *fervidus* colonies are combined. During the course of the summer, the writer made four such combinations (one colony in each case being queenless), but never noticed any daubing.

bumblebees never molest certain intruders, *e. g.* the larvæ of Brachycoma, even though the latter are very deadly to their brood.

At first there was some doubt as to the nature of the liquid which *Bremus fervidus* uses in connection with this interesting behavior, but the writer finally decided that it is honey. This conclusion is based on the following facts: (1) the liquid has a sweet taste; (2) a young *Psithyrus ashtoni* queen which was being daubed (experiment 1), lapped up a drop of liquid which accidentally adhered to some cotton; and (3) the *fervidus* workers themselves lapped up the liquid from the wings of a katydid (expirement 15) after the latter had been stung to death.

This habit of daubing certain intruders with honey recalls an interesting habit of the honeybee. According to Phillips (1921, p. 117), it sometimes happens that lizards or small snakes get into a hive. The honeybee workers seal up such intruders in propolis, a sticky substance which they obtain from trees and other sources. Because of the different nature of the substances used, it seems rather improbable that the habit of the honeybee and the habit of *Bremus fervidus* are related, yet it would be interesting to know whether there is any similarity in behavior while the substances are being applied.

It would also be interesting to ascertain whether any other species than *Bremus fervidus* resort to honey daubing. The writer found no trace of such a habit in his *affinis*, *bimaculatus*, *impatiens*, and *vagans* colonies. Nor is such a habit mentioned by Goedart (1700), Réaumur (1742), Huber (1802), Putnam (1865), Hoffer (1882-83), Kristof (1883), Coville (1890), Härter (1890), Bengtsson (1903), Lie-Petterson (1906), Wagner (1907), Gundermann (1908), Sladen (1912), Armbruster (1914), Bachman (1916), and Frison (1917, 1918), all of whom have paid more or less attention to the behavior of bumblebee colonies. However when we consider that Putnam (1865), who had colonies of *Bremus fervidus* under observation, did not notice this habit, it may well be that it was overlooked in other species.

According to the classifications of Franklin (1912-13) and Sladen (1912), one based on structure and the other on habit,

Bremus fervidus belongs to the Dumoucheli group and to the Pocket-makers, and it therefore is among the representatives of these groups that we should look first for species which are given to honey daubing.

As already mentioned, Bremus colonies are occasionally infested by parasitic bumblebees of the genus Psithyrus. According to Hoffer (1888, p. 132), this sometimes occurs in almost every second colony of certain species. Other Bremus species, on the other hand, never harbor these parasites (Cf. Sladen, 1912, p. 257), and this, as the writer pointed out recently (1922), also seems to be the case with *Bremus fervidus*. It can hardly be doubted that the honey daubing habit of *Bremus fervidus* plays an important role in keeping Psithyrus from breeding in its nests.

In his "Catalogue of British Hymenoptera" Smith (1855, p. 210) makes the following statement in regard to the apparent immunity of certain English Bremus species from Psithyrus infestation: "Although I have taken or examined a very large number of the nests of Bombus [Bremus], I have only occasionally met with the parasites [Psithyrus] in them; but never in the nests of the brown bumble-bees." All of these brown species to which Smith refers (*agrorum*, *distinguendus*, *helferanus*, and *muscorum*), like *Bremus fervidus*, are Pocket-makers. However, Hoffer (1888, p. 132) found that in Austria two of these brown species (*agrorum* and *helferanus*) are frequently victimized by *Psithyrus campestris* Panzer, and Wagner (1907, p. 78) reports that in Russia *Bremus muscorum* suffers severely from the depredations of various species of Psithyrus. *Bremus distinguendus* Morawitz, the other species mentioned by Smith, is very similar to *Bremus fervidus* in structure,[5] coloration, and habit. It is also very closely related to *Bremus latreillellus* Kirby[6] so that Morawitz (1881, p. 238) and Friese and Wagner (1910, p. 75) merely look upon it as a variety of the latter. According to Sladen (1912, p. 257), *Bremus latreillellus* is not preyed upon by any species of Psithyrus; nor has any

[5]Cf. Sladen (1912, p. 187) and Franklin (1912-13, I, p. 392).

[6]Cf. Hoffer (1882-83, II, p. 72); Radowszkowski (1884, p. 77); Sladen (1912, pp. 184, 187); d Lutz (1916, p. 503).

Bremus distinguendus colony ever been reported as victimized by a Psithyrus. These facts lead the writer to surmise that *Bremus distinguendus*, *latreillellus*, and perhaps also *Bremus fragans* Pallas, may prove to be "Honey-daubers."

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NOTES ON THE NESTING HABITS OF SEVERAL NORTH AMERICAN BUMBLEBEES. [1]

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In a comprehensive paper on the bumblebees of Central Europe, Friese and Wagner (1910, p. 69) make the following statement: "Insbesondere lässt die Kenntniss der Nester noch allzuviel zu wünschen übrig, was um so empfindlicher ins Gewicht fällt, als gerade von dieser Seite her die vielleicht wertvollsten Aufschlüsse zu erwarten stehen, weil allen Folgerungen, die lediglich auf einem durch Fang der frei fliegenden Tiere gewonnenen Materiale basieren, notwendigerweise eine gewisse Unsicherheit anhaften muss." The truth of this statement has been amply proved by the work of Drewsen and Schiödte (1838), Smith (1876), Schmiedeknecht (1878), Hoffer (1881, 1882 83, 1885, 1888), Coville (1890), Sladen (1899, 1912, 1915), and Frison (1916, 1917, 1918, 1921).

What Friese and Wagner (p. 69) have to say concerning the Central European bumblebees, is even more true of our American species. Of the 86 New World species of Bremus (Bombus) listed by Franklin (1912 13, 1914) and Frison (1921a), the nesting habits of only 17 have thus far been recorded,[2] but some of these data are so incomplete that they have little or no value. It is the object of this paper to add another species (*Bremus occidentalis* Greene) to those enumerated below and to supplement our knowledge concerning the nesting habits of

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 211.

[2]Those of *Bremus affinis, auricomus, bimaculatus, borealis, cayennensis, emeliæ* (*thoracicus*), *fervidus, flavifrons, impatiens, pennsylvanicus, perplexus, rufocinctus, separatus, ternarius, terricola*, and *vagans*;by Putman (1865), Coville (1890), Hudson (1892), von Ihering 1903), Franklin (1912/13), Howard (1918), and Frison (1916, 1917, 1918, 1921).

several others. A brief résumé of all that is known of the nesting habits of the 9 species treated in this paper has been added, in order to make these data as complete as possible. The new facts which I have recorded in the following paragraphs are based on observations of 55 bumblebee colonies which were discovered at Berkeley, Calif., Washington, Me., and Boston, Mass., during the summers of 1920, 1921, and 1922, and on copious field notes.

The interesting beetles of the genus Antherophagus, and also mites of the family Gamasidæ, occurred in almost every one of the 50 nests which I examined, and in one case over 20 of the beetles were found; but, to avoid useless repetition, the individual cases are not cited below.

Terrestris Group.

I. *Bremus affinis* Cresson.

Very little is known concerning the nesting habits of this bee. Some years ago, Franklin (1912/13, I, p. 280) found a nest in southern Vermont during the early part of July. It was situated in an open mowing place on the surface of the ground, and, since it contained but a few cells with partially developed larvæ, had apparently been started only shortly before by the queen. Franklin (p. 280) makes the following statement regarding the location of this nest: "Although this was a surface nest, the fact that the queens of this species are never seen in abundance, while the workers and males in late summer often appear in large numbers, together with the fact that their nests are so seldom found, leads me to the opinion that they are usually subterranean."

The surmise expressed in the forgoing quotation is confirmed by my own observations. Of 9 *Bremus affinis* nests discovered in the Arnold Arboretum (within the city limits of Boston) during the summers of 1921 and 1922, every one was subterranean. They were situated from 1 to 4 ft. below the surface of the ground and had tunnels varying from 18 inches to 8 ft. in length. The

largest colony was taken on September 1, 1922. It contained the old queen, 19 young queens, 27 males, and over 175 workers.

Not long ago, Bequaert (1920) described a new variety of *Bremus affinis* which he called *novæ-angliæ*. This variety occurred in 2 of the 8 nests mentioned above. The first of these was taken July 11, 1922. It contained (1) the old queen, 1 young queen, and 43 workers of *Bremus affinis*; (2) 12 workers of *Bremus affinis* var. *novæ-angliæ*; and (3) 1 worker of *Bremus terricola* Kirby. The second nest was taken August 4, 1922. In it were found (1) 23 workers of *Bremus affinis*; (2) 9 workers of *Bremus affinis* var. *novæ-angliæ*; and (3) 1 worker of *Bremus terricola*. The contents of these two nests, and the character of the bees reared from the second, suggest that *Bremus affinis* var. *novæ-angliæ* Bequaert is a hybrid between *Bremus affinis* and *Bremus terricola*, a question which will be discussed in another paper.

Two other of the 8 *Bremus affinis* nests were victimized by *Psithyrus ashtoni* Cresson. One of these, on August 9, 1921, contained (1) the old queen and about 100 workers of *Bremus affinis*; and (2) the old queen, 3 young queens, and 6 males of *Psithyrus ashtoni*. A detailed account of the subsequent history of this *affinis-ashtoni* colony has appeared in another paper (1922). The second colony parasitized by *Psithyrus ashtoni* was taken on July 26, 1922. It contained (1) the old queen and about 20 workers of *Bremus affinis*; and (2) the old queen (dead), 2 young queens, and 2 males of *Psithyrus ashtoni*. During the following weeks several more young Psithyrus queens and males were obtained from this colony.

Bremus affinis frequently stores a considerable quantity of pollen in long, waxen cells, which Hoffer (1882–83, II. pp. 85, 86) called pollen cylinders. I noticed a number of these pollen cylinders in 2 of the 8 *Bremus affinis* colonies. Both of these colonies were rather large, each one having over 150 workers. In one of these two nests most of the pollen cylinders were from 5 to 6 cm. long, and the total pollen contained in them weighed about 2 ounces.

The queen of *Bremus affinis* is colored differently than the workers and males, and for a time it seemed doubtful whether the two groups belonged together (cf. Franklin 1912/13, I, p. 280). My observations confirm the conclusions of Bridwell and Franklin.

In the vicinity of Boston, the queens of *Bremus affinis* leave their winter quarters toward the end of April, and most colonies are probably started in May. The workers begin to appear toward the end of May, and the young queens and males are largely produced in August and September. The more prosperous nests do not break up until October.

Bremus affinis is gentle as compared with such species as *Bremus fervidus* and *Bremus impatiens*. When one disturbs their nest, the foraging workers, as a rule, immediately fly away as soon as they notice the intruder.

II. *Bremus occidentalis* Greene.

There seems to be no record (cf. Franklin 1912/13, I, p. 273) that a nest of *Bremus occidentalis* has ever been taken. I accidentally discovered 2 nests of this species at Berkeley, Calif. during the summer of 1920, both of which were subterranean. One of these was about 2 ft. below the surface of the ground, and contained (July 12th) 5 young queens and over 80 workers. This colony was transferred to an observation box, but soon afterwards was destroyed by Argentine ants (*Iridomyrmex humilis* Mayr). The other colony was not dug up.

Bremus occidentalis is similar in disposition to *Bremus affinis*.

III. *Bremus terricola* Kirby.

Practically nothing is known concerning the nesting habits of this species. Coville (1890) probably took a colony near Ithaca, N. Y. during the summer of 1885, but he only briefly refers to its egg-laying habits.

I took a nest of this species near the Arnold Arboretum on July 3, 1922, and about two weeks later another nest was taken by Dr. E. S. Anderson, at Washington, Me. The nest which I took was situated 9 inches below the surface of the ground with

a tunnel 1 ft. long; the other, according to Dr. Anderson, was about 3 ft. below the surface, and had a tunnel 21 ft. long. The nest taken near the Arnold Arboretum contained (1) 9 young queens and about 60 workers of *Bremus terricola*; and (2) the well-preserved bodies of a *Bremus impatiens* and a Psithyrus queen belonging to the Laboriosus Group. In the other, Dr. Anderson found (1) the old queen and about 125 workers of *Bremus terricola:* and (2) numerous pseudo-scorpions.

In the vicinity of Boston, *Bremus terricola* is the first bumblebee to appear in spring. In 1922 several queens were seen on willow as early as April 13th. Most colonies are probably started between the 15th of April and the 15th of May. The workers begin to appear shortly after the middle of May, and most of the young queens and males are produced in July and August. I have never seen any workers after September 1st.

The workers of *Bremus terricola* are somewhat more vicious than those of *Bremus affinis*.

Borealis Group.

I. *Bremus borealis* Kirby.

Coville (1890, pp. 198,201) records taking a nest of this species in July 1885 near Ithaca, N. Y. It contained "the queen and a large number of workers," but nothing is said as to whether the nest was situated on, or below, the surface of the ground.

On July 8, 1922, I noticed a *Bremus borealis* queen searching for her nest among the mowed grass near a stump, about a mile from the Arnold Arboretum. She was carrying a big load of pollen and repeatedly arose into the air to take her bearings. Whenever she alighted, she hurriedly crept about among the grass, at times frantically shaking her wings. I removed all the cut grass within a radius of about 10 ft. of the stump, but even then she was unable to find her nest. Fearing that she might desert the place, I captured and used her for breeding experiments which will be described in a separate paper. Although I searched carefully near the stump, no surface nest

could be found, and it is therefore probable that this nest was subterranean.

In the neighborhood of Boston, *Bremus borealis* is extremely rare. Most of the queens probably do not appear until late in spring. Three other queens which I captured in 1922 were taken May 29th (on Diervilla), June. 6th (on Rhododendron), and July 2nd (searching for a nesting site). However I have never seen any workers or males of this species near Boston.

Pratorum Group.

I. *Bremus bimaculatus* Cresson.

The only nest of *Bremus bimaculatus* of which we have a record was taken by Franklin (1912/13, I, p. 308) on July 15, 1904, at Bernardstown, Mass. It was situated on the surface of the ground, among the bases of saplings, in a thicket of alders, and contained 6 queens, 10 workers, 9 males and a considerable number of cells with partially developed larvæ.

I found 4 nests of this species in, or near, the Arnold Arboretum during the summers of 1921 and 1922. All were subterranean, and from 6 inches to 1 ft. below the surface of the ground, the tunnels varying from 9 inches to 4 ft. in length. One of the shorter-tunneled nests, taken July 3, 1921, was almost completely destroyed by the larvæ of the tachinid fly, *Brachycoma sarcophagina* Townsend (det. Mr. C. W. Johnson). This nest also contained several thief ants (*Solenopsis molesta* Say (det. Dr. G. C. Wheeler). The largest of the 4 nests contained (July 8, 1921) the old queen, 23 young queens, over 60 workers, and a considerable number of queen cells.

In the vicinity of Boston, the queens of *Bremus bimaculatus* appear at about the same time as those of *Bremus terricola*, *i. e.* during the latter half of April. Most colonies are probably started in May. Like *Bremus pratorum* in Europe, *Bremus bimaculatus* completes its life-cycle very early. The workers begin to appear in considerable numbers toward the end of May, while most of the young queens and males are produced in June and July. The nests break up in August.

Franklin (1912/13, I, p. 309) says that the workers of this species are "very waspish," a statement which is corroborated by my experiences.

II. *Bremus impatiens* Cresson.

Putnam (1865, p. 101) reports taking a nest of this species under an old stump, in an orchard, but gives no further details, while Franklin (1912/13, I, p. 313) has the following to say concerning the nesting habits of this bumblebee: "I have taken several nests of this species and have known of their being taken by others and, as far as I have been able to ascertain, they are invariably subterranean and the colonies often consist of a very large number of individuals." On August 31, 1904, the same author took a nest of *Bremus impatiens*, at Amherst, Mass. It was about 2½ ft. below the surface of the ground and contained 4 queens, 15 males, 321 workers, and 330 unbroken cells, 154 of which were queen cells.

I took 16 nests of this species during the summers of 1921 and 1922. Of these 16 nests, 11 were discovered in, and 5 near, the Arnold Arboretum, one of the latter being taken on the grounds of the Bussey Institution. All of these 16 nests, as well as several others which were not dug up, were subterranean. They were from 1 to 3 ft. below the surface, and had tunnels varying from 18 inches to 5 ft. in length. A number of these nests were situated in decayed stumps. Most of the colonies were very populous, the largest one consisting of over 450 workers (August 4, 1921). Five of the nests taken during the early part of the summer contained, in addition to the queen which "ruled" the nest, from 1 to 4 dead *impatiens* queens.

One of the 16 colonies was parasitized by a Psithyrus belonging to the Laboriosus Group. This nest, on August 8, 1922, contained (1) 17 males and about 75 workers of *Bremus impatiens*, as well as the well-preserved body of the old queen; and (2) the old queen and 2 males of Psithyrus. During the next few weeks, a considerable number of Bremus and Psithyrus males, and several Psithyrus females, were reared from this Bremus-Psithyrus colony.

Another of the 16 nests which was taken on September 11, 1922, contained (1) 31 males and about 50 workers of *Bremus impatiens*; (2) many adults and larvæ of Antherophagus; (3) a large number of spiny, dipterous larvæ (probably those of Fannia); and (4) numerous pseudo-scorpions (*Chelanops sanborni* Hagen (det. Mr. Nathan Banks). A few of these pseudo-scorpions were also found in one of the *affinis* nests. Mr. Nathan Banks has informed me that *Chelanops sanborni* is frequently found attached to the appendages of insects, especially those of Diptera. This fact, together with the fact that all 3 nests in which these pseudo-scorpions occurred, were at least 3 ft. below the surface of the ground, and had exceptionally long tunnels, suggests that Chelanops, like the beetles of the genus Antherophagus, gets into bumblebee nests by phoresy (cf. Wheeler, 1919).

Franklin (1912/13, I, p. 313) states that in the large nest of *Bremus impatiens* taken by him, the majority of the cells seemed to be entirely separate from one another. This was the case with most of the 8 *Bremus affinis* nests which I took, but it was not true of any of the 16 *impatiens* nests.

In addition to the main tunnel, which was about 1¼ inches in diameter, 3 of the most populous nests also had a narrower tunnel, about ½ inch in diameter, leading to the nest from the side opposite the main tunnel. Through this narrow tunnel, probably made by the bees themselves, nesting material was dragged in. In Europe, Wagner (1907, p. 11) found a similar narrow, secondary tunnel in connection with a nest of *Bremus lapidarius*, and concluded that it was constructed by the queen. However it seems more likely that this passage, if made by the bees, is excavated by the workers, and that it probably also serves as a ventilating shaft, for *Bremus lapidarius*, like *Bremus impatiens*, frequently has very populous colonies.

A prosperous *Bremus impatiens* colony stores a considerable quantity of honey and pollen. The latter, as in the case of *Bremus affinis*, is sometimes stored in pollen cylinders.

In the vicinity of Boston, the queens of *Bremus impatiens* appear in large numbers in May, and most colonies are probably

started between the middle of May and the middle of June. The workers begin to appear about the first week of June, and the majority of the young queens and males hatch in August and September. The workers may be seen foraging as late as October.

Bremus impatiens is one of the more vicious species.

III. *Bremus vagans* Smith.

A nest of this species was discovered by Putnam (1865, p. 98) in 1862 at Warwick, Mass., but it is not clear from his description, whether it was situated in an old stump or under a pile of stones. A nest taken by Beutenmüller (cf. Franklin, 1912–13, I, p. 354), at Potato Knob, North Carolina (elevation 6,420 ft.), about July 1, 1902, was situated in a hollow tree, and contained 2 queens and 8 workers, but several individuals escaped. A third nest, taken by Franklin (1912–13, I, p. 354) July 20, 1904, on the surface of the ground, contained 2 queens, 2 males, and 8 workers.

I took 6 nests of this species in, or near, the Arnold Arboretum during the summers of 1921 and 1922. Two of these were surface nests, while the remaining 4 were subterranean. The latter were all about a foot below the surface of the ground and had tunnels varying from 1 to 5 ft. in length. The largest nest contained (August 2, 1921) the old queen, over 70 workers, and a considerable quantity of brood. This colony, as has been stated in another paper (1922), was later victimized by a Psithyrus.

In addition to the nest just mentioned, 2 others were parasitized by Psithyri. One of these was taken June 26, 1922. It contained (1) the old queen and about 40 workers of *Bremus vagans*; and (2) a Psithyrus queen belonging to the Laboriosus Group. The other, taken July 20, 1922, consisted of (1) the old queen and 6 workers of *Bremus vagans*; and (2) a Psithyrus queen belonging to the Laborisous Group. From one of these two colonies a considerable number of Psithyrus males and several Psithyrus females were reared which are different from those obtained from the *Bremus impatiens* nest referred to above.

The taxonomic position of these Psithyri will be dealt with in another paper.

In the vicinity of Boston, the queens of *Bremus vagans* appear comparatively late. In 1922, the first ones were seen on May 15th, on barberry and apple blossoms. Most nests are probably started between the 15th of May and the 15th of June. The workers begin to appear about the 1st of June, while the young queens and males are produced chiefly during August. The colonies break up in September.

Franklin (1912/13, I, pp. 348, 354) states that *Bremus vagans* is exceedingly ferocious, and that the workers of the nest taken by him were the most vicious and ready to sting of any with which he has had experience. This was not true of the 6 colonies taken by me, the workers of all of these colonies being rather gentle as compared with those of such species as *Bremus fervidus* and *Bremus impatiens*.

Dumoucheli Group.

I. *Bremus fervidus* Fabricius.

Both Putnam (1865) and Franklin (1912/13, I, p. 393) have taken a large number of nests belonging to this species. Putnam found them on the surface of the ground, under boards, piles of stones, the flooring of a shed, and in stumps, while the nests taken by Franklin were all surface nests. The largest nest taken by Putnam (July 23, 1863, at Bridport, Vt.) contained about 70 adult bees, 150 cocoons, and 200 larvæ. Of the two largest colonies reported by Franklin, one, taken July 22nd, consisted of 1 queen, 2 males, 30 workers, and 125 unbroken cells; the other, taken September 7th, 7 queens, 3 males, and 37 workers.

I took 13 nests of this species in, or near, the Arnold Arboretum during the summers 1921 and 1922, one of the nests being situated on the grounds of the Bussey Institution. Another nest of this species was taken (August 1922) at Washington, Me., by Dr. E. S. Anderson, who was kind enough to turn the

colony over to me for observation. Of these 14 nests, 1 was situated 2 ft. above ground, in a stone wall, 4 were surface nests, and the remaining 9 were subterranean. These latter were from $\frac{1}{2}$ to 1 ft. below the surface of the ground and had tunnels varying from $\frac{1}{2}$ to 2 ft. in length. As in the case of *Bremus impatiens*, several of the nests taken during the early part of the summer contained one or more dead *fervidus* queens besides the one living.

Franklin (1912/13, I, p. 393) states that the nests of *Bremus fervidus* never contain a large number of bees, the largest nest taken by him consisting of 47 individuals, of which 37 were workers. However this is not always the case. Of the 13 nests which I took, 3 consisted of from 100 to 125 workers each, and this despite the fact that one of them was taken comparatively early in the season (July 18, 1922). Each one of these 3 colonies later produced more workers and more than a hundred males and young queens.

Of the 14 nests, one contained 22 large, dipterous larvæ which, judging by Sladen's (1912, p. 74) figure, were probably those of Volucella. Attempts to rear the larvæ proved unsuccessful.

When the first large *Bremus fervidus* nest was discovered during the summer of 1921, I at first thought I was dealing with a surface nest, for a large quantity of nesting material which contained about a dozen workers, covered the opening of the tunnel. This was also the case with 2 populous, subterranean nests of this species which I took during the summer of 1922. In Europe, Hoffer (1882/83, II, pp. 35, 36), Härter (1890, p. 74), and Bachmann (1915, p. 76), each found a similar "Vornest" or "Scheinnest" in connection with the nests of *Bremus pomorum* The only plausible explanation for these "pseudo-nests" seems to be that more nesting material is gathered by the colony than the nest cavity can hold.

In the vicinity of Boston, the queens of *Bremus fervidus* appear in large numbers during the latter half of May. In 1922 the first one was seen on May 7th. Most nests are probably started between the middle of May and the middle of June.

The workers begin to appear about the 1st of June, while the males and young queens are chiefly produced in August and September. The colonies, like those of *Bremus impatiens*, do not break up until October.

On page 99, Putnam (1865) makes the following statement concerning *Bremus fervidus:* "This.....species.....is of quite a gentle disposition, allowing its nests to be disturbed for some time before it makes any show of resistance, merely exhibiting its uneasiness by buzzing." I cannot subscribe to this statement. Of all the species with which I have had experience—including *Bremus terrestris, lapidarius, agrorum, muscorum, sylvarum,* and *helferanus* in Europe—, *Bremus fervidus* is by far the most vicious. Usually, when its nests are disturbed, one or more workers at once pounce on the intruder and punish him. If he takes to his heels, they sometimes follow him for a hundred yards or more. I was stung severely by this species on several occasions.

Bremus fervidus, as I have pointed out recently (1922a), has the interesting habit of expelling the queens and workers of other Bremidæ from its nests by daubing them with honey.

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THE MATING OF DIACAMMA[1]

By W. M. Wheeler and J. W. Chapman.

Diacamma is a very clearly defined genus of Ponerine ants confined to India, Ceylon, Southern China, the Malay Archipelago, New Guinea and the northeast corner of Australia. The species were carefully monographed by Emery in 1897, and a list of those known in 1911 was published by the same author in the "Genera Insectorum". There are only thirteen species, but one of them, the Indomalayan *rugosum* has some 25 subspecies and varieties. All the species have large black or bronzy, more rarely beautifully metallic blue or green, workers (Fig. 1), and pale yellow or yellowish red males (Fig.2), with very long antennæ and the pygidium terminating in a curved spine.

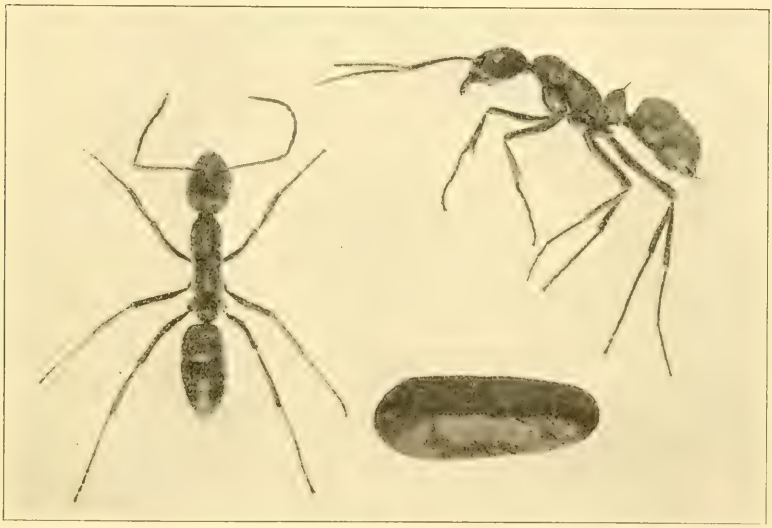

Fig. 1. Worker of *Diacamma australe*, dorsal and lateral view and black cocoon of same x4.

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 212.

Fig. 2. Male of *Diacamma australe* x5.

The workers are very agile and graceful in their movements and both Rothney (1889) and Bingham (1903) regard them as by far the most intelligent of Oriental ants.

The species of Diacamma are also of unusual interest from the fact that although several of them are common and have often been observed in the field, no one has ever been able to find in any one of them a form corresponding to the winged, fertile female, or queen of other ants. Frederick Smith (1863), nearly 60 years ago, described a worker and "female" of *D. rugosum* subsp. *tortuolosum* and remarked that "the sexes were identified by Mr. Wallace", but there can be little doubt that he had before him a female belonging to some very different Ponerine genus, possibly Bothroponera. In 1899 Col. Bingham remarked that "Diacamma ♀ has been for years a desideratum of Myrmecologists", and he adds: "It makes me feel sad to think of the many nests I have ruined, the hours of hard labour I have spent, and the language I have used in the futile search for ♀ Diacamma". He then describes two specimens which he found escaping from

a nest of *D. rugosum* subsp. *vagans* var. *indicum* and took to be queens, but in 1903 he was compelled to admit that what he had seen was "only a large male." The perusal of his description, however, shows that he could not have seen even males of Diacamma, for they were colored like the worker and sculptured, whereas the male of *vagans*, of which we have numerous specimens, is smooth and yellow. There can be no doubt that he saw males of a very different Ponerine ant, namely *Odontoponera transversa* Smith, and that he must have been mistaken in regard to their belonging with the *vagans* workers among which he found them.

These failures led Emery (1911, p. 64 *nota*) to conclude that "we must suppose that the female Diacamma resembles the worker so closely as to be confused with it." In 1914 the senior author studied *D. australe* at Cairns and Kuranda in Northern Queensland and, after alluding to the failure of previous observers to find the missing phase, made the following statement (1915b, p. 335): "In excavating the nests of *australe*, therefore, I scrutinized the ants very closely in the hope of finding the unknown female, but in vain. Though I searched dozens of nests, I saw nothing resembling a winged female or even a worker with conspicuously enlarged gaster. I found plenty of larvæ and pupæ and in some of the nests during late October a number of males. These are bright reddish yellow, with conspicuously long antennæ and quite unlike the bronzy black workers. As I failed to find any differentiated queen and as all the pupæ were of the same size, I feel confident that in Diacamma the egg-laying function must be usurped by one or more fertile workers during the breeding season."

That the assumptions of Emery and the senior author were well founded has now been demonstrated by the junior author's observations on *D. rugosum* subsp. *geometricum* Smith in the Phillippines. During a sojourn of six years at Dumaguete in Negros Oriental he found *D. geometricum* to be a common ant from sea-level to about 3000 ft., living in open "cogon" or shrubby places along the edges of forests, where the vegetation is only three or four meters high. Here it nests under the bark of

old logs or dead, standing tree-trunks and fills any chinks or openings with vegetable detritus.[1] The colonies are small, comprising, when fully developed, scarcely more than 50 workers and a dozen males. The workers are rather circumspect and cowardly and the males tend to fly out of the nest as soon as it is opened. The latter, like the males of Leptogenys and the Dorylines, are frequently taken at lights. On April 14, 1922 a nest of *geometricum*, situated under the loose bark of a large knot at the base of a standing tree trunk, was investigated and found to contain an average colony of workers with some eight males, a number of young and full grown larvæ and a few cocoons, which, as the senior author has shown (1915b) for this and other species of the genus, are dark brown or black. One of the males was copulating with a worker and as the pair failed to separate even after preservation in alcohol, we have been able to secure the accompanying photograph and drawing (Figs. 3 & 4). The fact that the wings of the male had been gnawed away at their

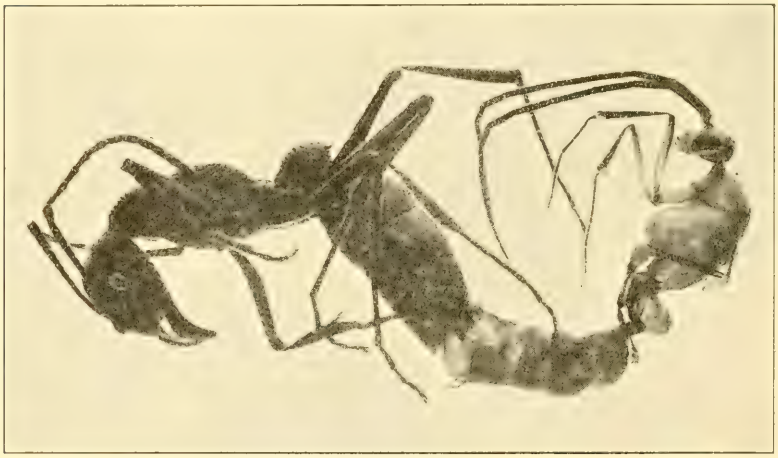

Fig. 3. Fertile worker and male of *Diacamma rugosum geometricum* in copula, from the left side x5.

[1]Nearly all the nests contain a number of small cylindrical vegetable bodies, which prove to be the joints of the flower panicle of a peculiar grass (Rottboellia).' These joints, each of which contains a seed, are scattered by the plant, collected by the ants and stored in their nests. It would seem, therefore, that *D. geometricum* is to some extent vegetarian.

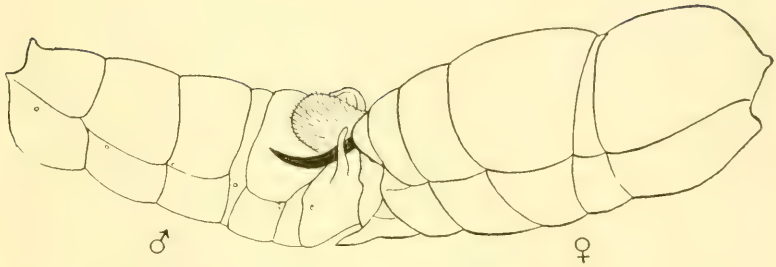

Fig. 4. Gasters of worker and male *Diacamma rugosum geometricum* from the right side x7.

bases suggests that the workers may thus prevent the escape of members of the opposite sex from the nest. The same mutilation is also practised on the males of Eciton, as noticed by W. Müller (1886) and the senior author (1921, p. 312). And since the other males taken in the same Diacamma nest were not deälated, it would seem that the workers do not mate with the males of their own colony, that is with their sons or brothers (adelphogamy), but with males that have come from other colonies. The very long sensitive antennæ of these insects, so like those of the Ichneumons, may enable them the more easily to seek out alien colonies of their own species. The small size of the Diacamma colony, moreover, indicates that only a single worker is fecundated and assumes the role of a queen, for if several or all of the workers laid fertilized eggs the colonies should be much more populous.

Externally the worker found *in copula* differs neither in size nor in structure from any of her sisters. Examination of the materials in the senior author's collection shows that both in *rugosum* and its varieties and in the various other species of the genus all the workers taken from the same colony are singularly uniform in size and structure, even to the minute details of sculpture and pilosity. As will be seen from Fig. 4, which shows the gasters of the mating individuals from the right side, the male and female genital orifices are in broad and very intimate contact. The powerful sting of the female is extruded and is held down by the finger-shaped process of the right external genital valve of the male.

Dissection of a number of Diacamma workers and especially of the mating worker supports the inference that only one individual in a colony assumes the reproductive function at a time. Unfortunately the material had been in rather weak alcohol for several months and the very hard chitinous integument of the gaster had prevented penetration, so that the internal organs were considerably decomposed. In many of the workers, of which more than 20, belonging to three colonies, were dissected, no ovaries could be detected. In one, however, two ovarioles were clearly seen, each of the type figured by Miss Holliday (1903, Fig. Ab, p. 295) for the ergatoid queen of *Lobopelta elongata*, i.e. with a large number of very small ova separated by clusters of nurse-cells. Such undeveloped ovaries were probably present in all the specimens but could not be detected on account of defective preservation. This may also explain our inability to find a spermatheca in any of these individuals. Fortunately the mating worker was in a somewhat better state of preservation. The ovaries were found very far forward, in the large first gastric segment and applied to the sides of the crop. There were five ovarioles in each ovary and the lowermost egg in each ovariole was fully developed and of an elongate-oblong shape, as in some other Ponerinæ (Pachycondyla, Lobopelta). The vagina and a large spermatheca attached to its dorsal wall were filled almost to bursting with compact masses of spermatozoa.

For some time evidence has been accumulating to show that Diacamma is not the only ant genus in which the winged queen has been lost and her function in the colony usurped by a fertile worker. The senior author, in the paper above mentioned (1915b, p. 337), called attention to the fact that winged females do not exist in the Ponerine genus Rhytidoponera, which is represented by a number of species in the Australian and Papuan Regions. The same condition very probably obtains also in the South African Streblognathus and Ophthalmopone and in the Neotropical Dinoponera, all genera belonging to the same subtribe as Diacamma (Pachycondylini). He also stated in his monograph of the Australian honey-ants of the Dolichoderine genus Leptomyrmex (1915a, p. 260) that true queens are in all probability absent

in this genus and "that there are in each colony one or more fertile workers which supply the eggs that delevop into workers and males." And Arnold (1916, p. 195) says of a species of the South African genus Ocymyrmex, which belongs to the subfamily Myrmicinæ: "I have frequently dug up the nests of the variety *arnoldi* [of *O. weitzaeckeri* Emery] without ever having found a female of any sort, nor have females of any species been described up to now. I believe that the genus will be found to have only ergatoid queens, or that the egg-laying function (with the production of males and females) is possessed by the whole worker caste."

The fertile workers of Diacamma which function as queens are obviously not to be confused with two other types of wingless females, the ergatoid, or ergatomorphic queens and the dichthadiigynes.[1] Ergatoid queens are of rather frequent occurrence, either as the only form of fertile female or coexisting in the same species with winged queens, in one genus of Pseudomyrminæ (Viticicola), in at least one genus of Formicinæ (Polyergus), in several Myrmicine genera (Monomorium, Myrmecina, Leptothorax, Crematogaster, Harpagoxenus, etc.) and especially among the Ponerinæ (Eusphinctus, Cerapachys, Acanthostichus, Acanthoponera, Paranomopone, Alfaria, Megaponera, Ponera, Onychomyrmex, Leptogenys, Anochetus and Champsomyrmex).

In some cases (Leptogenys, Paranomopone, Megaponera and Eusphinctus) the queens differ very little from the workers, except in having traces of ocelli, a somewhat thinner petiole or a larger abdomen; in others the thorax is more complicated in structure and approaches that of the winged queen, while in still others (Acanthostichus, Onychomyrmex, Nothosphinctus) there is an approach to the dichthadiigyne, which is the only queen in all the genera of Dorylinæ, a characteristic form with very simple thorax, without eyes or with minute vestiges of eyes and ocelli and with a huge abdomen. Most of the ergatoid forms may be derived from the typical winged queen through a loss of the wings and a progressive, degenerative simplification of other characters,

[1]A fourth form of female, the pseunogyne, is not discussed because it is pathological and does not function as a reproductive caste.

but it is conceivable that the dichthadiigynes may have arisen from fertile workers like those of Diacamma after complete phylogenetic suppression of the winged queen. The latter supposition will have to be tested by thorough morphological study of all the available fertile female forms.

The conditions in Diacamma are suggestive also from another point of view. It has long been known that well-fed worker ants may lay eggs, but no one has ever seen a male copulating with a worker, and only Reichenbach, Mrs. Comstock and Crawley have found that eggs laid by workers may develop into workers. All other authors (Miss Fielde, Janet, etc.) maintain that such eggs invariably produce males. In *Diacamma geometricum* we actually have an ant whose workers copulate with the males and must therefore produce worker as well as male offspring, since there is no morphologically differentiated queen. Further studies of tropical ants in the field will probably compel us to to abandon certain other generalizations which we have reached from a too exclusive study of temperate European and North American species confined in artificial nests.

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NOTES ON THE FEEDING HABITS OF SCORPION-FLIES (MECOPTERA: PANORPIDAE).

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New York City.

The classical theory that adult Panorpids, or scorpion-flies, are predatory has no basis in fact. I refer to the observations of Felt (Tenth Report, N.Y. State, Entom pp. 463-480, 1893), in America, of Campion (The Entomologist, Vol. xlv, p. 322, 1912 in England, and of Miyake (Journ. Coll. Agric. Tokyo, Vol. iv, pp. 117-139, 1912), in Japan, all of which tend to establish that these interesting creatures feed upon dead animal matter, but never prey upon the living. Moreover, Miyake noted that *Panorpa klugi* M'Lach., which he studied in captivity sometimes feeds upon flowers, causing the petals to drop. Later, he (Ibid, pp. 265-400, 1913) reported observing in the fields "many scorpion-flies (*P. klugi*) swarming about a shrub and eagerly sucking its juicy fruits."

In connection with these observations, I wish to put on record here, that two species of scorpion-flies common in the vicinity of Ithaca, N. Y., namely *Panorpa rufescens* Ramb. and and *P. maculosa* Hagen will in captivity feed upon raspberries, strawberries, cherries, sliced bananas and apples, just as readily as upon dead wasps, house flies, caterpillars, spiders, etc. A few specimens were kept in a glass jar, containg a little moist earth in the bottom, and care was taken to provide them with dead insects along with the fruits. The scorpion-flies showed apparently an equally keen appetite for the animal and plant food. These observations, made in the summer of 1920, and again in 1922, taken together with Miyake's reports mentioned above, seem to show conclusively that adult Panorpids are mixed eaters, and that they cannot be called carnivorous as is commonly done in text-books.

A few words may be said regarding the method of feeding. Anatomically, because of the biting type of the mouth-parts, scorpion-flies may seem to be biting insects. By carefully

observing many individuals during their feeding, however, it occurred to me that they must be regarded primarily as sucking insects, rather than as biting ones. They were often seen practically motionless with their long "beaks" deeply inserted in their food substances. When they feed on insects, they first bite a hole through the chitinous skin, and then appear to suck the body fluid. It would seem probable that the long rostrum provided with biting mouth-parts at the end, so characteristic of this group of insects, is an adaptive developed in relation to these interesting feeding habits.

It may not be amiss to add, in conclusion, that the excreta of the scorpion-flies under consideration are always of liquid nature, as might be expected if they were sucking insects. In no case was there observed any solid or semisolid excrement, such as that of a biting insect.

NOTES ON THE GIPSY MOTH IN MY UNSPRAYED WOODS AT EAST MARION, MASS. 1922.

By Fred C. Bowditch, Brookline, Mass.

The Gipsy has been increasing in numbers for the last two seasons and I judged that this year would be the high-water mark of their infestation. My woods near the house include a grove of oaks (largely white) and another group of oaks and white pine, and various detached oaks between.

The caterpillars have the habit before pupating of bunching together, sometimes in great numbers along the trunk of the tree or under a branch. They spin a slight web and pupate in more or less of a loose mass; others in numbers of up to, say, ten or twelve, curl up in the leaves, or their remains, rather tending to keep at the ends of the branches, drawing the parts together in a loose bunch.

About the middle of June the caterpillars were very plenty and the trees began to look thin. The Calosomas (green) were

seen running on the trees though I did not see any attacks by them on the caterpillars (as observed in previous years); about the end of June the caterpillars were beginning to bunch up and I noticed at once Calosoma larvae working on them. These nearly always operated on some bunch of caretpillars on or near the trunk. The larvae were very voracious, eating constantly and increasing rapidly in size, their preference, if any, seemed to be caterpillars hunched up ready to become pupæ, because then they are perfectly helpless, almost torpid, still they constantly attacked the caterpillars and sucked out the pupæ. One small larva fastened into the rear of a full grown ♀ caterpillar, the latter threshed about, but the larva with his legs bent up held on tght and finally the caterpillar, still threshing, began to crawl rapidly up the tree, then juice began to drop from the body of the larva. He had got his head into the caterpillar, the latter stopped and the liquid ran down the larva. Next morning the caterpillar was a dry skin.

Various diptera attended the caterpillar bunches; only one, however, was actually observed to attack. This was a grayish fly somewhat larger than the domestic, and noticeably grayish on the upper side. The fly hovered over the caterpillars, lit on one and deposited a small white object, which I could see wiggle. Calling my man, who happened to be near by, we saw this little wiggler disappear into the body of the caterpillar at about his anterior third. This caterpillar I boxed to get the fly, but the caterpillar died of wilt. In addition to the insect enemies, the caterpillars were attacked by some form of "wilt" disease, which developed tremendously when they began to bunch up. For several days I had under observation one particular bunch of about seventy-five caterpillars, mostly large females. The disease would first show in a distending of parts of the body which gradually became semi-shiny, then the vitality would seem to go out of the caterpillar, his entire viscera would become putrid, and breaking open drop out, leaving the remains hanging. This bunch of seventy-five was kept at about the same size for some days by fresh additions. Not one spun a web and only once was a Calosoma observed. They all died of disease. Just after

the first of July we had the bunches of caterpillars, with the various enemies and disease, all working together making what my wife called"a stinking mess". Then occurred a three days storm and these messes were in spots a good deal broken up and washed down. Most of the caterpillars had pupated and the Calosoma seemed largely to have disappeared (I found one dead, quarter grown) though some of the larger still showed, sucking pupæ which they continued to do until the moths began to emerge about July 10th. By this time a great bulk of caterpillars and pupæ along the trunks etc. had been killed, the former showing partly as old skins and the latter as sucked and broken shells, but there still remained thousands to hatch, especially in the leafy bunches at the ends of the branches; with this hatching arrived our friends the birds. Our oaks were alive with them, robins gulping down some whole and gathering bunches in their mouths and carrying them off to their nests, kingbirds swooping down and picking a male fluttering near the ground as well as attending to the tops; several kinds of vireos, chickadees, various kinds of sparrows and small birds, and last but by no means least, a family of five young blackbirds with their parents. The young were very amusing . They kept up a continual chatter, following up the old birds and begging for grub, jostling each other and always all day long on the go. It would seem that the position of a blackbird parent was no sinecure. For two or three days this bird-fest kept up. It was a rare thing thing to see a male gipsy on the wing. The females on the trunks were not molested nearly as much, perhaps because they were perfectly quiet, but the fluttering males, were everywhere gobbled up. As soon as the main moth emergence was over most of the birds faded away and only a few remained to pick up stragglers.

The females begin to lay eggs almost at once. On all egg clusters that I have examined under the moth and before she has dropped off are to be seen the egg parasite, (the imported Japanese) the imago of which emerges this Fall, and which leaves the egg cluster looking like a small pepper pot with its numerous holes.

Thus in unsprayed timber we have the various insect enemies, the "wilt" or whatever the disease is, the birds devouring imagoes and the egg parasite. I look for a distinct betterment in the outlook for 1923.

SOME PARASITIC HYMENOPTERA FROM NEW ZEALAND.[1]

By Charles T. Brues.

Dr. R. J. Tillyard, Chief of the Biological Department of the Cawthron Institute for Scientific Research in Nelson, New Zealand, recently sent me a small shipment of parasitic Hymenoptera for indentification. Although the collection consists of only a few specimens, these are of considerable interest on account of our almost complete ignorance of the insect fauna of New Zealand belonging to these families, and I have therefore taken this occasion to report upon them, although Dr. Tillyard has promised more extensive material in the future.

All the species mentioned below are apterous or nearly so, distributed in three families, the Ichneumonidæ, Braconidæ and Belytidæ. The types are in the collections of the Cawthron Institute.

Family Braconidae.

Metaspathius gen. nov.

♀ Apterous. Head globular; antennæ inserted on a frontal prominence, 17-jointed, scape short and thick, pedicel moniliform; first three flagellar joints much elongated; eyes very small, round; ocelli obsolete; head margined behind; clypeus excavated, leaving a rounded mouth opening; palpi simple; slender. Prothorax elongate; mesonotum without furrows; scutellum small, narrow, shield-shaped; propodeum coarsely reticulated. Legs with the

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 214.

femora much thickened; tibial spurs very small. Abdomen petiolate, the petiole three times as long as broad at apex which is twice as wide as the base, spiracles at the basal fourth, projecting laterally as tubercles; sides of petiole not continuous with the sides of the gaster. Ovipostor slightly longer than the abdomen.

Type. *M. apterus* sp. nov.

This genus differs from all other Spathiinæ known to me in the the form of the antennæ which have only 17 joints, the basal flagellar joints elongated and the antennæ are not attenuate toward the tips. Otherwise its characters are so typically those of this group that it could not be placed elsewhere. Kieffer[1] has described a genus, Folchinia, from the mediterranean region which may be related, but unfortunately he gives no characters which allow of its being placed in any subfamily.

I have a second species which is probably congeneric, but the antennæ are broken off near the base. It was sent me some years ago by Dr. Hans Brauns, collected at Bothaville, Cape Colony.

Metaspathius apterus sp. nov.

♀. Length 2mm. Fusco-ferruginous, the gaster and tips of antennæ piceous. Head above smooth and shining, highly convex and broadly rounded on the sides, with the eyes placed very far forward; above the eyes on the front are a few horizontal striæ and the very small ocellar space is indicated by minute hyaline points. Frontal projection like that of Belytid, as broad as the width of the eye. Face shagreened, clypeus shining; palpi yellowish white, slender. Eyes very small, nearly circular, bare, no wider than the thickness of the antennal scape. Scape two and one half times as as long, as thick, pedicel small, globular; first flagellar joint as long as the width of the head; more than six times as long as thick; second and third each three fourths as long as the preceeding, following growing shorter, but each more than twice as long as thick; tip of flagellum as thick as the base. Prothorax above as long as the mesonotum, reticulate. Mesonotum areolate, but without parapsidal furrows.

[1]Ann. Soc. Sci. Bruxelles, vol. 30, pt. 2, p. 11 (1905)

Propodeum convex above, reticulate or irregularly areolate; perpendicularly delcivous behind. Pleuræ shagreened, the underside of the thorax clothed with long whitish hair. Petiole of abdomen coarsely shagreened and with four longitudinal carinæ, two above and one on each side at the level of the spiracle. Gaster smooth and highly polished, ovate, the second segment occupying more than one-half of the surface, before the tip with a transverse line of widely separated white hairs; following segments each with a similar line of hairs.

Type from Nelson, New Zealand, December 8, 1921 (A. Philpott).

At first glance this insect looks very much like a species of Pezomachus.

Family Ichneumonidæ.

Pezomachus (*Gelis*) *philpottii* sp. nov.

♀ Length 2 mm. Mesonotum, legs, second and third abdominal segments, except sides, pale brownish yellow; head and pleuæ black; antennæ, except extreme base, petiole, and the sides and apex of abdomen piceous. Head twice as broad as thick, deeply excavated behind with the temples very strongly oblique; eyes very large; seen from above, extending nearly to the hind margin and highly convex; malar space as long as the width of the mandible, with a distinct furrow; face delicately shagreened, clypeus small, protuberant. Antennæ 23-jointed, slightly longer than the body, slender, especially at the base. Ocelli in a small triangle, the posterior ones equidistant from one another and the eye. Thorax rather strongly bilobed, the scutellum faintly indicated but not distinctly separated. Propodeum shining, with a faint tooth at the upper hind angle. Pleuræ smooth and polished. Petiole gradually and evenly widened behind, the sides straight with no indication of spiracular teeth; apex twice as wide as base; upper surface, seen from the side evenly convex,not angled near tip. Second and following segments smooth, sub-shining. Ovipositor projecting a distance equalling the length of the

petiole. Legs unusually long and slender, the middle and hind coxæ large and swollen.

Type from Aniseed V., New Zealand, March 23, 1922 (A. Philpott).

This species resembles closely certain palæarctic and nearctic species of this highly polymorphic and no doubt also polyphyletic genus. It will be readily recognized by the black head and pleuræ and the very pale legs and mesonotum

Family Scelionidæ

Hoplogryon novæ-zealandiæ sp. nov.

♀. Length 1.0. mm. Head, abdomen and antennæ, except extreme base of scape black; legs, including coxæ, pale fuscous or yellowish brown, the tips of the tarsi blackened; thorax above, and on the pleuræ below, dark fuscous or piceous, the pleuræ yellowish brown above; mandibles, except tips, and extreme base of antennal scape yellowish. Entire body clothed with conspicuous pale hairs. Head, seen from above, twice as wide as thick, the ocelli in a rather low triangle, the lateral ones as far from the eye margin as from one another. Front smooth and polished above, with median line from the ocellus to the base of the antennæ; vertically striate below to the base of the mandible; cheeks, temples and occiput shagreened, vertex more strongly so. Antennal scape, funicle and club each of about equal length, the latter 6-jointed; scape slender; pedicel two-thirds as long as the first flagellar joint which is one-half longer than wide; second the same size as the first; third and fourth very small, moniliform; first club-joint quadrate, the following, except the last, each distinctly transverse. Mesonotum reticulately rugulose; parapsidal furrows indicated behind, but very indistinct anteriorly; scutellum more finely sculptured, nearly smooth behind; postcutellar spine short, acute. Lateral teeth of propodeum large, blunt at tips. Propleura with a large impression, areolate by very coarse raised lines; mesopleura deeply impressed below, irregularly horizontally wrinkled above. Wings short, extending to the tip of the second abdominal segment. Abdomen one-half wider than the thorax, almost globose; first segment as long

as the width at base, apex twice as wide, coarsely longitudinally striate above; second segment twice as long as the first; coarsely striate, except at apex, which is smooth and shining; third segment very convex, delicately shagreened, as long as wide, broadest behind the middle, almost twice as long as the first and second together; fourth and fifth very short, sixth minute, occupying a median emargination of the fifth.

Type from Mt. Arthur (4000 ft.) New Zealand (A. Philpott).

This is the first member of this widely distributed genus to be found in New Zealand. It is similar to the European *H. pleuralis* Kieffer said to be probably from England, but differs by the longer striæ on the second abdominal segment and by the presence of the median frontal line. Among the species known from Australia, several of which have the thorax somewhat similarly colored, it may be known by the smooth third abdominal segment and different conformation of the antennal joints.

Paragryon castaneus sp. nov.

♀. Apterous; length 2 mm. Reddish brown, the antennæ and legs, including coxæ, more nearly fulvous; pleuræ piceous. Abdomen, especially beyond the second segment, thinly clothed with sparse, appressed, golden yellow hairs. The hairs, due to differences in direction, form more or less curved or sinuous patches which reflect light differently in relation to the source of illumination and give a peculiar mottled appearance. Head one-third broader than the thorax; twice as wide as long; temples rounded; occiput broadly emarginate and strongly margined; ocelei widely separated, the lateral ones separated by only their own diameter from the eye-margin; eyes pubescent, ovate; malar space as long as the width of the eye; head more or less irregularly longitudinally striate above; front smooth medially above the antennæ and vertically striate-punctate at the sides; cheeks with striæ converging toward the base of the mandibles, head behind coarsely and rather closely punctate. Antennæ 12-jointed; club 6-jointed; funicle and club of equal length, scape a little longer, reaching the vertex; scape slender; pedicel twice as long as thick; first flagellar joint longer than the pedicel, three times as long as

thick; second, third and fourth decreasing in length, the fourth quadrate; club-joints about equal in length except, for the longer apical joint, the second to fifth about twice as broad as long. Thorax above rugose-striate, irregularly so on the mesonotum and longitudinally so on the scutellum; tegulæ present, but wings entirely absent. Propodeum deeply emarginate medially to receive the elevated base of the first abdominal segment, faintly toothed at the sides of the emargination and at the posterior angles. Pleuræ shining; striate below, in front and along the sutures; smooth elsewhere. Abdomen above shining; first segment rugose, second and third rugose-striate, the lines more or less longitudinal; fourth segment closely punctate; fifth confluently so; first segment as broad as long; second twice as long as the first, the width at apex greater than the length; third as long as the first and second together; distinctly broader than long; fourth to sixth decreasing in length, the fourth half as long as the third and equaling the apical ones together. Legs quite stout; tibial spurs very weak; tarsal claws simple.

Type from Mt. Arthur, New Zealand (A. Philpott) December 26, 1921, taken at an altitude of 4000 ft.

This species resembles *P. gracilipennis* Dodd,from Australia, in the elongated first flagellar joint, but differs in the configuration of the other antennal joints, and is wingless.

Family Belytidæ

In 1889, Cameron described from Greymouth, New Zealand, the genus Betyla, and in 1892 Marshall proposed the genus Tanyzonus for a Belytid reared from the larvæ of the remarkable New Zealand glow-worm, Bolitophila. Later in the same year, however, Marshall regarded Tanyzonus as synonomous with Betyla, believing the type species of both genera to be identical. In the material sent by Dr. Tillyard there are a number of specimens of Betyla-like insects representing three distinct genera; one of these is evidently Cameron's Betyla, while the second and third are undescribed. In view of the fact that there are several closely related genera and species present in New

Zealand, it must remain for the present somewhat doubtful whether *Tanyzonus bolitophilæ* Marshall and *Betyla fulva* Cameron are identical. Concerning this point, I cannot satisfy myself from Marshall's description.

The three genera may be distinguished by the following key, which includes also the related Neobetyla Dodd of which I have a specimen kindly sent me by Mr. Dodd.

Females.

1. Petiole of abdomen bearing a large tooth below; scutellum absent. *Betyla* Cameron

   Petiole of abdomen simple below; scutellum present . . 2.

2. Antennæ 13-jointed; wings present, much abbreviated, attaining the tip of the propodeum . . . . . *Probetyla* gen. nov.

   Antennæ 15-jointed; wings entirely wanting. . . . . .3.

3. Propodeum with three spines, one at the middle above and one at each side behind the middle; pronotum along the median line, as long as the mesonotum. . . . .*Parabetyla* gen.nov.

   Propodeum without spines; pronotum visible from above only at the sides . . . . . .*Neobetyla* Dodd.

There are two specimens which are probably Cameron's *B. fulva*, taken by Mr. Philpott on Dun Mt. .,March 15, 1921 at an altitude of 2000 feet.

Probetyla gen. nov.

Antennæ 13-jointed, the club slender, not clearly differentiated, although the last six joints of the flagellum are thicker and moniliform; first flagellar joint longer than the pedicel, simple. Head seen from above quadrate, the temples broad. Eyes small, round, hairy. Maxillary palpi 5-jointed; labial palpi 3-jointed; left mandible with two long teeth; right one broader and probably with three teeth. Ocelli small, hyaline, in a small triangle. Thorax two-thirds as wide as the head, not constricted behind the mesothorax. Pronotum scarcely visible from above

medially; parapsidal furrows present; scutellum with two foveæ at the base. Propodeum densely hairy, without spines; wings reaching to the base of the abdomen, strap-shaped. Petiole one-half longer than thick; second segment occupying most of the abdomen, following very short, the last not elongated nor compressed. Legs very slender, femora and tibiæ clavate. Body thinly clothed with erect, long, glistening pale hairs as well as with more dense pile on the prothorax and abdominal petiole.

Type: *P. subaptera* sp. nov.

Probetyla subaptera sp. nov.

♀. Length 2.2 mm. Uniform yellowish brown, the legs paler than the body. Head, seen from above, but little wider than thick, the eyes set at the anterior corners, about two-thirds as long as the temples which are suddenly narrowed behind; occiput margined; seen from the side, the head is high as long, the frontal projection rather small; face nearly horizontal, the eyes more than their own length from the base of the mandibles; surface of entire head smooth. Antennæ but slightly thickened apically; scape as long as three following joints taken together; thicker near the middle, not spinose at apex; pedicel twice as long as thick; first flagellar joint longer and more slender, three times as long as thick; second to sixth gradually shorter and thicker, four following moniliform, each about one-half wider than the first flagellar joint. Pronotum short medially, but distinctly visible from the above; mesonotum as long as broad, with a deep groove next its anterior margin extending from tegula to tegula; parapsidal furrows complete, nearly parallel. Scutellum with two large, narrowly separated foveæ at base. Upper surface of propodeum nearly horizontal, convex. Pro- and mesopleuræ smooth and shining; metapleura finely rugose and densely pubescent. Petiole finely longitudinally aciculate; two-fifths as wide as the propodeum; gaster one-half wider than the thorax and as wide as the head.

Type from Nelson, New Zealand, December 8, 1921 (A. Philpott).

Parabetyla gen. nov.

♀. Entirely wingless. Head, thorax and petiole narrow; gaster broad. Head with a very prominent frontal projection, longer than wide; eyes small, with a few long hairs; ocelli absent. Antennæ 15-jointed, with a stout 6-jointed club. Maxillary palpi 5-jointed; basal joint minute; apical one much longer than the others. Thorax much elongated; pronotum medially half as long as at the sides; mesonotum small; scutellum without basal impressions, half as long as the mesonotum; propodeum separated by a constriction basally above; apically with three long thorn-like spines, one median and another at each side. Petiole twice as long as thick, without tooth below. Gaster large, elongate oval, composed almost entirely of the second segment. Legs stout, the femora very strongly clavate, but the tibiæ not noticeably so. Body clothed with nearly erect sparse pale hairs..

Type: *Parabetyla spinosa* sp. nov.

Parabetyla spinosa sp. nov.

♀. Length 3.3 mm. Entirely rufo-ferruginous, the abdomen and antennæ slightly paler. Head, seen from above, one-third longer than wide, including the frontal projection; widest at the eyes which are near the middle, obliquely narrowed anteriorly to the base of the antennal projection, rounded behind, the occipital margin strongly and conspicuously carinate. Head seen from the side sub-triangular, the face long, straight; front above highly convex; eyes their own diameter from the frontal projection and three times as far from the mandibles; entire surface smooth and shining. Antennal scape as long as the head, thickest basally, as long as the seven following joints together; pedicel twice as long as thick, slightly longer and stouter than the first flagellar joint; three following of equal length, becoming moniliform; fifth, sixth and seventh larger; beyond this the joints become large, forming a very gradual but stout club, of which the joints except the last are barely wider than long. Pronotum slightly projecting at its humeral angles, twice as long as the mesonotum at the sides; the mesonotum separated by a deep grooved line, no longer than the portion of

the pronotum visible medially; scutellum large, as broad as the mesonotum, the basal suture not impressed nor foveate. Propodeum very short, twice as high as long, its spines curve backwards, with the median one set somewhat forward of the lateral ones. Pro-and mesopleuræ smooth and polished; metapleura and sides of propodeum rugose, with several more or less regular oblique carinæ extending downwards and backwards. Petiole finely longitudinally rugose-striate, narrower at base and apex. Gaster about three times as broad as the head or thorax. The hairs on the body are denser on the petiole, propodeum and base of abdomen, and entirely absent on the pro- and mesopleuræ. Tarsal claws stout, simple; tibial spurs minute; hairs on femora very sparse, those of the tibiæ conspicuous.

Type from Dun Mountain, New Zealand, at an altitude of 2000 feet, March 15, 1921 (A. Philpott).

THE EUROPEAN HOUSE CRICKET; HEARTH CRICKET.

By A. P. Morse, Peabody Museum of Salem.

This cricket, in the winter of 1920, became a nuisance in a dwelling at Swampscott, Mass., damaging clothing in the basement laundry and annoying by its persistent chirping (recorded in my manual of N. E. Orth., p. 393), but shortly after disappeared and is not now found there.

On Oct. 16, 1922, I captured an adult male in an open pasture at Marblehead, Mass., several miles away. No others were seen. Curiously enough, in connection with the fireside association of the species, tho probably without definite significance, this specimen was found hiding under a fragment of partly burned board lying on the charcoal of an old bon-fire site.

NOTES ON *LIVIA MACULIPENNIS* (FITCH) (HOMOPTERA; CHERMIDÆ)

By Harry B. Weiss and Erdman West

Highland Park, N. J.

This jumping plant louse which is recorded by Van Duzee[1], as occurring in Quebec, New Hampshire, New York, Massachusetts New Jersey, Pennsylvania, District of Columbia and Alabama has been known for some time to be associated with the elongate gall on rush (*Juncus* sp.), the floral parts being aborted, the bracts of the inflorescence increasing to many times their normal size and forming closely imbricated clusters from 3 to 4 cm., in length. For several years this species has been noted at Monmouth Junction, N. J., and the following notes have been accumulated.

The adult overwinters and appears during the middle and last of May. The oval, lemon-yellow eggs are deposited in rows on the inflorescence and bracts, each egg being fastened on the plant tissue by means of a short, backward projecting, basal stipe. A few eggs were found as late as June 17 after the galls were fully developed and these occurred on the inner surface of the lowest bract. After hatching the nymphs make their way to between the folded leaf-like parts, most of them feeding head downward between the sheaths. By the last week of June many are fully developed and the first adults emerge several days later. Most of the nymphs inhabit the outer sheaths and only a few are found in the tightly rolled inner sheaths. Some galls were found to contain from 25 to 100 nymphs. Those with fifty or more were quite swollen. The larger nymphs have the ends of their abdomens clothed loosely in waxy threads. As a rule nearly all nymphal stages can be found in a gall during the last of June, with the possible exceptions of newly hatched ones. Based on size and structure, the nymphs were easily arranged into five stages and the following descriptions indicate the development which takes place from egg to adult.

[1]Van Duzee, Cat. Hemip. Amer. North of Mexico.

EGG. Length, 0.3 mm. Greatest width 0.9 mm. Lemon yellowish; elliptical, somewhat flattened on one side, bluntly pointed at distal end, basal end terminating in a short projecting stipe. First Nymphal Stage Length 0.4-0.45 mm. Width of head across eyes, 0.12 mm. Color, pale yellowish or whitish tinged with brown. General shape, subrectangular, somewhat flattened. Head truncate, slightly narrower than thorax; eyes red, lateral; antennæ erect, cone-shaped, tip truncate and bearing two hairs. Thorax with sides subparallel, slightly converging posteriorly, length about one-third greater than length of abdomen, segmentation indistinct. Abdomen subcircular to oval except where it joins the thorax, segmentation indistinct, fringed with a row of equidistant hairs. Sheath of rostrum extending almost to between second pair of legs. Legs short, chunky, gradually tapering toward tip which bears a sucker disk and two hairs.

Second Nymphal Stage. Length about 0.73 mm. Width of head across eyes 0.22 mm. similar to preceding stage in color, shape and general proportions.

Third Nymphal Stage. Length about 1.1 mm. Width of head across eyes, 0.3 mm. Color, shape and general proportions somewhat similar to those of preceding stage. Dorsal surface of thorax bears brownish spots. Upper surface of last few abdominal segments brownish. Tips of legs and tips of antennæ brownish. Sides of mesothorax produced laterally into pronounced pads. Sides of metathorax produced laterally into pads less pronounced than those of mesothorax. Abdomen about as long as thorax, more oval in shape than formerly and with a more decided yellowish tinge, tip clothed with many fine hairs. Fourth Nymphal Stage. Length about 1.7 mm. Width of head across eyes 0.5 mm. Yellowish white. Head as wide as thorax broadly rounded anteriorly. Eyes, red, prominent, lateral.

Antennæ conical, erect, as long as width of head between antennæ. Thorax subrectangular, about as long as abdomen, sides parallel, dorsal surface bearing several brownish spots. Wing pads large, pronounced extending obliquely, posteriorly. Wing pads bearing few short hairs. Abdomen oval, constricted somewhat anteriorly, strongly convex, segmentation indistinct, apical

segments covered dorsally by a somewhat chitinous plate, tip and sides sparsely clothed with short hairs. Legs chunky. Sheath of rostrum extending to between first and second pairs of legs.

Fifth Nymphal Stage. Length about 2.5 mm. Width of head across eyes, 0.6 mm. Color pale or dirty yellowish tinged with brown. Tips of antennæ, tips of legs and edges of wing pads somewhat brownish. Ventral surface pale. Head and thorax subequal in width. Eyes, lateral, prominent, red. Head and almost all of dorsal surface of first thoracic segment except for a broad, median line on head and thorax covered by a light brownish chitinous area. Prothorax two-thirds as long as mesothorax. Metathorax slightly less than one-half as long as prothorax. Wing pads of mesothorax extending to beginning of first abdominal segment. Wing pads of metathorax extending almost to end of second abdominal segment. Dorsal surface of mesothorax bearing a small, brown area and a dot on the anterior margin each side of a median line; on posterior margin a large brown area and three closely placed darker spots or dots on each side of median line. Metathorax bears dorsal areas and spots similar to those of mesothorax. Anterior edge of first abdominal segment bears areas and spots similar to those on anterior edge of metathorax. Abdomen subcircular, strongly convex. First segment narrowed, gradually widening to fourth and then narrowing to broadly rounded extremity. First six abdominal segments distinct, remainder fused and covered with a darker, dorsal, chitinous plate; a tubercular, process on each side of anal opening. Sides and tip of abdomen bearing short hairs Dorsal surface of abdomen has a velvety appearance. Antennæ, head, wing pads and legs bearing several short hairs.
Adult. This was described by Fitch in 1857 (Ann. Rept. N. Y. State Agric. Soc. XVII, p. 740) from specimens collected during the middle of May in extensive tracts of sweet flag (*Acorus Calamus*) growing on the banks of the Raritan River two miles below New Brunswick, N. J. His description follows.

"Spotted winged Diraphia, *Diraphia maculipennis* N. sp.

This is a smaller species, measuring but 0.10 to the tips of its wings, and is tawny red, with the thorax tinged more or less with dusky, the antennæ with a broad black band towards their tips, the anterior wings more short and broad than in any of the other species, and hyaline with a broad smoky brown band on their tips, a spot back of the shoulder and some freckles near the margin also smoky brown, the veins, including the marginal, all white alternated with numerous black rings, the breast and hind breast blackish and the legs dusky brown tinged more or less with tawny yellow."

Miss Edith M. Patch has referred to this species several times and these references can be found in Van Duzee's catalogue. In *Pysche* (vol. XIX, p. 6,1912) Miss Patch places Provancher's *Livia bifasciata* as a synonym of *maculipennis*.

This insect which has commonly been known as the sedge psyllid has for its most conspicuous host a *Juncus* which is a plant belonging not to the "sedges" but to the "rushes", hence it might be called more correctly, the rush psyllid.

HEMIPTEROLOGICAL NOTES[1].

By Roland F. Hussey, Forest Hills, Mass.

I.

During the summers of 1920, 1921, 1922, I found a very agile species of Orthotylus abundant on the hollyhocks in the grounds of the University Observatory at Ann Arbor, Michigan. From June until late September, at least, adults and nymphs were numerous, occurring on the *upper* side of the leaves, and the plants showed plainly the effect of their work. At the time when I first collected this form, I was unable to identify it with any described species of the genus, but subsequently I

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 214.

discovered a description which applies perfectly to the specimens before me. This description appears to have been overlooked, and is not listed in Van Duzee's catalogue.

In 1891, A. J. Cook[2] gave an account of the hollyhock bug, and described and figured the species under the name "*Orthotylus* (*Psallus*) *delicatus* Uhler[3]." His description is quite ample for recognition of the species; and, inasmuch as the name he employs is merely one of Uhler's manuscript designations, the species must be known as *Orthotylus delicatus* Cook. Heidemann[4] also records an *Orthotylus delicatus* Uhler MS, from the District of Columbia; but since his form occurred only on ash trees, while Cook's species, in my experience, is confined to hollyhocks, I doubt the identity of the two.

That the specimens taken by me at Ann Arbor belong to Cook's species is confirmed by examination of the specimens standing in the collection of the Michigan Agricultural College under the name *Orthotylus delicatus* Uhler, which Professor R. H. Pettit has kindly forwarded to me. Only two of these specimens were collected prior to the date of Cook's description, and I have therefore designated one of these as the lectotype of the species. The following redescription is drawn up from fresh material.

Orthotylus delicatus Cook.—Oblong-oval; green, the membrane smoky with the veins calloused, greenish or whitish; body sparsely clothed with white hairs, the dorsal parts also with short, thick, closely appressed black hairs. Length, $3\frac{1}{2}$ mm.

Head, with the eyes, very nearly $\frac{3}{4}$ as wide as the pronotum at base, and about twice as wide as long (in dorsal aspect); basal carina low and inconspicuous, vertex broadly flattened; clypeus, seen in profile, projecting beyond the frons by nearly the thickness of the basal antennal segment. Eyes occupying about one-half (19/36) of the vertical height of the head. Antennæ

[2]Bull. 76, Mich. Agr. Coll. Exper. Sta. p. 10. This bulletin is entitled "Kerosene Emulsions."

[3]This is not the *Psallus delicatus* Uhler 1887, described in Ent. Amer. iii, p. 34.

[4]Proc. Ent. Soc. Wash., ii. 1892, p. 226.

inserted near the lower angles of the eyes, yellowish or greenish, the fourth and sometimes the apical half of the third segments infuscated; all segments with short appressed hairs; ratio of lengths of segments, 20:77:68:32, the basal segment as long as

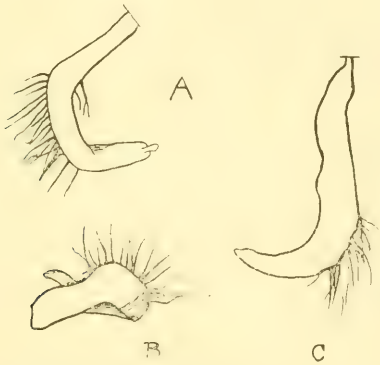

Fig. 1. Male genital claspers of *Orthotylus delicatus* Cook. A, right clasper, dorsal aspect; B, right clasper, lateral aspect; C, left clasper, dorsal aspect.

the dorsal aspect of the head, the second segment about one-fourth longer than the basal width of the pronotum. Rostrum yellow, its apex piceous, reaching onto the middle coxæ. *Pronotum* transverse, twice as wide as long, the lateral margins very lightly sinuate, the anterior angles broadly rounded; callosities distinct, joined anteriorly by a transverse elevation behind which are a pair of deeply impressed punctures; disk rather flat, the lateral submargin broadly impressed; anterior angles with a long seta directed obliquely outward and forward. *Hemelytra* rather short, the abdomen reaching to the middle of the cuneus (♂) or somewhat beyond its apex (♀). Male genital claspers (Fig. 1) distinctive of the species.

Color: dorsal parts green in fresh specimens, fading after death to yellow on head, pronotum anteriorly, and scutellum; pectus

and venter greenish or yellowish; membrane smoky, the smaller areole and a small rounded spot next to the cuneus hyaline, the veins calloused, greenish, becoming white at the apex of the larger cell. Legs yellowish; tibiæ piceous at the extreme apex, the fore and middle tibiæ often greenish on the apical half; third segment of tarsi, often also the base of the first segment, piceous. Body rather sparsely clothed with white hairs, most conspicuous on the lateral margins of pronotum and hemelytra; dorsal parts (including head) also with conspicuous short black hairs which are flattened and deciduous.

Orthotylus (*Psallus*) *delicatus* Cook, 1891, Bull. 76, Mich. Agr. Coll. Exper. Sta., p. 10, fig. 1 (manuscript name of Uhler).

This species is readily distinguished from the other American representatives of the genus Orthotylus by the character of the vestiture and the genital claspers.

Redescribed from numerous specimens collected at Ann Arbor, Mich., June to September, 1920, 1921, 1922. I have also seen individuals from Stockbridge, Mich., 1-IX-1920 (R. F. Hussey); Battle Creek, Mich., 18-VI-1922 (Priscilla Butler); and four from East Lansing, Mich., bearing the label "Ag. Coll. Mich." Lectotype, ♀, "Ag. Coll. Mich. 7-29-'90. 1642.", in collection of the Michigan Agricultural College.

II.

In my recent paper on Hemiptera from North Dakota[5], there are two errors which require correction.

p. 9, line 27. In place of *Ischnodemus falicus* (Say), read *Ischnodemus hesperius* Parshley (1922, Bull. Brookl. Ent. Soc., xvii, p. 123, = *I. brevicornis* Parshley, 1922, S. Dak. State College Techn. Bull. No. 2, p. 8; name preoccupied).

p. 10, line 28. In place of *Peritrechus fraternus* Uhler, read *Peritrechus saskatchewanensis* Barber (1918, Jl. N. Y. Ent. Soc., xxvi, p. 60).

[5]Occas. Papers Mus. Zool. Univ. Mich., No. 115, July 1, 1922.

III.

Dr. Bergroth has kindly called to my attention a reference which was omitted from my bibliographical notice on the Reduviid genus Triatoma[6]. In their "Textbook of Medical Entomology," Patton and Cragg (1913) give figures of *T. rubrofasciata* (Pl. LIX, fig. 1) and *T. megista* (Pl. LIX, fig. 2), of the eggs and nymphs of *T. rubrofasciata* (Pl. LX, fig. 2, 3, 5, 7), and some of the anatomical details of *T. rubrofasciata* (Pl. LXII, figs. 1, a, 1b, 5, 8, 10). They also give translations of Neiva's descriptions of some of his species, as follows;

p. 492. *T. mexicana* Neiva (as var. of *rubrofasciata*),

p. 494. *T. sanguisuga ambigua* Neiva, *T. uhleri* Neiva. *T. neotomae* Neiva.

p. 495. *T. brasiliensis* Neiva, *T. flavida* Neiva, *T. heidemanni* Neiva, *T. occulata* [sic] Neiva.

Descriptions are also given of *T. rubrofasciata* (p. 487), *T. megista* (p. 492), and *T. sanguisuga* (p. 493); and the bionomics of the genus are well treated (pp. 488-493). Throughout this treatment, Patton and Cragg use the name *Conorhinus* for the genus.

IV.

Stenopoda cinerea Laporte. This species was first described by Fabricius (1775) under the name *Cimex culiciformis*, and is antedated by *Cimex culiciformis* DeGeer (1773), a species now placed in the genus Ploiariodes. Laporte's name is the next availiable designation for the Fabrician species.

[6]Psyche, xxix, 1922, pp. 109-123.

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CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p. m. at the Bussey Institution, Forest Hills, Boston. The Bussey Institution is one block from the Forest Hills station of both the elevated street cars and the N. Y., N. H. & H. R. R. Entomologists visiting Boston are cordially invited to attend.