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THE SOCIAL PARASITISM OF THE ANT *HARPAGOXENUS AMERICANUS*

By A. H. Sturtevant

Columbia University, New York City.

Harpagoxenus americanus was described by Emery (1895), from workers found by Pergande in a nest of *Leptothorax curvispinosus* Mayr at Washington, D. C., and from a single specimen collected by Schmitt at Beatty, Pa. Schmitt later informed Wheeler (1910) that this and a few other specimens were taken while he was sifting for beetles. There was no evidence as to their habits or any association with other ants. Wheeler (1905) found three nests at Bronxville, N. Y., that contained *H. americanus* and *L. curvispinosus.* One nest contained a single Harpagoxenus worker, another six, and the third eight workers and a deälated queen. In 1925 I found a nest (Sturtevant 1925) at Tarpaulin Cove, Naushon Island, Mass., that contained both *H. americanus* and *L. curvispinosus.* So far as I have been able to discover, these are the only recorded occasions on which H. *americanus* has been collected.

During the summer of 1926 I was fortunate in finding 16 nests of the species, at three different localities in New Jersey. Included in the new material are three kinds of individuals not previously described: males, winged queens, and individuals that look like workers but have rudimentary ocelli. I have also been able to make a few observations on the habits of the species. The present paper contains an account of this new material, with a discussion of the previous data and a comparison with the European species, *H. sublœvis*, studied by Adlerz (1896) and Viehmeyer (1908, 1921).

Nest No.	Locality	Date	Harpagoxenus W	Harpagoxenus deal. W	Harpagoxenus winged ♀	Harpagoxenus ♂	Harpagoxenus pupae	*Leptothorax curvispinosus* W	*Leptothorax curvispinosus* pupae	Genus uncertain eggs	Genus uncertain larvae	Genus uncertain pupae
1	Naushon, Mass.	Au. 30'25	9	1	0	0	?	152	W	+	21	W
2	BelleMead, N. J.	Jl.8'26	16	0	0	0	W	20	?	+	+	W
3	Morristown,, N. J.	Jl.12'26	0	0	6	1	0	10	0	0	0	0
4	" "	Jl.12'26	1	0	0	0	?	2	1.,2♀,1♂	1	1	0
5	" "	Jl.14'26	3	0	0	60	♂	30	0	+	+	0
6	" "	Jl.14'26	3	0	0	14	♂	60±	5W	+	+	+
7	" "	Jl.20'26	1	0	0	4	♂	0	0	0	+	0
8	" "	Jl.20'26	2	0	0	0	0	10	0	+	0	0
9	" "	Jl.30'26	30	1	3	0	?	100±	?	+	+	♀, ♂
10	" "	Se. 1'26	9	1	0	0	?	41	W	+	+	W
11	" "	Se. 4'26	0	1	0	0	0	12	0	0	+	0
12	" "	Se. 4'26	10	0	0	0	?	104	W	+	+	W
13	" "	Se. 6'26	2	0	0	0	0	25	0	+	+	0
14	" "	Se. 15'26	6	0	0	0	?	74	W	+	+	W
15	" "	Se. 15'26	12	1	0	0	?	77	W	+	+	W
16	" "	Se. 15'26	0	1	0	0	0	10	3W	2	3	0
17	" "	Se. 15'26	4	0	0	0	?	43	W	+	+	W

Numbers 7 and 8 each contained a dead Harpagoxenus male.

Number 10 also contained eight workers of *Leptothorax longispinosus* Roger.

Numbers 1 and 8 taken in oak galls; 2, 3, 5, 6, 7, and 9 in old hickory nuts; 4, and 10 to 17 inclusive, in old acorns.

Table 1 gives the statistics for the 17 nests in which I have found Harpagoxenus. Numbers 3 to 9 were found in a small patch of woods near the village of New Vernon, numbers 10 to 17 about four miles away, near Morris Plains. In the first locality 50 pure nests of L. curvispinosus were taken in July and August; in the second 30 were found in September, and at Belle Mead eight pure nests were taken on July 8. I have collected 27 pure nests of L. curvispinosus at various other localities. This gives a frequency of infection of 17: 132=13%. The frequency can hardly be as high as this over most of the range of Harpagoxenus, for the species would then hardly be so rare in collections. It is probably local in distribution, though my success in finding it in four localities suggests that it may be commoner in galls and old nuts than in hollow stems, where the host has apparently been most often collected. I have taken only eight host colonies in hollow stems (of sumac and hickory); none of these were parasitized. I have also taken three pure nests of L. longispinosus (one in each of the regions near Morristown where Harpagoxenus was found and the third also near Morristown). None of these were parasitized.

At least two of the nests in Table 1 seem to represent fragments of colonies. Number 3 had no Harpagoxenus workers or deälated queen, but contained six winged queens and one male—the mother of which was therefore not present. Number 7 contained no Leptothorax at all. My observations agree with Wheeler's that Harpagoxenus is quite unable to care for itself, so this colony must have had Leptothorax workers. Perhaps they were out foraging when I collected the hickory nut. Similar observations have been made on pure nests of L. curvispinosus: e. g., over 20 nests have been found that contained no queen. Accordingly I was led to test nests from nuts lying within four or five feet of each other on the ground. In two cases (pure L. curvispinosus) the individuals from such nests showed no hostility whatever to each other, over a period of several days, though they promptly and vigorously attacked workers from nests taken in different localities. In several cases (including a few parasitized nests) such experiments led to mild fighting, which often did not occur for several minutes after the introduction of the strange ant, and was not continued long enough to seriously damage either contestant. Such attacks usually took the form of pulling legs or antennæ, without the usual accompaniment of doubling up the abdomen and rolling about the floor of the nest. These data suggest that a colony may break up into two or more daughter nests, and that these then gradually come to react toward each other as strangers. In accordance with this view is the fact that after the mating season[1] many of the pure nests have from two to twelve dealated queens; but the number of these seems then to decrease, until by the time winged forms are again produced practically no nest has more than one old queen. The data of Table 1 must then be studied with this evidence in mind, for it is clear that the individuals in one nest do not necessarily constitute an entire colony, whether we are dealing with pure or with parasitized colonies.

There are two chief problems concerning *H. americanus*: 1. How are pure colonies of Leptothorax first infected with Harpagoxenus—i. e., what is the method of colony formation? 2. Does an established Harpagoxenus colony recruit new auxiliaries, and, if so, by what method?

On July 31 I removed all but some irregular stumps of the wings of a queen Harpagoxenus (from nest number 9), and placed her in a pure *L. curvispinosus* nest that contained one deälated queen, about 70 workers and brood. The Harpagoxenus queen was attracted by the brood, but was quickly attacked by the workers. She at once became much excited, and moved so rapidly that the workers did not succeed in grasping her, except occasionally by the stumps of wings. She attacked them, but only by "nipping" at the antennæ or legs—never did she get the "bulldog grip" that is so characteristic of ants—even of Harpagoxenus workers. These nips were, however, effective, for within half an hour about ten workers had portions of one or both antennæ amputated. Usually the scape was cut in two. The remaining workers in the nest rapidly moved the brood as far as possible away from the invading queen—under

[1]Winged forms of *L. curvispinosus* were found in the nests from July 8 to July 30, with one belated male on August 10.

natural conditions they would presumably have left the nest entirely. The Leptothorax queen did not fare differently from the workers, and ultimately she was so maimed that she died. It seems probable that under natural conditions she too would have migrated. Battles occurred from time to time for several days, until most of the workers were more or less maimed. The Harpagoxenus queen showed interest in the brood only intermittently, but occasionally rested on it. New workers emerged in a few days, and on August 4 one of these callows was seen to feed the Harpagoxenus queen by regurgitation. The old workers still attacked her, however, and she grew gradually weaker, until she died on August 10.

If one may judge from this experiment, the fertilized queen of *H. americanus* enters a nest of pure Leptothorax and appropriates some of the brood. The workers and queen are attacked, and emigrate probably to find a new nest, taking much of the brood with them. The intruder is then adopted by the workers that emerge from the brood she has appropriated. It may be surmised that nests numbers 11 and 16 represent cases in which this has just happened. In each of these nests there was present a single deälated Harpagoxenus queen, with a few Leptothorax workers, but no Harpagoxenus workers or pupæ.

Nest number 10 constitutes the best evidence that *H. americanus* makes "slave raids," for this nest contained, besides nine workers and a queen of Harpagoxenus, two different host species—41 L. curvispinosus and eight *L. longispinosus.* Both Adlerz and Viehmeyer have found nests of the European *H. sublœvis* that contained two host species, and they have argued that these could be explained only on the assumption that *H. sublœvis* makes raids. Wheeler (1905) found a mixed nest of *L. curvispinosus* and *L. longispinosus* (without a queen). and argued that if Harpagoxenus parasitized such a nest the result would be like that observed by Adlerz and Viehmeyer, but would not be due to raids. Viehmeyer (1921) has now actually witnessed the raids of *H. sublœvis,* so there is no necessity for explaining away the "triple" nests of that species. It is to be noted that Wheeler's mixed nest was taken at the same place as his Harpagoxenus nests: it therefore seems to be most probable that this mixed nest was in reality a portion of a parasitized colony (like number 10), that happened not to include any parasites.

The following experiment also suggests that raids are made by *H. americanus.* On August 2 an island was made by inverting a large pan and surrounding it by a moat. Three small piles of earth were placed on the island, and on each of these was placed a bit of sponge and a few bits of paper. Nest number 9 was placed on one pile of earth, and on each of the others was placed a pure nest of *L. curvispinosus.* The three colonies all became established, in the soil under their respective sponges. By August 10 there was very little loss by drowning in the moat, and relatively seldom were fights between foraging workers seen. Each Leptothorax nest had a single deälated queen, but these and the Harpagoxenus were practically never seen except when the nests were examined by lifting the covering bits of sponge or paper. The ants were fed chiefly on molasses and Drosophila larvæ, and all seemed to be thriving. But by August 21 one pure colony had disappeared and the other was very weak. On September 14 careful search revealed only the one flourishing parasitized colony. At this time there were observed to be some callow workers of Leptothorax present. While no raid was actually observed, it seems probable that both pure colonies were plundered by the Harpagoxenus (or perhaps by the auxiliaries) of the mixed colony, which did not change its position on the island during the course of the experiment.

Another reason for thinking that raids occur is that pupæ and callows of Leptothorax are so regularly present in the parasitized nests.

Winged queens are rare in *H. sublævis.* Adlerz failed to find any in Sweden, and in Germany Viehmeyer has found only a few. Their place is taken by worker-like forms that usually possess one or more ocelli. Adlerz has observed that these ergatoids mate, and has shown by dissection that they possess spermathecæ and well-developed ovaries. Such ergatoids have not been described in *H. americanus*, and the data show that true queens are common. Wheeler found one deälated queen, and six are recorded in this paper, together with nine winged queens. These differ from the workers in the same ways as do the queens of most ant species. In addition, however, I have found a number of workers with rudimentary ocelli. Such specimens were present, for example, in nests 1 and 5. Usually the ocelli are represented in these specimens only by small chitinized humps, but sometimes small lenses are present. The number of these rudiments varies from one to three; the majority of workers do not show any trace of ocelli. Since 11 of the 17 nests found (and three of the four recorded by Emery and Wheeler) contained no deälated queens, one is led to suspect that H. americanus, like H. sublævis, has fertile worker-like females. This view is borne out by observations made on nest number 4. The only adult Harpagoxenus in this nest was a worker that had two small rudimentary ocelli. When collected, only one egg was found in the nest, but two days later four eggs were present. This observation is not conclusive, since it is not possible to be certain that the three eggs in question were not present all the time; and even if they were newly laid the Leptothorax workers may perhaps have produced them. I have dissected three workers (Harpagoxenus) from nest number 9. There were three ovarioles present in each ovary in all three specimens, and a sac arising from the anterior end of the common oviduct in every specimen is evidently the seminal receptacle. No spermatozoa were present, and no eggs were differentiated in the ovaries; but these specimens came from a nest that had an old queen, and they had been kept alive in the laboratory for three months, so the ovaries may not have been in normal condition. The evidence thus indicates that H. americanus has fertile worker-like females. It remains to be discovered whether these females infect new colonies by the method Viehmeyer supposes to occur in H. sublævis. This author surmises that such ergatoid forms take part in raids, and then remain in the raided nest and appropriate the remnants after their nest-mates have returned to the home nest.

It will be seen from table 1 that sexual forms of Leptothorax were present only in nest number 4, which contained two queen and one male pupæ. The two former emerged after the nest was brought into the laboratory. They were cared for by the

Leptothorax workers, and were not molested by the Harpagoxenus worker. They were not deälated, as is reported to occur for sexual forms (of both sexes) of the host species that emerge in nests containing *H. sublævis.* However, this nest was not long kept under observation.

My observations on the general behavior of the ants in the parasitized nests agree with those of Wheeler. The Harapagoxenus workers will eat if they happen to stumble onto a drop of food; but they do not forage, and are fed almost entirely by regurgitation from the Leptothorax workers. When the nest is disturbed they do not move the brood, and often are themselves transported by the much smaller Leptothorax workers. When a Leptothorax from a strange colony is put into the nest it is usually attacked by the auxiliaries, though in one case I have seen a Harpagoxenus take part in resisting such an intruder.

The male of H. americanus has not before been recorded. In the case of *H. sublævis* Adlerz did not at first distinguish the males from those of the host; but H. *americanus* males are strikingly different from those of *L. curvispinosus* in that they are shining black in color, and from those of *L. longispinosus* in that they have pale whitish yellow legs and antennæ. The eggs, larvæ, and newly formed worker pupæ I have not yet succeeded in distinguishing from those of Leptothorax; but worker pupæ nearly ready to emerge may be distinguished by their shoe r epinotal spines.

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AN INTERESTING BUTTERFLY CAPTURE.

By A. P. Morse,

Peabody Museum, Salem, Mass.

On August 6, 1926, while in southern New Brunswick, I took several specimens of a butterfly which looked unfamiliar, though it recalled both *Brenthis montinus* and *B. bellona.* Comparison with available examples of *B. chariclea* and *boisduvali* showed that it was most like the latter but differed in being considerably larger. As no example of that form was reported from nearer than Natashquan, Labrador, a specimen was sent, by permission, to Dr. F. H. Benjamin, curator of the Barnes collection, for determination. He tells me that it agrees perfectly with the type of *Brenthis chariclea grandis* of Barnes and McDunnough (Can. Ent., vol. 48, p. 223 (1916) from Hymers, Ont.

The original description emphasizes the deep purple color on the under side of the secondaries and the apex of the primaries. In my specimens the color is a deep golden brown, more or less suffused with purplish (lavender on the mesial pale band of the secondaries), a combination which, with the numerous dark and light spots of varied outline and arrangement, gives a very rich effect to the aspect of the lower surface of the wings.

This butterfly was captured in Charlotte County, N. B., only a few miles from the coast,—several hundred miles from Natashquan on the north shore of the St. Lawrence River, which is, I believe, the nearest point from which *boisduvali* has been recorded. This would seem good reason for believing that it will ultimately be found to be a resident locally of the mountainous portions of eastern Quebec, the colder sections of New Brunswick, especially near the coast, and also, perhaps, even of the eastern portion of Maine in the vicinity of Trescott and Cutler.

THE SLAVE-RAIDS OF *HARPAGOXENUS AMERICANUS.*

By W. S. Creighton,

Bussey Institution, Harvard University.

The observations here recorded were made at the American Museum of Natural History's Station for the Study of Insects at Tuxedo, N. Y. Through the courtesy of Mr. Frank Johnson of New York City the author was enabled to spend the summer of 1926 at the Station. To Mr. Johnson and to Dr. Frank E. Lutz, whose encouragement and support greatly facilitated this work, the writer wishes to express his sincere thanks. After the manuscript had been prepared it was learned that Dr.Sturtevant had made a number of observations about the same time on *Harpagoxenus* colonies found in New Jersey. I have had the opportunity of reading Dr. Sturtevant's manuscript and his results and mine amplify each other with very little repetition. In several cases observations have confirmed hypotheses in a remarkable manner, all the more striking in that neither of us knew of the work of the other. Dr. Wheeler has, therefore, suggested the simultaneous publication of the articles as they were originally prepared.

In 1893 Pergande found, near Washington, D. C., a mixed nest composed of *Leptothorax curvispinosus* (Fig. 1. B), and an unknown ant to which Mayr subsequently gave the name *Tomognathus americanus* (Fig. 1, A). Later the generic name was changed by Forel to *Harpagoxenus*, the specific name remaining unaltered. Besides the type specimens of *H. americanus* Mayr had a few others accidentally taken by Schmitt while collecting beetles at Beatty, Pa. During the next twelve years there are no further records of this ant until, in 1905, Dr. Wheeler discovered, near Bronxville, N. Y., three small mixed colonies of *H. americanus* and *L. curvispinosus* nesting in hollow elder twigs. The next observation on this rare insect came twenty years later when Sturtevant, during the summer of 1925, found on Naushon Island (Woods Hole) a mixed *Harpagoxenus—L. curvispinosus* colony inhabiting an oak gall.

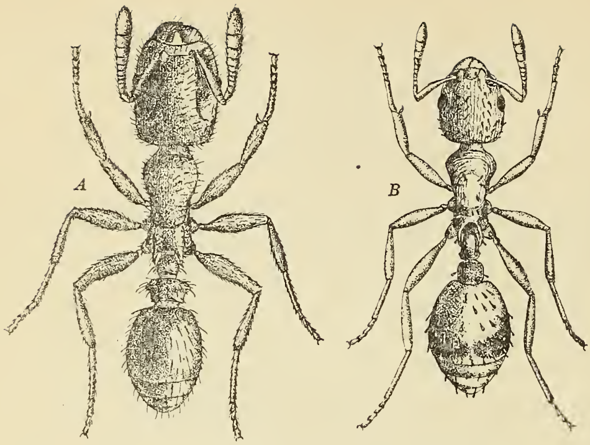

Fig. 1. A, worker of *Harpagoxenus americanus*; B, worker of *Leptothorax curvispinosus*, after Wheeler.

During the past summer I found a number of nests of *H. americanus* near Tuxedo, N. Y., and was fortunate enough to see these ants engaged in slave raids. In all but one nest the slave ant was *L. longispinosus*. The remaining colony contained slaves of both *L. longispinosus* and *L. curvispinosus*, a condition parallel to that described for the European *H. sublævis*, which enslaves both *L. acervorum* and *muscorum*. Dr. Wheeler postulated that such colonies should occur, since he found a queenless *longispinosus-curvispinosus* colony in the vicinity of the *Harpagoxenus* nests. However, since he did not think *H. americanus* a dulotic ant, he considered the colony as one which needed only the advent of a deälated *Harpagoxenus* queen to form a mixed colony containing two species of slaves. For reasons to be subsequently given I would consider Dr. Wheeler's mixed *Leptothorax* colony as a remnant, originally formed by dulosis, from which the *Harpagoxenus* had migrated or been killed off while raiding.

Before taking up the discussion of *H. americanus* it seems advisable to briefly outline the ethology of the European species. *H. sublævis* has been known since 1848, and since that time a number of observations have been made on its habits. It appears to have a wider distribution than its American cogener, for it has been taken in Finland (Nylander), Denmark (Meinert), Sweden (Stolpe and Adlerz), Saxony, West Prussia, Bohemia (Viehmeyer) Kärnten, Austria (Wolf), and the Swiss Engadine (Emelius). In this last location it occurs at an altitude of 1600-1700 meters. The pioneer observer of *sublævis* was Adlerz, who in 1896 conducted numerous experiments on these insects in artificial nests, supplemented by observations in the field. He found that in the mixed colonies the slave ant was usually *L. acervorum*, occasionally *L. muscorum* and rarely *L. tuberum*. Normal deälated *Harpagoxenus* queens were never present, their place in the colony being taken by the ergatoid female, a wingless worker-like insect possessing ocelli and a *receptaculum seminis*. Alderz further showed that the *sublævis* workers, if forced to do so through the absence of slaves, are able to feed themselves but do not care for the brood. This is normally tended by the slaves who feed the larvæ with regurgitated material and fragments of insects. This last observation was later confirmed by Viehmeyer, who amplified the work of Adlerz by discovering, near Dresden in 1906, the true winged queens of *sublævis* which Adlerz had supposed did not exist. Viehmeyer's observations '08) show that the actions of a *sublævis* female in founding a colony closely parallel those of *sanguinea* queens. After the entrance of the parasitic female into the *Leptothorax* nest the workers attack her, but are eventually killed or driven away by the larger insect who then takes possession of the nest and brood. Adlerz had previously observed similar actions of the ergatoid females and had concluded that *sublævis* customarily obtains its slaves in this manner. Such dispossession was thought to be fundamentally different from the raids of the amazons and sanguinary ants, who, after the pillage of the strange nest, return to their own with the plundered brood. Both Adlerz and Viehmeyer saw the "raids" of *Harpagoxenus*, if by this term we may translate the *eröfringstag* of the former writer and the *Raubzug* of the latter. Unfortunately both these investigators interrupted the proceedings by disturbing the nests, with the result that it is impossible to tell from their observations whether they witnessed a true raid or the dispossession of *Leptothorax* nests by the *Harpagoxenus*. Indeed, Adlerz considered that this last was what he had seen, but Viehmeyer seems to have interpreted the two forays which he discovered as true raids. Moreover each found mixed colonies which contained slaves of both *L. acervorum* and *L. muscorum.* Since the possibility that such colonies could have been formed by dispossession is very remote, these investigators concluded that *H. sublœvis* must make dulotic raids. It is gratifying to be able to supplement their observations with others on the dulosis of *H. americanus.*

The slave raids of *Harpagoxenus* show none of the organization and spirit so characteristic of those of *Polyergus.* They fall far short even of the lesser degree of cooperation exhibited by *F. sanguinea.* Nevertheless they are of great interest, since they appear to be the last manifestation of a vanishing character. They show the decay of dulosis and foreshadow a state of abject parasitism. During the progress of a raid the *Harpagoxenus* workers and their slaves cluster about the entrance of their nest in a manner suggestive of *Polyergus,* but with this the similarity ends. There is no rapidly moving phalanx of raiders, no concentration about the entrance of the raided nest, no frantic activity to enlarge the entrance. The *Harpagoxenus* leave their nest singly and amble awkwardly and uncertainly to the nest of their victims. Only once did I see more than one *Harpagoxenus* leave the nest at the same time. On one occasion a column of three departed for the *Leptothorax* nest. However, this column broke up almost at once and was, I believe, purely fortuitous. On arriving at the *Leptothorax* next the *Harpagoxenus* wastes no time in preliminaries but enters at once. Having secured a larva or pupa it emerges as quietly as it entered and returns with its burden to its own nest. Quite often they lose their way and I have seen a number of them captured by small spiders while raiding. The action of *Harpagoxenus* after it enters the raided nest could not, of course, be followed in the field. However, observation of ants in artificial nests show that the brood is obtained by force and not by stealth, although indeed, the action of the *Leptothorax* during a raid furnishes ample evidence that this is the case.

The nest which yielded most of the observations on the slave-raids was ideally situated for such work. It was in a crevice in one of the many out-jutting ledges of rock which studded a slope above a small pond. Jammed into the crevice was a small flake of stone which formed a little shelf on the perpendicular face of the ledge, and between this flake and the solid rock the nest was constructed. The entrance had been enclosed by a carton of lichens, perforated in the center by an almost circular aperture. Eleven feet away under the bark of a small log which rested on the ledge was the nest which the raiders visited. Between the two nests the ledge was bare except for large black lichens and occasional leaves and fragments of bark. The progress of the raiders could therefore be followed with the greatest ease, an important consideration when dealing with small, slowly moving insects.

The first raid was observed on August 4th. Arriving at the nest at 3:00 P. M. I noticed a crowd of *Leptothorax* and *Harpagoxenus* about the entrance. At 3:02 a *Harpagoxenus* arrived with a pupa. Another at 3:04. In both cases the *longispinosus* workers crowded about the returned raider apparently attempting to relieve it of its burden. A third pupa was brought in at 3:08 and carried directly into the next by the *Harpagoxenus*, which turned and backed into the entrance pulling the pupa in after it. At 3:25 a *Harpagoxenus* arrived with a callow. Another with a pupa at 3:26. In each case the raider entered the nest with its burden in the manner just described. During transportation the pupæ are held in such a way that they project forward and upward in front of the head of the raider.

The log in which the raided nest was located was small and badly decayed. The bark had loosened with the decomposition of the underlying wood and, as was later determined, just under the bark in a roughly oval excavation was the raided nest. To this the *Harpagoxenus* gained access through a rupture in the bark several inches away. The actions of the raiders on arriving at the log were somewhat disconcerting. They entered as nonchalantly, if I may be pardoned an anthropomorphic term, as though it had been their own nest. However any doubts as to the nature of their visit were quickly dispelled by the action of the *Leptothorax*. About ten inches from the point where the raiders entered a group of *longispinosus*, with part of the brood, had collected on the surface of the bark. They were huddled above the brood or moving uneasily nearby. In the group were several males. The importance of this observation cannot be minimized. It is proof positive that the actions of the *Harpagoxenus* were dulotic and not migrational. It removes the possibility that the nest in the log was a remnant of the mixed nest in process of transportation to a new site. It shows that the *Leptothorax* were aware of the presence of the raiders and, being unable to prevent the pillage of their nest, had resorted to flight to save the brood. Coupled with the actions of the raiders it establishes their dulosis in a manner which seems incontrovertible.

Additional evidence of a less conclusive nature was obtained by an examination of the raided nest. This was made on August 9th, after a heavy thunderstorm had put an end to the raids. The *Leptothorax* colony was in no respect a remnant. No *Harpagoxenus* were present. There were about forty *longispinosus* workers, a brood consisting largely of larvæ, and a dozen virgin queens. The old queen I could not find. It is entirely likely that she had perished during the raid, but in any case the presence of the virgin queens is a guarantee that the colony had been queenless for only a short time, if at all. Alderz's observation that sexual forms of the slaves are sometimes present in mixed colonies of *H. sublævis* invalidates what might be otherwise considered additional conclusive evidence of the individuality of the raided nest. However the character of the *Leptothorax* colony is at least not contradictory to the conclusion reached above.

I shall cite one further field observation before taking up those made on ants in artificial nets. It may perhaps serve to impress the reader with the degenerate nature of the dulosis of *Harpagoxenus*. On August 5th I arrived at the mixed colony at 2:00 P. M. The entire ledge was in the shade and no ants were outside the nest, although I could see the head of one in the entrance. During the next three quarters of an hour a few *Leptothorax* left the nest and wandered about on the ledge nearby. During this time also the shadow had shifted, so that when at

2:45 the first *Harpagoxenus* emerged the ledge was in the bright sunlight. After a short period of aimless wandering the *Harpagoxenus* started in the direction of the raided nest. Its progress was slow and uncertain, and on several occasions it became lost, to judge from its haphazard movements. It entered the *Leptothorax* nest at 3:14, having required twenty-nine minutes to cover 3.35 meters. Five minutes later it emerged with a callow and began to retrace its steps. In so doing it passed close to a *longispinosus* worker. The later drew back at its approach and then stood perfectly quiet until the raider had passed, an action which I subsequently observed many times in the artificial nests. Despite the added burden the *Harpagoxenus* completed the return trip in twenty-two minutes, entering its nest at 3:42. Neglecting the preliminary movements after its emergence from its nest, and deducting the five minutes spent in the raided nest, the entire trip of about 6.7 meters had been completed by the *Harpagoxenus* in fifty minutes. This gives it an average speed of 13.5 cm. per minute. Compare this with Dr. Wheeler's observations ('10) on the speed of *Polyergus* when raiding, viz: 1.3 meters per minute. It is true that *Harpagoxenus* is a small ant, scarcely a third the length of *Polyergus*, yet its smaller size will hardly account for its discrepancy in speed. I recently had the opportunity to study the rate of movement of *Iridomyrmex humilis*, a smaller ant than *Harpagoxenus*, and found that under optimum conditions it moved at the rate of approximately 2.75 meters per minute. Size, then, has little to do with the activity of an ant. If, as seems altogether likely, we can assume the correctness of Dr. Wheeler's postulate, ('07) that the ancestors of dulotic ants were active, predatory insects; if from this condition dulosis arose as a refinement of active predatism; then we must regard an ant which, though a raider, is slow and clumsy of movement as one in which the dulotic instincts are nearing extinction.

We now take up a series of observations upon ants in artificial nests, which are of interest in that they suggest what takes place when the raiders first enter the nest of their victims. On August 20th, while collecting in a damp wood, Mr. Brandt Steel called my attention to what I at first took to be a mixed colony of *Harpagoxenus* and *L. curvispinosus.*The nest was situated in a hollow twig that rested on a moss-covered rock. The open end of the twig had been plugged with a beautiful lichen carton with the customary circular aperture in its center. On the outside of the twig a group of the yellow *curvispinosus* clustered about a *Harpagoxenus* worker, while on the rock immediately below was a similar group. The entire colony was easily collected, placed in a handkerchief, and subsequently transferred to a plaster observation nest. On splitting the twig two more *Harpagoxenus* workers were found. Once the nest was installed in the observation nest it became apparent that I had misjudged the situation. The only queen present was that of the *Leptothorax.* Moreover under the binocular I could see the curvispinosus workers clinging with locked mandibles to the legs and antennæ of the *Harpagoxenus.* Here was no mixed colony but a number of raiders, fiercely resisted by the *curvispinosus.* That the latter had suffered in spite of their superior numbers was evident from their missing legs and antennæ. While I was watching, one of the *curvispinosus* maneuvering for a grip on the antenna of the *Harpagoxenus* had both its own antennæ bitten off when it came within reach of the intruder's jaws. Three of the four *Harpagoxenus* workers were thus surrounded. The fourth had found a shelter under ȧ piece of leaf mould. Here it remained coming out only to drive away any *curvispinosus* that approached its refuge. By next day the *curvispinosus* had established themselves in a small cavity in the plaster at one end of the nest. The brood had been carried inside and the entrance partially blocked by vegetable detritus. During the night two of the *Harpagoxenus* workers had succombed to the attacks of the *curvispinosus* and a third seemed badly crippled. The remaining *Harpagoxenus,* in all probability the one who had stayed under the leaf mould, was now surrounded by three *curvispinosus* workers which had fastened their mandibles on its legs and antenna. It made no efforts to extricate itself during the entire day but must have succeeded in doing so during the following night, for on the morning of the 2nd, it was wandering about the nest apparently uninjured. At this time there were nine dead *curvispinosus* workers in the nest.

At 1:37 P. M. the *Harpagoxenus* entered the little cavity in which the *Leptothorax* had placed their brood. Thirty seconds later the *curvispinosus* queen came hastily out and ran to the opposite end of the nest. After another thirty seconds a *curvispinosus* worker emerged with a pupa. This worker was followed by the *Harpagoxenus* for a short distance, but the latter quickly returned to the cavity. One minute later it appeared in the entrance to the cavity with a *Leptothorax* worker in its mandibles. This it dropped outside the cavity and immediately reentered. A general distrubance now pervaded the *Leptothorax.* An exodus of those in the cavity, many of them carrying pupæ, was followed by a spread of the excitement to the workers in the nest, who ran about in a confused and terrified manner. A few bold individuals remained at the entrance of the cavity and two ventured inside long enough for each to recover a pupa. A third worker who attempted to enter was apparently seized by the *Harpagoxenus,* for it disappeared into the cavity with startling suddenness and did not come out again.

At 2:00 P. M. the *Harpagoxenus* began a series of manouvers which can best be described as "reconnoitering.". At first it thrust only its head out of the entrance of the cavity and waved its antennæ about. At such times any *curvispinosus* near the cavity rushed away as though in terror. After about forty minutes of this behavior, it began making short sorties from the cavity. At first it hardly more than emerged, returning at once, but after twenty minutes it began to extend its reconnoiters. Twice during these sorties the *Harpagoxenus* attacked and injured a *curvispinosus* worker. In both cases this was done in a deliberate and spiritless manner. Most of the *curvispinosus* workers who chanced to encounter the intruder ran from it and were not attacked. When it left the cavity at 3:40 a change seemed to come over the *Harpagoxenus.* It no longer lumbered about the nest in its customary manner. Its movements were quick and active. During the next thirty-two minutes the *Harpagoxenus* attacked and injured eight *curvispinosus* workers with a ruthlessness and a "mordlust" that would have done credit to *Polyergus.* The victims were bitten in the thorax and abdomen and left in a dying condition on the floor of the nest. Twice during the absence of the *Harpagoxenus* from the cavity a *curvispinosus* entered and secured a part of the brood, and once the raider returned in time to drive away two others who were about to enter. During the foregoing period most of the *Leptothorax* had collected in two groups on the floor of the nest, the larger of which contained the queen and the majority of the brood carried out of the cavity. The *Harpagoxenus* now began to pass close to the *curvispinosus.* At 4:19 it approached the smaller group and attacking the workers, drove them away from the brood. This it examined with great care, touching the larvæ and pupæ with its antennæ. Two *curvispinosus* workers which attacked it in a half-hearted manner were quickly driven away. To my surprise it left the brood unmolested and turned to the larger group of *Leptothorax* which was now in great confusion. Some of them the *Harpagoxenus* drove away, attacking so vigorously two workers burdened with pupæ, that the pupæ were abandoned and their bearers put to flight. It then attacked a *curvispinosus* callow and soon afterwards bit off the antennæ of a worker. At 4:28 it returned to the cavity having taken no further notice of the brood. At this point the observations were interrupted for an hour and a half. When I returned the *Harpagoxenus* had left the cavity and had been seized by three *curvispinosus* workers. All of its former spirit and activity was gone, nor did it ever again manifest these characteristics. It lay supine and unresisting on the floor of the nest, its antagonists attached to its legs with locked mandibles. This was the condition at 10:00 P. M. However by next day it had freed itself and, to judge from the diminished brood of the *Leptothorax*, had carried a number of larvæ and pupæ into the cavity. At 11:17 A. M. it emerged, secured a pupa and returned with it to the cavity. The disorganization of the *Leptothorax* was complete. Twenty dead or dying workers were scattered about the nest. The queen lay on one side apparently dead. The remaining workers moved aimlessly about, a few carrying pupæ or larvæ. They no longer resisted or ran from the *Harpagoxenus* but stood perfectly quiet when it apsroached, and even allowed it to touch them with its antennæ. by the following day the *Harpagoxenus* had obtained practically all of the *curvvspinosus* brood. Only five larvæ and pupæ remained outside the cavity. During the next night the *curvispinosus* recovered a part of their brood but this was again taken by the *Harpagoxenus.* This see-saw possession of the brood continued until September 3rd., when it was ended by the death of the *Harpagoxenus.* At this time there were eight *curvispinosus* workers still alive. They immediately occupied the cavity and resumed the care of the brood.

Any interpretation of the facts just described may be criticized on the grounds that the ants were captive insects placed in artificial surroundings. I am convinced that their actions may be explained on just such a basis, viz: that they were captives, unable to leave the artificial nest. There can be little doubt that the actions of the *Harpagoxenus* constitute a "dispossession" of the *Leptothorax* of their nest and brood. Nevertheless this cannot be regarded as the founding of a mixed colony. With this in mind I examined the four *Harpagoxenus* individuals with the greatest care and can positively state that not one of them was an ergatoid female, if one may judge by the absence of ocelli or a female type of gaster. Under such circumstances the most plausible explanation is that of an interrupted raid. A condition making the return of the raiders to their own nest impossible, in this case confinement in the artificial nest, is, I believe, the reason for such occurrences. I have already given reasons for believing that the vestigial dulosis of *Harpagoxenus* makes its raids, even under the most favorable circumstances, very precarious. The surroundings of the nest from which the raids described above took place were as nearly ideal as could have been wished. The distance between the two nests was compararatively short. The smooth rock surface with its scattered lichens offered a minimum of obstructions and a substrate which facilitated the progress of the raiders. Yet even here the *Harpagoxenus* had difficulty in finding their way to and from the raided nest and frequently lost their way. Under the less favorable conditions of terrain which usually surrounds the colonies the chances for a successful raid would be greatly lessened. The initial entry into the raided nest is, as the above observations show, a difficult matter requiring much time. During the interval, perhaps several days, from the advent of the first intruder to the successful defeat of the defenders of the nest, there is ample time for altered external conditions. A heavy thunder shower might completely change the character of the ground between the two nests, efface any scent trails present, and render the return of the raider to its own nest extremely difficult or impossible. Under such circumstances there would result a mixed nest containing no queen but *Harpagoxenus* and *Leptothorax* workers. I found one such nest during the past summer and two of the nests which Dr. Wheeler discovered near Bronxville were of this character. It seems likely that the development of the ergatoid females in the European *sublævis* may have come about as a response to frequently interrupted raids. An insect of this type, able to participate in a raid and equally able to function as a queen, should a return to its own nest become impossible, is at least a logical outcome of such conditions.

An enumeration of all the mixed colonies found during the past summer will be given here, together with such observations as have not been already recorded.

No. 1, found Aug. 4th, is the colony from which the raids took place. Since it was never distrubed an accurate count of the number of ants present cannot be given. It was, however, a comparatively large colony and I should estimate that it contained at least a dozen *Harpagoxenus* workers and ten or twelve times that number of *L. longispinosus* slaves.

No. 2, discovered on Aug. 6th, was the largest colony of any that were seen. It was under a stone on one of the ledges about thirty-five meters to the west of No. 1. Since the nest was almost entirely surrounded by an area of perfectly bare rock it was an easy matter to collect the whole colony. Stragglers that escaped the initial transfer were picked up with a camels-hair brush and placed in the artificial nest. I am certain that not more than half a dozen ants escaped. The colony contained a normal *Harpagoxenus* queen with vestiges of wings, 17 *Harpgagoxenus* workers, 30 *L. curvispinosus* workers, 206 *L. longispinosus* workers 2 *longispinosus* males and considerable brood, most of which subsequently proved to be *Leptothorax*. The *Harpagoxenus* workers were very inactive, rousing themselves only to solicit food from their slaves. The *Leptothorax* workers spent much time diligently licking their lethargic masters.

No. 3 can hardly be considered a mixed colony, for as such I designate the *L. curvispinosus* nest attacked by the four *Harpagoxenus* raiders. It was found Aug. 20th, and is included here for the sake of clarity.

No. 4 was taken on Aug. 24th. It was located under a small flake of stone on the top of a boulder about eight meters from the spot where No. 3 was discovered. It contained a normal, deälated *Harpagoxenus* queen, 11 *Harpagoxenus* workers, 113 *L. longispinosus* workers and a fair amount of brood. I feel sure that the raiders found in No. 3 came from this nest, but experiments to prove this, while not invalidating the opinion, gave inconclusive results. Six *Harpagoxenus* males were produced in this colony after its transfer to an artificial nest. These are so different from the insect figured by Alderz ('96) as the male of *H. sublævis* that, were it not for his statement that he observed *Harpagoxenus* males in copulation with ergatoid females, it would seem likely that he had described aberrant males of *Leptothorax*. A figure of a *Harpagoxenus* male, together with a description is given at the end of this paper.

No. 5 was found on Aug. 30th., in dry, fairly open woods. The colony was under a flake of stone on the top of a boulder. Not wishing to disturb it I removed the covering stone only long enough to make certain of the presence of the *Harpagoxenus* queen, and to count the *Harpagoxenus* workers, of which there were twelve. I did not atetmpt to count the *longispinosus* slaves but would estimate that there were about a hundred.

No. 6, a small queenless colony was also found on Aug. 30th., about fifteen meters from No. 5. It consisted of two *Harpagoxenus* workers, ten *L. longispinosus* workers and a small brood of a dozen or more larvæ. When the stone covering the nest was removed both the *Harpagoxenus* and the *longispinosus* seized the larvæ and attempted to move them out of danger. I am of the opinion that this nest represents a *L. longispinosus* colony "dispossessed" by raiders from No. 5, who for some reason were unable to return to their own nest.

No. 7 was found on Sept. 3rd., about seventy-five meters to the west of No. 5. It was plainly an incipient colony containing a normal deälated *Harpagoxenus* queen, one *Harpagoxenus* worker and thirty-five *longispinosus* slaves and a large brood composed entirely of larvæ. The queen was subsequently found to lack the last pair of legs, only the stumps of these remaining.

This mutilated condition was also true of a deälated *Harpagoxenus* queen which was taken on Aug. 3rd. This insect, which was crawling over a stone when discovered, lacked the left antenna and one leg on the left side. It seems likely that it had been repulsed in an attempt to enter a nest of *Leptothorax*, since there were two fairly large *longispinosus* colonies about three meters from the stone where the *Harpagoxenus* queen was found. A most careful search failed to reveal any mixed colony in that vicinity.

As may be seen from the foregoing descriptions *H. americanus* presents one striking contrast to the European species. Normal winged queens are the general rule with *americanus* instead of the ergatoid females which usually take their place in *sublævis*. The ergatoid form seems to be as rare in the colonies of *americanus* as are the winged queens in those of *sublævis*. I have never seen an ergatoid female in any of the colonies thus far observed.

While much remains to be done it is now possible to sketch the ethology of *H. americanus*; a hasty sketch to be sure with many missing features hypothetically supplied, but at least a beginning. In this picture we see the fertilized *Harpagoxenus* queen entering a *Leptothorax* nest by force. Having driven away or killed the original owners of the brood she appropriates this, tends it and is in turn tended by the resulting *Leptothorax* workers, until in time there arises a mixed colony. When the colony is well established the dulotic instinct manifests itself in the *Harpagoxenus* workers. These gain entrance to some *Leptothorax* nest after a long struggle in which their greater hardiness and superior size finally enables them to kill or intimidate the *Leptothorax* workers. If the external conditions are favorable the raid is carried to a successful conclusion and the brood of the pillaged nest is carried back to the mixed colony. If the return of the raiders is rendered impossible then a fragmentary mixed *Harpagoxenus-Leptothorax* colony results.

The phylogeny of *Harpagoxenus* has been a matter of considerable speculation. The development of its raiding habits, a point formerly much disputed, is now agreed as paralleling that of *Polyergus*. . Viehmeyer ('21) eventually concluded that his hypothesis of the lestobiotic derivation of the raids of this ant was untenable and accepted the above explanation. On the other hand, there has never been any doubt of the close morphological affinities of *Harpagoxenus* to *Leptothorax*. *L. acervorum* (subgenus *Mychothorax*) is considered as closely related to, or identical with the ancestral form. It is generally believed that the parasitic ants (intraspecific parasitoids) have been devired from those species which they parasitize. (Wheeler '19). Occasionally when the parasitic relation has been of long standing the original host may have become rare or extinct and have been replaced by another closely related to it. The relation of *Harpagoxenus* to its slaves clearly illustrates both these points. The resemblance between the European *H. sublævis* and *L. acervorum*, its usual host, is close. On the other hand *H. americanus* parasitizes either *L. longispinosus* or *curvispinosus*, neither of which it particularly resembles. This is exactly what we should expect from the distribution of the host species. *L. acervorum*, a dominant ant in the European palæartic fauna, is rare in North America. The dominant neartic forms in this country are *L. longispinosus* and *L. curvispinosus*. It would be expected that the American *Harpagoxenus* would have adopted these forms in place of the rare *acervorum*.

In the study of phylogenetic relationships the males play an important part because of their morphological stability. Since the males of *H. americanus* have been hitherto unknown it seems advisable to devote a brief survey to the phylogeny of this ant. Through the kindness of Dr. Wheeler I have been enabled to examine material in his collection, and on this the following comparisons were made. We should expect morphological similarities to be most manifest in the males of the two genera and least apparent in the workers. Nevertheless even the latter exhibit a number of significant features in common. The workers of *L. acervorum* and *Harpagoxenus* both have eleven-jointed antennæ. The importance of this lies in the fact that the subgenus *Mychthorax*, to which *acervorum* belongs, is the only one of the holarctic subgenera of *Leptothorax* which exhibits this characteristic. Furthermore, in both *Mychothorax* and *Harpagoxenus* there is an impressed mesoepinotal suture. Since the combination of these two characters is the criterion by which *Mychothorax* is separated from all the other subgenera in the group, their occurrence in *Harpagoxenus* leaves little room for doubt as to the close relation of the two genera.

The similarity between the males of *H. sublævis* and *L. acervorum* was close enough to confuse even such a careful observer as Adlerz. (96). Unfortunately it has not been possible to examine the male of *sublævis* but a comparison of Adlerz's figure with the male of *acervorum* showed differences which are rather surprising in the light of that author's statement. In *H. americanus* there are even greater differences. Nevertheless these insects show a sufficient number of similar characters to justify the view that *Harpagoxenus* has been derived from *Mychothorax.* The males of both genera have twelve-jointed antennæ and in *H. sublævis* the shape of the joints is almost identical with that of *L. acervorum.* Curiously enough except for the number of joints, the antenna of *H. americanus* resembles that of *L. longispinosus* rather than *acervorum.* The mandibles of *H. sublævis* are similar to those of *L. acervorum* in that they are toothless and so short that they do not meet. The mandibles of *H. americanus* are longer, toothed and mucronate at the tip. In regard to petiolar structure *H. americanus* more closely approaches *L. acervorum* than does *sublævis.* Neither of the former possess the ventral tooth which arms the second node of the petiole in *H. sublævis.* It is interesting to note that the second petiolar node in *L. acervorum* is somewhat expanded laterally, since the squamiform second node is a marked characteristic of *Harpagoxenus.* Allowing for the minor variations which occur within the species, the anterior wing venation in the males of the two genera is practically identical. The hind wings of *H. americanus* are veinless, but those of *sublævis* and *acervorum* are correspondingly veined.

From the foregoing consideration it is clear that *H. sublœvis* shows closer affinities to *L. acervorum* than does *H. americanus.* This may be correlated with the habits of the two slave-makers. *Sublœvis* has apparently always lived with the host from which it was derived and has therefore changed only slightly. On the other hand, *americanus*, adopting new hosts, has diverged to a greater extent from the ancestral type.

In conclusion is given a description of the male of *H. americanus* (Fig. 2.)

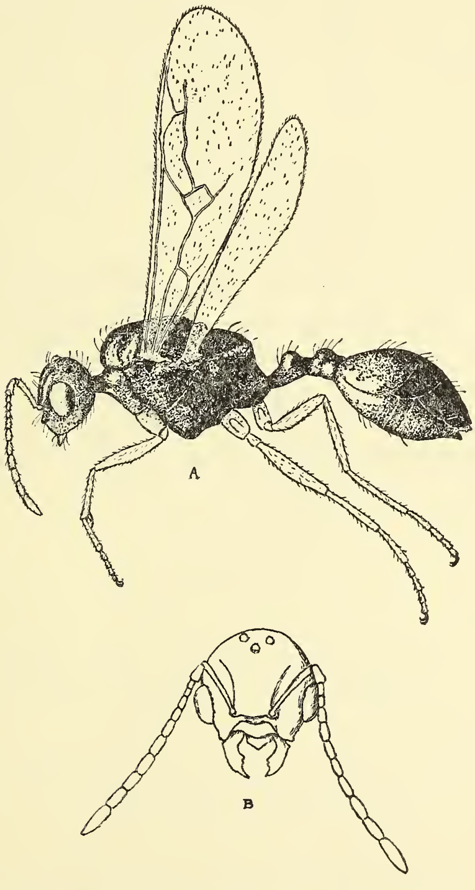

Fig. 2. A, male of *Harpagoxenus americanus*; B, head of same.

Length: 2.7 mm.

Color: head, thorax and abdomen brownish black; antennæ and legs very pale, almost transparent in fresh specimens.

Head rugulose with numerous erect hairs. Thorax feebly rugulose, somewhat glabrous, and with fewer hairs. Abdomen glabrous with sparse erect hairs. Antennæ 12-jointed. Funiculus without a distinct club but the joints gradually increasing in diameter towards the tip. First funicular joint pyriform, much broader than those immediately succeeding it. Second and third funicular joints cylindrical and distinctly shorter than the adjacent joints. The following joints sub-oval and gradually increasing in length towards the tip. Scape one quarter the length of the funiculus. Scape and funiculus clothed with a short erect pubescence. Antennal scrobes much shallower than in female and worker, but distinct. Mandibles long and narrow, feebly toothed and sharply mucronate at the tip. Neck long and flattened dorso-ventrally.

Anterior face of mesonotum abruptly projecting above pronotum. Mayrian furrows strongly impressed at the pro-mesonotal suture, but becoming feeble at their point of confluence. Fore wings with a short open radial cell. Hind wings veinless except for faint impressions at the base of the wing. Epinotum unarmed. Second node of petiole without ventral tooth, squamiform, broader and less constricted behind than in worker. Petiolar hairs sparse.

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NOTES ON A COLLECTION OF AMBER ANTS.[1]

By F. M. Carpenter.

In a collection of parasitic hymenoptera from the Baltic Amber, now at the Bussey Institution, a number of other insects were accidently included, among which were 89 ants. This small ant collection is peculiar in that it contains a higher percentage of males than has been the case with former material. In such collections the workers have far excelled the sexual forms in respect to the number of individuals present, but in the collection before me the males are almost twice as abundant as the workers. The species represented in this material are listed below, together with a few notes on their occurrence, and the numbers identifying the specimens in the two collections (Museum of the University of Könisberg and the Fritsch collection) to which the fossils belong. The species present, except one, were described by Mayr[2] in his paper, "Die Ameisen des baltischen Bersteins", and by Professor W. M. Wheeler[3] in "The Ants of the Baltic Amber."

Myrmicinae

Erebomyrma antiqua Mayr: Two males in the Univ. Königsberg collection, both without numbers. These two specimens increase the number of observed males of the species to seven.

Stenamma berendt Mayr : One male, Univ. Königsberg (xxB979). This is the third specimen of this species that has been found. It is curious that the species should be present in so small a collection as this, since only two other individuals have been seen in the 11678 amber ants that have previously been studied.

[1]Contribution from the Entomological Laboratory of the Bussy Institution, Harvard University, No. 274.
[2]Beiträge zur Naturkunde Preussens, hereausgegeben v. d. physik.—ök Ges. zu Königsbreg, 1, 1868.
[3]Sonderabdruck aus den Schriften der Phpsikalisch—ök. Ges. zu Königsberg, i. Pr., LV. 1914.

Nothomyrmica rubis Mayr: One worker in the Univ. Königsberg (xxB859).

Leptothorax gracilis Mayr: One worker and one male, both in the collection of the University of Königsberg, and without numbers.

Dolichoderinae

Dolichoderus balticus Mayr: One specimen, Univ. Königsberg collection (11017/364), the sixth individual to be found.

Dolichoderus tertiarius Mayr: One male in the Univ. Königsberg collection. (137060/437).

Iridomyrmex geinitizi Mayr: Three males and three workers in the Univ. Königsberg collection (9561/289, 7501/239, xxB768, B18282, and two without numbers); one worker in the Fritsch collection (207).

Iridomyrmex gœpperti Mayr: Eight workers and one male in the Univ. Königsberg collection (B19423, xxB1771, 7444/182, and six without numbers); one worker in the Fritsch collection (186).

Formicinae.

Prenolepis henschei Mayr: One worker and one male, Univ. Königsberg collection (xxB104, 7479/217).

Prenolepis pygmæa Mayr: Nine males in the Univ. Königsberg collection (9757/303, 4195/76, etc.); ten males in the Fritsch collection (163, 62, 96, 186, etc.).

Lasius schiefferdeckeri Mayr: Two males in the Fritsch collection (246, 229).

Lasius punctulatus Mayr: One female in the Fritsch collection. (230).

Formica flori Mayr: One worker and two males in the Univ. Königsberg collection (xxB908, and two without numbers); four males in the Fritsch collection (241, 216, 197, 138).

The remaining specimens are too poorly preserved to permit satisfactory determination, and with the exception of one individual none of these presents any striking characteristics. The specimen referred to is a male ponerine (Fritsch collection, number 4) and differs from other known males of the subfamily by having a twelve-jointed antenna; a low, rounded petiole with an anteroventral keel; and forewings with the veins crowded anteriorly and basally. Professor Wheeler kindly examined this specimen, but did not regocnize it as belonging to any existing genus. However, the present knowledge of extant male ponerines is too incomplete to allow determination of the affinities of this species, until the worker has been found.

DIPTEROLOGICAL NOTES

By Charles W. Johnson

Boston Society of Natural History

The Infestation of Bluebird Nests by Protocalliphora: From Mr. A. W. Higgins of Rock, Mass., I received (July 23, 1926) an abandoned bluebird's nest containing 154 larvæ and pupæ of Protocalliphora. The nest was packed in a tight tin box and as the weather was exceedingly warm it heated in transit and the larvæ were dead. Between July 30 and August 3, 24 flies emerged, all representing *P. splendida* form *sialia* Shannon and Dobroscky. Among the pupæ were 17 that were parasitized by a small chalcid, kindly determined for me by Mr. A. B. Gahan, as *Mormoniella brevicornis* Ashm. Some 204 specimens of this chalcid emerged between August 3 and 4 from these pupæ. Another bluebird's nest collected by Mr. J. D. Smith at Needham, Mass., contained 33 pupæ, from which emerged between August 3 and 5, 21 flies, all representing the form *sialia*. Of these 4 of the pupæ were parasitized by the above chalcid. The blood sucking larvæ of the Protocalliphora undoubtedly cause the death of many nestling birds. The above facts have been written up more in detail for an ornithological journal.

A large number on Hipi oboscids on an Owl: On September 28, 1926, Dr. John C. Phillips captured a Great Horned Owl (*Bubo virginianus*) at Wenham, Mass. The specimen was sent to the Boston Society of Natural History and from it were taken 19 specimens of *Ornithopomus americanus* (Leach) and 34 *Ornithoica confluenta* (Say). Seven puparia of the latter species were also found. In skinning the owl Mr. J. D. Smith found six of the *O. confluenta* and three of the pupæ in the ears of the bird. These figures do not represent by far all the flies infesting the owl, as the cahuffeur said a number of the flies left the bird and were flying about the automobile on the way to the Museum.

Records for *Muscina pascuorum* Meigen, for 1926: Two males of this species were taken by the writer at Salisbury Cove, Mt. Desert, Me., August 7 and 9, and four males and one female on Nantucket Island, Mass., Sept. 8, Mr. Howard J. Shannon reports finding eight in his attic at Jamaica, Long Island, N. Y., Oct. 22, 27 and 30. The two sent me were females. These figures show that in the late summer and early fall the males predominate, the females in October seeking buildings in which to hibernate. I am quite sure that this species covers a much greater area than has been recorded, but owing to its resemblance to other common muscids it has been overlooked. Mr. H. C. Curran has recently published (Can. Ent., vol. 58, p. 235) an account of the distribution of this fly in Canada.

The first record for the Narcissus fly (*Merodon equestris*): in America: There is apparently no doubt that this fly has been present in the immediate vicinity of Boston, Mass., for more than fifty years. The first record is that given by Packard.[1] who says:—"Mr. Sanborn has also reared from the pupa state *M. narcissi* which probably lives in the soil about decaying bulbs. It has been introduced from Europe according to Mr. Sanborn by the importers of Dutch bulbs." The fly was reared a year if not more before the publication of the work, 1869. Mr. F. G. Sanborn worked on the collection of insects at the Boston Society of Natural History at that time.

Osten Sacken in his Catalogue of Diptera 1878 says: "No American species are as yet recorded. The European *Merodon narcissi* has been occasionally introduced to the United States in dutch bulbs and the fly reared from them by Mr. F. G. Sanborn." Evidently at that time Osten Sacken had no record of the species having been taken afield and to this day the species is only found in close proximity to gardens which offer a suitable habitat.

The most interesting account of the Narcissis fly and its appearance in the vicinity of Boston is that by Professor J. G. Jack,[2] from which I quote the following: "In the Agassiz Museum Cambridge, Mass., there are larvæ of this pest and damaged bulbs of Narcissus which were received from a garden in Brookline, Mass. in 1879. During the past year or two this same es-

[1]Guide to the Study of Insects, p. 399, 1869.

[2]An enemy of Narcissus and Amaryllis, Garden and Forest, vol. X, p. 154-156, with figs. Apr. 1897.

tablishment has suffered more than usual damage from the ravages of the Merodon which appears to have been present in more or less abundance every season since it was first noticed in the place nearly twenty years ago. At that time besides various species and varieties of Narcissus, it was found to attack bulbs of *Vallota purpurea* and its varieties. Recently it has been found very destructive to many rare and beautiful Hippeastrum hybrids formerly known under the generic name of Amaryllis. And it is probable that it will be found to attack other plants of the Amaryllis family to which the Narcissus belongs. The pest has affected bulbs both in the open air and in the greenhouses." Although recorded by Banks in the "Bibliography of Economic Entomology," pt. 7, p. 50, 1901, this important paper on the history of this species in America seems since then to have been overlooked. A specimen in the Museum of Comparative Zoology bears the following label "From Hippeastrum bulbs in Greenhouse, Brookline, Mass., March 16, 1897, J. G. Jack." There is also a specimen from Prof. Jack in the collection of the Boston Society of Natural History. In 1902 I received from G. Chagnon for determination a specimen collected at Montreal, which was recorded in Aldrich's Catalogue in 1905. This record probably led Curran[3] to say, "The Species was first reported outside from Montreal." The later history of the species (1908-1916) is given by Dr. C. L. Metcalf (Ent. News, vol. 30, p. 173, 1919).

[3]Kansas Univ. Sci. Bull., vol. 15, no. 1, p. 169. Dec. 1924.

ON THE AFFINITIES OF THE GRYLLOBLATTIDÆ

By A. D. Imms, D. Sc.,

Rothamsted Experimental Station, Harpenden, England.

The family Grylloblattidæ includes two known genera viz· *Grylloblatta* Walk. (N. America) and *Galloisiana* Caudell (Japan). In its morphological characters it is evidently the most primitive living family of Orthopterous insects. Viewed from the phylogenetic standpoint, the Grylloblattidæ are of exceptional interest in that they combine features of the Orthoptera (*sensu lat.*) Isoptera, Dermaptera and Embioptera. Most of these characters have already been pointed out by Walker (1914) and in a series of papers by Crampton. The possession of a combination of "synthetic" characters, that are exhibited also in other groups, has rendered it difficult to settle the taxonomic position of the Grylloblattidæ and the affinities of the latter have consequently given rise to some divergence of opinion. In so far as the main characters are concerned, Walker considered that they are nearest allied to the family Blattidæ of the Orthoptera Cursoria. The present writer (1925) also maintained that the Grylloblattidæ are more closely related to the Cursoria than to the Saltatoria. On the other hand, Crampton in his most recent publication (1926) on the subject emphasises his previous opinion that the family should be placed along with the Orthoptera Saltatoria. In endeavouring to clear up the cause of this bone of contention it is useful to enumerate the principal characters that distingiuish these two main divisions of the old order Orthoptera and they are summarised below.

ORTHOPTERA CURSORIA. (Blattidæ and Mantidæ, together with the more distantly related Phasmidæ). Legs usually of approximately equal size and the hind pair not modified for leaping: tarsi 5-jointed. Sound producing organs wanting. Cerci most often multiarticulate, often with 8 to 15 or more joints. Ovipositor reduced and concealed. Penis asymmetrical.

ORTHOPTERA SALTATORIA (Orthoptera *sensu stricto*: Acridiidæ, Tettigoniidæ and Gryllidæ). Legs of unequal size, the hind pair modified for leaping: tarsi never more than 4-jointed. Sound producing organs almost always present. Cerci never multiarticulate. Ovipositor well developed and almost always exserted. Penis bilobed and symmetrical.

On the characters enumerated above it may be said that the Grylloblattidæ only differ from the Cursoria in the possession of a well developed exserted ovipositor. It is, however, necessary to examine certain other criteria and not base a definite conclusion solely upon this diagnosis. Furthermore, several of the features stressed by Crampton in maintaining his point of view need some comment.

(1) Absence of ocelli. This character is of little phylogenetic value as ocelli tend to degenerate or disappear in various Orthoptera. Thus, among the Cursoria they are reduced or wanting in some apterous Blattidæ as well as being absent in many Phasmidæ. Their absence, therefore, is no criterian of affinity with the Saltatoria.

2; Multiarticulate cerci only occur in the Blattidæ and the related family Mantidæ. Unjointed setiform cerci are found in the Gryllidæ but there is no indication that this superficial similarity to the same, but multiarticulate, organs in the Grylloblattidæ is anything more than a parallelism, induced perhaps, by a similar terrestrial life.

(3) Dr. Crampton has already pointed out the structural similarity that exists between the terminal abdominal segments of the Grylloblattidæ and Mantidæ. He has likewise stressed the similarity of the coxæ, trochanters and divided trochantins, as seen in the Grylloblattidæ and Blattidæ, so no further comment here is needed.

(4) The various Isopteran characters displayed in the Grylloblattidæ, and emphasised by Crampton, afford indirect support to the relationship of that family with the Blattidæ. It is generally accepted by such competent authorities as Holmgren and others that the Isoptera are closest related to the Blattidæ on the sum total of their characters. Evidences of affinity of the Grylloblattidæ with the Dermaptera and Embioptera have very little bearing upon their systematic position within the Orthoptera.

(5) The Saltatorial affinities of the family are undoubted as Walker was the first to demonstrate. My contention is that they are insufficient to warrant its transference from the Cursoria. The most important character is the exserted ovipositor ot the Tettigonid type but here, as Walker has shown, it is constructed on a somewhat more primitive plan. The presence of the vaginal orifice between sterna 8 and 9 affords another character of the Saltatoria but is it also shared with the Phasmidæ. The general resemblance of the head to that of the Gryllidæ has been pointed out by Walker and subsequently by Crampton. The antennæ, on the other hand, show no such affinity and are definitely Embiid in character. The mouth-parts yield no decisive data although in some particulars they exhibit slight, but unconvincing, resemblances to those of the Gryllidæ.

(6) The full evidence of internal anatomy is at present unavailable but when Miss Ford's study of this aspect is completed we shall be in possession of data of considerable importance. Her recent study of the abdominal muscles (1924), however, indicates that the Grylloblattidæ betray Blattid and Mantid relationships rather than affinities with the Saltatoria.

In conclusion, it is hoped that the present article sufficiently explains the grounds for including the Grylloblattidæ as a family of the group Cursoria of the Orthoptera (*sensu lat.*) I wish to thank thank Miss Norma Ford for kindly supplying me with a well preserved example of the species *Grylloblatta campodeiformis*.

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THE OCCURRENCE OF *FORMICA FUSCA* L. IN SUMATRA.

By William Morton Wheeler.

In a preceding number of Psyche (Vol. 29, Aug. 1922, p. 175) I cited the occurrence of two common North American ants, *Formica fusca* L. and *F. neogagates* Emery, as having been taken by Dr. J. W. Chapman at Dumaguete, on the Island of Negros in the Philippines, and conjectured that they might have been introduced by commerce. Recently I have come to doubt the provenience of the specimens to which I referred. It seems that when he left the Bussey Institution to teach at the Silliman Institute in Dumaguete, Dr. Chapman was supplied by our laboratory with a number of empty vials to be used in collecting ants and other insects. Possibly two of these vials contained some specimens of *F. fusca* and *neogagates* that had been collected near Boston by one of the students and had been accidentally included among the material amassed by Dr. Chapman near the Silliman Institute. Since all this material was collected in a small area he did not provide the individual vials with locality labels. Until, therefore, the species of Formica above mentioned are again taken at Dumaguete, it is inadvisable to include them among the Philippine ant-fauna. No such doubt, however, can arise in regard to the species of Formica discussed in the following paragraphs.

Among a number of ants collected for me by Dr. David Fairchild and his son Graham Fairchild in Northern Sumatra, I find a series of twelve workers, which evidently belong to the common circumpolar *Formica fusca,* though they may be regarded as representing a distinct variety, var. *fairchildi* var. nov. These specimens were taken by Dr. Fairchild March 8th, 1926 above Kota Dah, at an altitude of 4000 ft., in a pine forest. Careful comparison with many specimens of the typical *fusca* reveals only the following slight differences: Body averaging slightly smaller (4-5 mm.); funicular joints of the antennæ a little shorter. Border of petiole distinctly sharper and more compressed. Bristles on the flexor surfaces of the middle and hind tibia stouter, less reclinate and more conspicuous. Pubescence much as in the true *fusca,* but finer and somewhat more dilute on the upper surface of the gaster, but distinctly longer on its sides and venter. The gaster is somewhat more shining and metallic, more as in the North American var. *subœnescens* Emery. The color is a deeper black than in *fusca* and the legs and palpi are more blackish, the mandibles and antennæ somewhat deeper red. One of the specimens has distinct bluish reflections like the Mexican *F. subcyanea* Wheeler. The male and female, when discovered, will probably exhibit additional differences.

We must, I believe, regard the var. *fairchildi* as a true tropical relict and not as a recent importation. Its occurrence in a remote locality, at a considerable altitude and among pines makes the latter supposition very improbable. It is quite different from the var. *japonica* Motschulsky from Japan and China, a form which we might, perhaps, expect to find in Indonesia. The present wide distribution of *fusca* and its many varieties throughout northern North America and Eurasia, and its very close relationship, if not identity, with *F. flori* Mayr of the Baltic Amber (Lower Oligocene Tertiary) suggest an even wider distribution during the geologic past. Further investigations at high altitudes in Sumatra and possibly also in Java and Borneo may show that *fusca* has survived also in other localities in these tropical islands. A somewhat similar case is presented by *F. picea* Nylander, a peat-bog ant which is widely distributed over northern Eurasia and as far south as Switzerland and Thibet, though it is not known to occur in North America or Japan. In 1913 Forel described from Taihorin, on the island of Formosa, a variety of this ant (*formosæ*) which like the above described *fairchildi* would seem to be a tropical relict.

BURMESE ANTS COLLECTED BY PROFESSOR G. E. GATES.

By William Morton Wheeler.

In 1923 Professor Gordon E. Gates of Judson College, Rangoon, Burma, sent me a small but interesting series of Formicidæ which he collected in that locality. Most of the forms are well-known and widely distributed in the Indomalayan Region, but the collection includes a new species of Aphænogaster and a new variety of *Ænictus binghami* Forel.

Dorylinæ.

Dorylus (*Typhlopone*) *orientalis* Shuckard. A few soldiers and workers.

Ænictus binghami Forel var. *gatesi* var. nov.

Worker. Differing from the typical form of the species in having the pronotum entirely opaque and densely punctate like the remainder of the thorax. The petiole is also more coarsely punctate, more opaque and darker in color.

Numerous specimens from a single colony.

Ponerinæ.

Odontoponera transversa F. Smith. Several workers and a winged female.

Diacamma scalpratum F.Smith. Numerous workers.

Diacamma rugosum Le Guill. subsp. *vagans* F. Smith. var. *birmanum* Emery. Numerous workers.

Bothroponera bispinosa F. Smith. A few workers.

Ectomomyrmex astutus F. Smith. A few workers.

Euponera (*Brachyponera*) *luteipes* Mayr. Several workers.

Leptogenys (*Lobopelta*) *diminuta* F. Smith. A single worker.

Leptogenys (*Lobopelta*) *kitteli* Mayr. Several workers.

Pseudomyrminæ.

Sima rufonigra Jerdon. Several workers.

Tetraponera binghami Forel. A few workers.

Tetraponera allaborans Walker. A few workers.

Myrmicinæ.

Aphænogaster (*Deromyrma*) **feæ** Emery.

Female (undescribed). Length 6.5-7 mm.

Resembling the worker. Cheeks with two parallel carinæ, instead of one, forming the external border of the antennal fovea. Mesonotum not overarching the pronotum, convex, as broad as long. Epinotum sloping, the base twice as long as the declivity, feebly concave, the spines stout, fully twice as long as their basal diameter, as long as the declivity, directed upward and backward. Petiole and postpetiole as in the worker, but their nodes higher and stouter. Gaster more voluminous than the thorax.

Sculpture, pilosity and color as in the worker, but the base of the epinotum coarsely and regularly, transversely rugose, the petiolar node transversely rugulose. Wings long, their membranes uniformly brownish, their veins and pterostigma darker brown.

Male (undescribed). Length 4.5 mm.

Head resembling that of the worker but shorter, the portion behind the prominent eyes less convex and narrowing more rapidly to the collar. Mandibles with a sharp apical tooth and five or six subequal basal denticles. Cheeks short and straight, without carinæ. Clypeus convex, its anterior border rounded and entire. Antennal scapes reaching a little beyond the posterior ocelli; funiculi slender, first joint longer than broad and distinctly thicker than the succeeding joints. Mesonotum strongly overarching the very short pronotum, very convex in front; epinotum long, the base long and sloping, strongly concave in front, horizontal and feebly convex behind, without spines or teeth, but with a distinct angle on each side where it passes into the very short declivity. Petiole and postpetiole as in the worker, but the nodes lower and that of the petiole more angular in profile.

Sculpture and color as in the worker and female, very smooth and shining, but the base of the epinotum and upper surface of petiolar node without rugæ. Hairs sparser, more delicate and pointed than in the female and worker. Wings slightly paler than in the female.

Eleven workers, two females and four males from a single colony.

Aphænogaster (*Attomyrma*) gatesi sp. nov.

Worker. Length nearly 4 mm.

Head subrectangular, fully as broad as long, a little broader behind than in front, with straight, transverse posterior border and evenly rounded sides. Mandibles large, rather flat, with scarcely concave external borders, the teeth, except the apical, small, numerous and irregular. Clypeus broad, somewhat depressed anteriorly, the border entire, broadly and evenly rounded. Frontal area large, distinct and triangular. Frontal carinæ subparallel, nearly as far apart as their distance from the sides of the head. Eyes rather small, at the middle of the sides of the head. Antennæ moderately stout, scapes slightly flattened at the base, extending nearly half their length beyond the posterior corners of the head; funiculi with distinctly 4-jointed club; joints 2-7 subequal, about $1\frac{1}{2}$ times as long as broad, basal joint nearly twice as long as broad. Thorax moderately stout but much narrower than the head, broadest through the pronotum which is subhemisperical, as broad as long. Promesonotal suture distinct and somewhat impressed; mesonotum narrow, sloping, with an abrupt angular projection on the middle and a lower angular projection at its posterior end near the mesoëpinotal suture. Mesoëpinotal constriction pronounced; base of epinotum straight and horizontal in profile, from above with a median longitudinal impression; declivity sloping, somewhat shorter than the base from which it is separated by a pair of small erect teeth which are as broad at the base as long. Petiole narrow, about twice as long as broad, laterally compressed, violin-shaped from above; the node rather small and conical. Postpetiole fully three times as broad as the petiole, as broad as long, broader behind than in front, the node in profile low and rounded, not as high as the petiolar node. Legs moderately long, femora distinctly thickened in the middle.

Shining: mandibles finely striate and sparsely punctate; clypeus with five widely separated longitudinal rugæ; cheeks and sides of head sharply but not densely longitudinally rugose; antennal foveæ with a few concentric rugæ; remainder of head and pronotum with scattered piligerous punctures; meso- and epinotum densely punctate-reticulate, but not opaque; nodes of petiole and postpetiole faintly longitudinally striate above; gaster and legs with scattered piligerous punctures.

Hairs yellowish, rather long, coarse but not obtuse, erect or suberect, both on the body and appendages, conspicuous on the scapes and legs.

Piceous brown; mandibles, funiculi, legs, borders of gastric segments and sutures of thorax and pedicel, except the nodes, paler and more reddish.

Described from four specimens.

This species is related to *A. smythiesi* Forel from the northwest Himalayas, but differs in the shape of the head and of the mesonotum, the angular projection of which is much further back in *gatesi*, the greater width of the postpetiole, very different sculpture of the head and epinotum, coarser, longer and more erect hairs on the appendages, etc.

Pheidole sulcaticeps Roger subsp. *yeënsis* Forel. Numerous soldiers and workers.

Pheidole malinsi Forel. Soldiers, workers and males.

Myrmicaria brunnea Saunders. Several workers.

Crematogaster dohrni Mayr. subsp. *rogenhoferi* Mayr. Workers and a deälated female.

Crematogaster hodgsoni Forel. Several workers.

Crematogaster rothneyi Mayr. Two workers.

Crematogaster (*Oxygyne*) *travancorensis* Forel. Several workers.

Solenopsis geminata Fabr. subsp. *rufa* Jerdon. Workers and females.

Pheidologeton affinis Jerdon. Soldiers, intermediates and workers.

Pheidologeton diversus Jerdon. Soldiers, intermediates and workers.

Carebara lignata Westwood. Two deälated females.

Meranoplus bicolor Guérin var. *lucidus* Forel. Three workers.

Dolichoderinæ.

Dolichoderus (*Hypoclinea*) *bituberculatus* Mayr. Three workers.

Dolichoderus (*Hypoclinea*) *affinis* Emery var. *glabripes* Forel. Numerous workers, a deälated female and four males.

Dolichoderus (*Hypoclinea*) *taprobanæ* F. Smith. Several workers and a deälated female.

Technomyrmex albipes F. Smith. Five workers.

Formicinæ.

Anoplolepis longipes Jerdon. Numerous workers.

Plagiolepis (*Anacantholepis*) *rothneyi* Forel. A single worker.

Œcophylla smaragdina Fabr. Numerous workers and a deälated female.

Camponotus (*Tanæmyrmex*) *variegatus* F. Smith var. *dulcis* Emery. Numerous workers and four females.

Camponotus (*Myrmosericus*) *rufoglaucus* Jerdon subsp. *paria* Emery. Numerous workers.

Camponotus (*Myrmosaulus*) *singularis* F. Smith. A single worker.

Camponotus (*Colobopsis*) *leonardi* Emery. Several workers.

Polyrhachis (*Myrma*) *proxima* Roger. Three workers.

Polyrhachis (*Cyrtomyrma*) *rastellata* Latreille. Five workers.

Paratrechina (*Nylanderia*) *birmana* Forel. A single worker.

NEW WEST INDIAN MEGACHILE.[1]

By Theodore B. Mitchell.

The following new species were found partly in a series of *Megachile* collected in Cuba by Dr. George Salt during the winter and spring of 1925, and partly in some unidentified material in the collection of the Museum of Comparative Zoology at Cambridge.

Megachile bahamensis n. sp.

♀. Head very broad, eyes slightly converging below, pubescence fuscous; supraclypeal plate almost impunctate medially, with only a few scattered punctures; clypeus coarsely and irregularly punctate, rather sparsely so in the center, apical margin polished and impunctate, somewhat thickened and very slightly incurved; mandibles broad, irregularly and very sparsely punctate above, 5-dentate, the two apical teeth approximate, and the three inner ones approximate, the second and third widely separated and with a cutting edge between them which ends abruptly just before the subapical tooth; cheeks narrow, shining, finely punctate, carinate on posterior margin; vertex flat, shining, with a few larger scattered punctures interspersed with more numerous smaller ones which are more shallow and indistinct; lateral ocelli about equally distant from eyes and edge of vertex; front sparsely punctate just below ocelli, but closely and finely punctate between antennæ; antennæ blackish above, pale brownish beneath with a slight violet tinge, the middle joints slightly longer than broad.

Thorax entirely bare above, pubescence at sides and behind brownish, becoming fuscous below; mesonotum shining, with large scattered punctures, almost impunctate medially; scutellum impunctate medially, with scattered punctures laterally, posterior margin broadly triangular; pleura closely and finely

[1]Contribution from the Department of Zoology and Entomology, North Carolina State College, in cooperation with the Entomological Labaratory of the Bussey Institution, Harvard University [Bussey Institution No. 271]. Published with the approval of the Director of the North Carolina Experiment Station as paper number 14 of the Journal Series.

punctured above, more coarsely and sparsely so below; propodeum very finely and closely punctured laterally, more sparsely so posteriorly; tegulæ piceous, finely punctured, the punctures widely separated; wings pale fuliginous, more strongly so apically and along costa, nervures testaceous, basal nervure much beyond transverse median, second recurrent nervure entering second submarginal cell slightly nearer apex than the first does to the base; legs black, black pubescent, that on the tarsi beneath and on the mid tarsi without, with somewhat of a fuscous tinge; middle metatarsi almost as broad as their tibiæ and the hind metatarsi fully so; spurs reddish-testaceous; claws testaceous basally, ferruginous apically, with short but distinct basal teeth.

Abdomen cordate, shining, segments with but few scattered punctures apically, but more numerous on basal portions of discs, bare of pubescence above, the concavity of the first segment peculiar in having a longitudinal sharp ridge dividing it into two separate concavities; segment 6 but very slightly concave at sides viewed from above, practically straight in profile, the surface hidden by fine appressed brownish pubescence, which contrasts rather strongly with the otherwise black abdomen; scopa entirely black; apical ventral segment with a free polished apical lip which projects slightly beyond the scopa. Length 11 mm.

Type: Female (Type No. 15716, Mus. Comp. Zool.); Mangrove Cay, Andros, Bahamas, Aug. 1, 1904 (Allen, Barbour and Bryant, collectors).

This is close to *M. maura* Cress. but differs in the color of the pubescence, in the double punctation of the vertex, and in the peculiar ridged condition of the concavity of the first abdominal segment. In *maura* the pubescence is deep black, the vertex has only a few scattered punctures and no evidence of double punctation and the basal concavity is normal.

Megachile poeyi alleni n. subsp.

♂. Head broad, eyes slightly converging below, pubescence mostly white, short and blackish on vertex; clypeus closely punctured, apex beneath beard entire, shining; mandibles 4-

dentate, apical portion reddish except the teeth, very finely punctate, rounded on outer margin viewed from above, inferior tooth basal; cheeks about as broad as eyes, punctures shallow and indistinct, densely pubescent on lower angle, thinly so above; vertex flat, deeply punctured, the punctures close behind ocelli, otherwise well separated; lateral ocelli slightly nearer edge of the vertex than to nearest eye; front below ocelli very densely punctured; antennæ long, the joints fully twice as long as wide, piceous above, red below, apical joint not much modified.

Thorax very densely and finely punctured above, the punctures coarser and well separated on pleura below, sparse on the sternum, pubescence whitish on the sides, behind and beneath, apparently black on mesonotum (specimen rubbed) with large anterior patches of dense pale pubescence, and probably margined laterally and behind with dense pubescence of the same color in fresh specimens; tegulæ piceous, very densely and finely punctate; wings fuliginous, nervures brownish to testaceous, second recurrent nervure entering the second submarginal cell somewhat nearer apex than first does to base.

Legs piceous, all the tarsi ivory color; front coxæ with rather stout but flattened spines, front trochanters reddish-testaceous beneath; front femora strongly keeled beneath apically, the punctate portion of the posterior face much reduced, confined largely to the apical half of the femur, with a short sharp carina on upper margin at center, ferruginous, the lower margin at the keel ivory color, the upper face reddish-testaceous, polished, antero-inferior face also polished, paler testaceous, margined at sides with ferruginous and with a median longitudinal stripe of the same color extending from the base about half way to apex; outer face of front tibia piceous and punctate, the posterior margin carinate, the other two faces polished and testaceous, the anterior one more reddish; anterior tarsi broadly dilated, the basal joint only slightly longer than wide, hollowed out anteriorly, the two anterior margins fringed with short yellowish pubescence, the remaining joints gradually narrowed to tip, the fifth not dilated but quite flat and parallel-sided, very slightly darker apically; tarsal fringe white, brownish apically, largely brownish beneath, second joint with a large black spot beneath; middle and hind tarsi not dilated but distinctly ivory colored.

Abdomen somewhat parallel-sided, finely and closely punctured, black pubescent, the pubescence of segment 1 entirely white, and segments 1-5 with entire white apical fasciæ; segment 6 with dorsal surface vertical in position, rugoso-punctate above the carina, the carina with a conspicuous rounded emargination, otherwise entire, apical margin slightly carinate on either side of middle, and with a small but sharp lateral tooth on each side beyond the carina; four ventral segments visible, these shining and sparsely punctured. Length 9 mm.

♀. Head broad, eyes slightly converging below; supraclyeal plate and clypeus coarsely punctate, rather sparsely so medially, the clypeus with an impunctate median line, the apical margin slightly denticulate, pubescence very thin and pale; mandibles broad, reddish apically, sparsely punctate above, conspicuously 4-dentate, a straight cutting edge between the two inner teeth, and another between the two middle teeth, the latter ending abruptly about half way between them; cheeks narrow, closely punctate and quite densely pubescent, the pubescence yellowish-white; vertex flat, deeply punctured, the punctures well separated, pubescence black; lateral ocelli much nearer the edge of the vertex than to the nearest eye; front below ocelli densely punctate; antennæ piceous above, red below, the middle joints slightly longer than broad; pubescence yellowish-white on face, some short inconspicuous black hairs on supraclypeal area.

Thorax black pubescent above, pale ochraceous at sides, below and behind; mesonotum finely punctate, punctures separate medially, close laterally and posteriorly, with two lateral anterior patches of dense ochraceous pubescence, a spot of the same color just back of the tegulæ, and the scutello-mesothoracic suture lined with it; scutellum long black pubescent across middle, with short dense pale pubescence behind, finely and rather closely punctate; pleura closely and finely punctate above, more coarsely and sparsely so below; propodeum granular, punctures indistinct; tegulæ black, closely and finely punctate; wings pale fuliginous, somewhat darker apically, nervures yellowish brown, the second recurrent nervure entering the second submarginal cell nearer apex than the first does to base; legs piceous, all the tarsi ferruginous, pubescence whitish, yellow on all the tarsi beneath and on the middle metatarsi without; spurs pale yellow; claws testaceous basally, ferruginous apically, with sharp basal teeth.

Abdomen ovoid, finely and closely punctured, black pubescent, the pubescence on the first segment entirely pale ochraceous, and segments 1-5 with entire and conspicuous apical fasciæ of pale ochraceous pubescence; segment 6 rather distinctly concave at sides viewed from above, straight in profile, with greyish appressed pubescence, that on the basal middle dark brown, with rather short black erect hairs at sides basally; scopa white, black on segment 6, with a considerable amount of black at sides of segment 5, and with a small amount at sides of segments 4 and 3; apical ventral segment with a free polished apical lip which projects slightly beyond the scopa. Length 11 mm.

Type: Male (Type No. 15715, Mus. Comp. Zool.); Mangrove Cay, Andros, Bahamas, Aug. 1, 1904. Allotype; topotypical (Allen, Barbour and Bryant, collectors).

This is probably only a subspecies of *M. poeyi* Guer. from which it differs as follows: The male is smaller (11 mm. in *poeyi*) and the legs above the tarsi are piceous (bright red in *poeyi*); the pubescence on the disc of segment 2 is entirely black, whereas in *poeyi* it is entirely ochraceous, and the pale pubescence is nearly white, while in *poeyi* it is strongly ochraceous; in the female the apical margin of the clypeus is less strongly denticulate and the vertex is somewhat less closely punctured than in *poeyi*, and the bright red legs of the latter at once distinguish it from this form; and there is considerably more black pubescence in the scopa of the subapical segment in *poeyi*, being black almost entirely across the segment apically.

Megachile salti n. sp.

♀. Head broad, eyes converging slightly below, vertex broad and flat; supraclypeal plate shining and bare, finely tessellate, impunctate medially, closely punctate laterally; clypeus with a rather broad impunctate median area, but rather closely punctate laterally, apical margin slightly concave medially, with a slight median tubercle, pubescence white with a faint ochraceous tinge, and with a few long black hairs laterally; mandibles broad, 4-dentate, the third tooth truncate, almost impunctate and tinged with red above, with fine close punctures at base in front, with a distinct line above leading from the incision between the two apical teeth almost to the base; cheeks very narrow, carinate posteriorly, rather finely punctate, and entirely white pubescent; vertex very short, sparsely punctate, being almost impunctate between the eyes and ocelli, with conspicuous, rather long, erect black pubescence; ocelli much nearer edge of vertex than to nearest eye; front below ocelli closely punctate, with mixed black and white pubescence; antennæ black above, more piceous below; pubescence white on inner orbits, and around and between the antennæ.

Thorax mostly white pubescent below and at sides; mesonotum sparsely punctured medially, more closely so around the margin, rather dull, pubescence black in general, but pale ochraceous anteriorly, with two conspicuous anterior oblique lines of white pubescence, and a very conspicuous line of short whitish appressed pubescence in the suture between the mesonotum and scutellum, reaching across from one tegula to the other; scutellum finely and closely punctured, with pubescence entire y black, contrasting with the white pubescence just below on the narrow metanotal plate and propodeum; pleura rather closely punctured, white pubescent, but with a round spot of black pubescence just beneath the wings; propodeum tessellate, with scattered very fine punctures, basal triangle impunctate, tessellate; tegulæ blackish, finely punctured, with a tuft of white pubescence in front; wings subhyaline, slightly infuscated apically, nervures blackish, basal nervure beyond transverse median, second recurrent nervure entering second submarginal cell nearer apex than the first does to base; legs white pubescent, that on the tarsi beneath brownish; all the coxæ black, trochanters black to obscure red, all the femora and tibiæ bright red, all the tarsi deep black, contrasting strongly with the tibiæ and femora, hind metatarsi very broad and rather short; claws yellowish basally, ferruginous apically, without distinct basal teeth; spurs pale yellow.

Abdomen cordate, flattened above, the segments not very deeply impressed basally and not at all apically, finely punctate, shining, with short black pubescence on the discs except on segment 1 where it is long and white; segments 1-5 conspicuously white fasciate, all the fasciæ entire, but rather narrow basally; segment 6 slightly concave at sides viewed from above, also slightly concave in profile, with appressed, very dark brown pubescence, and with scattered erect black hairs basally; scopa pure white, mostly black on segment 6, and black at extreme sides of segments 3-5.

Length 10 mm.

♂. Head broad, much as in the female, pubescence dense and ochraceous; clypeus closely punctured, densely pubescent, with a considerable amount of black hair above and at sides, apical margin beneath the beard smooth and shining, broadly emarginate or incurved medially; mandibles 4-dentate, shining above, with a few scattered black hairs in front, inferior tooth subbasal, rather small, sharply pointed; cheeks and vertex as in the female, the cheeks simple below (not excavated nor toothed); antennæ long, the joints more than twice as long as wide, black above, more piceous below; pubescence somewhat longer on vertex than in the female.

Thorax with pubescence arranged as in the female, but rather longer above; tegulæ and wings as in the female; legs much as in the female, but the femora suffused with blackish basally; front coxæ black, thinly pubescent in front, with flattened curved pointed spines of moderate length; front tarsi simple, with hardly any fringe, with long mixed black and white hairs; front tibiæ with black pubescence on outer face; pubescence on front tarsi beneath brownish, pale yellowish on the middle and hind tarsi beneath, legs otherwise white pubescent.

Abdomen somewhat narrowed posteriorly, shining, punctures very fine and rather sparse; pubescence long and pale on segment 1, black on discs of segments 2-4, segments 3 and 4 with basal fasciæ, 5 broadly appressed pubescent basally, the pubescence pale ochraceous, the surface otherwise with rather long erect black hairs; apical fasciæ poorly developed, represented by mere tufts of whitish pubescence at extreme sides of segment 1, and widely interrupted on segments 2-4; segment 5 without an apical fascia; segment 6 with a low inconspicuous carina, which is broadly, shallowly and evenly emarginate medially, otherwise entire, the segment above the carina with ochraceous appressed pubescence and scattered long erect black hairs; morphological apex of segment carinate on either side of the middle, the carina low and inconspicuous, extending to the lateral teeth which are vestigeal; segment 7 pointed; venter with three unmodified visible segments, which are fringed with white hair apically, the fourth segment visible, but membranous and transparent, considerably modified from the usual condition. Length 8 mm.

Type: Female (Type No. 15706, Mus. Comp. Zool.); Soledad, Cuba, May 22, 1925. Allotype; Mina Carlota, Trinidad Mts., Cuba, 1500 ft. altitude, on flowers of *Neurolæna limbata*, March 25, 1925. Paratypes: 2 females; Mina Carlota, March 25, on *Neurolæna*; 1 female, Soledad, June 1, on flowers of *Parkinsonia aculeata*; 1 female, Soledad, June 20, on flowers of *Psidium cattleyanum*; 2 males, Mina Carlota, March 25, on *Neurolæna*, and 1 male, Soledad, June 20. All of the series collected by Dr. George Salt. Two of the paratype males, one from each of the localities cited, vary from what has been designated as the type form in having entirely black legs, and with the pubescence more nearly pure white.

In general form, and in structure of the clypeus, mandibles, cheeks and vertex in both sexes, and in the form of the apical abdominal segment in the male, this species closely resembles *M. petulans* Cress. to which it is evidently very closely related. The cheeks are slightly narrower than in *petulans* however, and the clypeus is less strongly and closely punctured in the female. In the male the carina of segment 6 is much less deeply emarginate, and the fourth ventral segment is modified. The color of the pubescence and the red femora and tibiæ at once distinguish them, however. Of the Cuban species, this superficially resembles *M. poeyi* Guér. but here again the color of the legs will serve to distinguish them.

Megachile carlotensis n. sp.

♂. Facial quadrangle much longer than wide, densely ochraceous pubescent; clypeus closely and finely punctured, apical margin smooth and shining, slightly incurved; mandibles 4-dentate, obscurely reddish apically, otherwise black, inferior tooth triangular in shape, submedian, somewhat nearer base of mandible than to apex; cheeks broad, closely punctured, carinate posteriorly; vertex considerably extended behind eyes, flat, closely and quite deeply punctate posteriorly, an impunctate area on either side of the lateral ocelli, and a small oval impunctate area between them, the posterior margin of the vertex definite but hardly carinate; ocelli considerably nearer eyes than to edge of vertex; antennæ not especially long, the joint being hardly twice as long as wide, the apical joint dilated and somewhat flattened; pubescence of face and clypeus ochraceous, tinged with red on vertex, some short black hairs above eyes on vertex, pubescence short and white on middle of cheeks, cheeks below with large patches of pale fulvous hair, and the inferior angle just below with long dense white pubescence, while just behind the inferior mandibular tooth is a small excavation densely covered with pale ochraceous pubescence, and the gular region back of this has long dense pale ochraceous pubescence.

Thorax with pubescence ochraceous above, paling to white below, a patch of fuscous pubescence in center of mesonotum; mesonotum strongly and closely punctured; scutellum with a median longitudinal impunctate area, with strong punctures on either side, but not so closely punctured as the mesonotum, with hair all pale; pleura closely punctured; propodeum shining behind, where it is almost bare, laterally minutely roughened and quite densely pubescent, basal triangle tessellate and impunctate; tegulæ piceous, minutely punctate, pubescent basally and anteriorly; wings fuliginous, considerably darker apically, violaceous, nervures ferruginous, basal nervure beyond transverse median, second recurrent nervure entering second submarginal cell nearer apex than the first does to base; hind wings hyaline.

Middle and hind coxæ, trochanters and femora black, the tibiæ bright ferruginous, the tarsi yellowish-ferruginous; middle tibia without the usual spur, the metatarsus as long as the tibia, narrow, somewhat curved, and densely yellowish pubescent exteriorly; hind tibia with spurs pale yellow, the metatarsus short, and rather thick and wide; front coxæ black, bare in front, thinly pubescent behind, and with a dense patch of white pubescence on outer side, with short flattened triangular pointed spines and with a patch of red bristles to one side and in front of the spines; trochanters black, fringed posteriorly with pale hairs, and with considerable black pubescence intermixed apically; front femora reddish-yellow, piceous above on apical third, sharply keeled beneath on slightly more than the apical half, pubescence whitish, pale ochraceous basally, and with a few black hairs below at extreme base; front tibiæ ferruginous, shining and deeply punctate on outer face, where the pubescence is short, sparse and pale yellow, the two inner faces polished and more yellowish, a fringe of short reddish pubescence on the edge between these two faces; spur large, hollowed out, reddish-yellow; front tarsi enormously dilated, pale yellow to whitish, the second joint somewhat longer than the first at base, but the first expanded and lengthened into a large hollow scale in front, the second produced as far as the tip of the metatarsal scale, but not much lengthened, the third with a small process in front, the fourth small, the second and third joints are not hollowed out but merely expanded anteriorly; the tarsal joints are fringed behind with long pale ochraceous hair, this tipped within with dark brown; anteriorly the first joint has a fringe of long reddish-brown stiff hair, and the inner margin of the scale has a short paler fringe; the second and third joints are covered within with reddish-brown bristles, and the second joint has also a definite fringe of reddish-yellow pubescence at the tip exteriorly; all the claws are ferruginous basally, piceous apically, the second and third pair deeply cleft, those on the front legs with a rudimentary inner tooth.

Abdomen oblong, parallel-sided, shining, punctures distinct but rather fine, well separated; segments 1 and 2 with rather long ochraceous pubescence, a few black hairs on the second apically; segments 3 and 4 with black pubescence on the discs and with conspicuous basal ochraceous fasciæ; segment 5 covered, except the apical margin, with ochraceous appressed pubescence and with scattered erect pale hairs; none of the segments with apical fasciæ except at extreme sides of segments 2-4; segment 6 finely rugoso-punctate, the carina low and inconspicuous, broadly emarginate, so that the two teeth are all that is left, the segment above the emargination bare, on either side the surface covered with dense appressed ochraceous pubescence, morphological apex of the segment slightly carinate at the sides and with small lateral apical teeth; segment 7 broadly rounded, flat below, carinate apically, the carina projecting very slightly beyond the sixth segment medially; venter with four visible segments, the first three fringed behind with white hair, the fourth with an ochraceous apical fringe. Length 11.5 mm.

Type: Male (Type No. 15705, Mus. Comp. Zool.); Mina Carlota, Trinidad Mts., Cuba, 1500 ft. altitude, on flowers of *Neurolœna limbata*, March 25, 1925 (Geo. Salt, coll.).

Although the superficial resemblance is very slight, due to the color of the pubescence and legs, this insect is very similar in structure to *M. xylocopoides* Sm. and *M. morio* Sm., especially to the latter. It seems hardly possible that this can be the male of *M. maura* Cress. which belongs to the *xylocopoides-morio* group, although it was caught at the same time and place as females of *maura*. *M. sedula* Sm. belongs to this same group, however, and the color of the pubescence and of the scopa suggests the possibility that this is the male of that species. *M. sedula* is recorded from St. Domingo, but may possibly occur on the island of Cuba. If this is not *sedula* it is at least a close relative.

Records of other species of *Megachile* in this series follow:

Megachile maura Cress.

6 ♀♀: Mina Carlota, near Cienfuegos, Cuba, March 21-24, at *Neurolœna*.

Megachile poeyi Guér.

7 ♂♂, 15 ♀♀: Mina Carlota, March 22-25; La Milpa (near Cienfuegos, at practical sea level), June 24 and July 4; Soledad, February 14, 22 and 23, April 6 and 10, June 9-29: on flowers of *Neurolœna limbata*, *Vernonia neuthœfolia*, *Psidium cattleyanum* and *Caseria aculeata*.

Book Notice.

The Heteroptera or True Bugs of Eastern North America by W. S. Blatchley. 1116 pages, 215 figures, 12 plates. 1926. The Nature Publishing Company, Indianapolis.

This is another hegemonic work on American insects by W. S. Blatchley, to whom entomologists are already indebted for his previous books on the Coleoptera, Orthopetra, and Rhynchophora written in collaboration with Mr. Chas. W. Leng. Containing as it does, descriptions and keys to over 1200 species, it fills a need that was only partly supplied by the Hemiptera of Connecticut and is a tribute to Mr. Blatchley's skill, knowledge and determination. With this manual the study of the Heteroptera should be greatly accelerated, as it is now no longer necessary for the student, unless he is a specialist and disagrees with some of Mr. Blatchley's opinions, to wade through the scattered literature in order to identify his species. Mr. Blatchley says his manual "has been prepared mainly for the use of the tyro," but we are all abecedarians outside of our own, usually restricted, fields. When the author deviates from the tracks of his predecessors, this is noted either in the text or footnotes, with reasons. In addition to the descriptions and keys, numerous notes deal with habits, food plants, localities, dates and general distribution, special attention being given to the Heteropterous faunas of Indiana and Florida. With the exception of some thirty pages devoted to external structures, general habits, methods of collecting, etc., the entire work is a descriptive catalogue of the order, a broad survey covering the entire field. In these days of intense specialization few entomologists become proficient in even the classification of a single order of insects and all the more credit is due Mr. Blatchley for the successful culmination of what at times, must have declined, in spite of his professional interest, into mere drudgery. Systematic entomology will always appear chaotic and uninspiring to the uninitiated until there are more works of this kind, leading into the wilderness of literature and opinions.

H. B. Weiss.

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THE THORACIC SCLERITES AND WING BASES OF THE ROACH *PERIPLANETA AMERICANA* AND THE BASAL STRUCTURES OF THE WINGS OF INSECTS

By G. C. Crampton, Ph. D.

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The head and abdominal structures of the American roach have been described in Vol. 32, p. 195 of Psyche for 1925. In the present paper the thoracic sclerites and wing bases of the roach are discussed, and certain previously overlooked structures in the basal region of the wings of insects in general are described, since they appear to be of considerable interest from the standpoint of phylogeny and the interpretation of the wing veins

In examining the thoracic sclerites, it is preferable to study them in relation to the internal structures for muscle attachment, etc., and with this purpose in view, the dorsal (or the ventral) region of the thorax should be cut away, and the parts should be boiled in 10% caustic potash to remove the muscles and other soft parts, which may be washed away with a pipette. The parts should be studied immersed under water or alcohol, and the field of the binocular should be illuminated by a brilliant light provided with a bulls-eye condenser.

The neck ("cervicum" or eucervix) is a demarked anterior portion of the prothorax, whose membranous walls permit greater freedom of movement for the head. Its sclerites, called the cervical sclerites (cervicalia) are homologous with the intersegmental plates (intersegmentalia) occurring between the thoracic segments in certain Apterygota, and, according to their position, they are called the dorsal, lateral and ventral cervicals.

The ventral cervicals *pgu* and *is* of Figs. 1 and 5 are narrow, transverse sclerites, homologous with the sclerites called the postgulare and intersternite by Crampton, 1926. The lateral cervicals *lc* of Figs. 1 and 5, are the largest neck plates, and each is made up of three parts, or subdivisions. The anterior subdivision *ec* bears a cephaliger *cg* or process which articulates with the occipital condyles *occ* of the head. The median lateral cervical *ic* touches its fellow of the opposite side in the median ventral line of the body, in the fashion characteristic of most roaches, mantids and termites. The posterior lateral cervical area *poc* is inflexed and bears a small internal protuberance at the point *f* of Fig. 5. The small sclerite *t* of Figs. 1 and 5 may be included with the lateral, or with the dorsal, cervicals. The dorsal cervicals *pr* (Fig. 15) are small and unimportant, but the dorsal cervicals *it* are quite large and unite posteriorly to form a horse-shoe-shaped area bearing a pair of internal protuberances. The posterior dorsal cervicals (or postintertergites) bear the internal tendons *et* (Fig. 15) for muscle attachment.

The sternal region of each thoracic segment (excepting the metathorax) contains three typical sternites or sternal sclerites as follows. The basisternite *bs*1, *bs*2, and *bs*3, of Fig. 1, is the principal sternite and is usually connected with the episternal region *es* by a precoxal bridge *pc*. In the mesothorax and metathorax, the basisternum *bs*2, and *bs*3, of Fig. 1 is composed of an unpaired median portion and two lateral halves.

The furcasternite (or furca-bearing sternite) *fs*1, is subtrapezoidal in the prothorax, but it is shaped like an inverted "Y" in the meso— and metathorax. The furcasternite *fs* (Fig. 1) bears the furcal pits, or furcacavæ *fp*, which are the external manifestations of the invaginations forming the internal diapophyses, or furca *fu*, of Fig. 5. These paired apophyses, or diapophyses (furca), serve to hold the nerve chain in place, and they furnish attachment for muscles etc. Miall and Denny in their book on the cockroach failed to find the prothoracic furca *fu* of Fig. 5, but these structures are quite well developed in the prothorax, and are composed of a delicate shaft, or basifurca, and a broad distal portion, or distifurca, which extends to the apodeme *ap* of the pleural region.

The spinasternite *ss* of Figs. 1 and 5 is not very greatly elongated in the prothoracic region, but in the mesothorax it is long and slender. The spinasternite of the metathorax is atrophied, or it is indistinguishably united with the furcasternite *fs*, in this region. The spinasternite *ss* of Fig. 1, bears the spinal pit, or spinacava *sp*, which is the external manifestation of the invagination forming the internal, median, unpaired apophysis called the monapophysis, or spina *spi*, of Fig. 5, which serves for muscle attachment etc.

The internal sternal processes, such as the furca *fu* and spina *spi*, may be called the endosterna, and as was mentioned above, these endosterna serve tor the attachment of muscles etc. As was suggested by Crampton, 1918, instead of designating muscles by their function etc., it is preferable to designate them by their points of origin and insertion; and if this method be followed, we may speak of the furco-apophysal muscles, the furco-coxal muscles, furco-trochanteral muscles, etc., or the profurco-mesofurcal muscles, prospino-mesospinal muscles, etc., and the terms are self-explanatory.

In the three thoracic segments (Fig. 1) a pre-coxal bridge composed of the sclerites *pc* and *ac* connects the basisternite *bs* with the episternum *es*. The sclerite *pc* is very loosely connected with the pleural region in the meso- and metathorax, and may possibly represent the sclerite called the lateropleurite, while the sclerite *ac* which is well developed and is connected with the sternal region in the mseo- and metathorax, may represent the laterosternite; but provisionally, at least, I have followed- the interpretations indicated by the labelling, (see list of abbre viations) until the matter can be definitely determined.

In the meso- and metathorax, a ventral prolongation of of the suture *s* (Fig. 1) demarks the preepisternum *pes* or anterior marginal sclerite, which bears an internal protuberance for muscle attachment. In front of this region is a "dimple-like" impress, or depression labelled *i* in Fig. 1, which marks the location of an internal tumulus, or protuberance labelled *en* in Fig. 5, to which certain muscles are attached

An infolding (or "inpocketing") of the integument of the pleural region forms an internal ridge, or endopleuron *ep* of Fig.

5, while the external lips of the fold meet to form the pleural suture *ps* of Fig. 1, which demarks the epimeron *em* from the episternum *es*. At the ventral end of the pleural suture *ps* of Fig. 1, is the coxifer *cf*, or coxa-bearing process, while at the dorsal end of the pleural suture *ps* is the alifer *o*, or pleural fulcrum of the wing. Internal processes of the coxifer labelled *ecf* 3 in Fig. 5, and internal processes of the alifer, labelled *ea* 2 in Fig. 5, are fairly well developed in the roach; and the endopleuron *ep* of Fig. 5 gives off an apodeme, or process *ap*, rather closely associated with the furca *fu*.

In the meso- and metathorax, there occurs in front of the pleural suture *ps* of Fig. 1, a suture *r*, which divides the episternal region *es* into an upper region *aes*, or anepisternite, and a lower region, or katepisternite (bearing the label *es* in Fig. 1). An anepisternal incision *aei* divides the anepisternite into an anterior and posterior region. The basalar sclerites *x* and *u*, situated dorso-caudad of the anepisternal incision *aei* (Fig. 1), are portions of the pleural region. The anterior basalare *u* of Fig. 1 is demarked by the suture *s*, and it bears an internal process *eb* of Fig. 5. The posterior basalare *x* of Fig. 1 is a detached portion of the pleural region in front of the alifer *o*, and both of the basalar sclerites are associated with the movements of the wing in flight.

Above the alifer *o* of Fig. 1 is the intraalare *ia* (See also Figs. 13 and 14), which is an alar ossicle connected with the dorsal alar ossicle *a* of Fig. 16 (Compare also Figs. 13 and 14). The sclerite *ia* may be a detached portion of the wing structures, but it is hardly a detached portion of the pleural region. The subalare *sa* of Fig. 1, however, may have been formed by the deposition of chitin in the membrane below the wing, for the attachment of the mero—subalar muscles extending between the meral region of the coxa and the subalar plate in question.

The trochantin, bearing the labels *atn* and *ptn* in Fig. 1, is a triangular plate in front of the coxa, and the trochantin bears at its tip an internal trochantinal tendon *ttn* of Fig. 5, for muscle attachment. A trochantinal suture, with its corresponding internal ridge or endotrochantin *etn* of Fig. 5, divides the trochantin of the meso— and metathorax into an anterior region *atn* and a posterior region *ptn* (Fig. 1), while a transverse "break," or cleft, divides the prothoracic trochantin into a basal region *btn* and a distal region, *dtn*, as is also the case in other roaches, mantids and termites, etc. In such cases, the small distal region *dtn* is usually interpreted as the entire prothoracic trochantin, although the basal portion *btn* also belongs to the prothoracic trochantin. The trochantin of all segments is closely associated with the pleural region (from which it is separated by the pleurotrochantinal suture *p* of Figs. 1 and 5) and it may be a detached portion of the pleural plate. On the other hand, it is maintained by several investigators that the trochantin (or even portions of the pleural plate itself) is a detached basal region of the leg, to which the term subcoxa is sometimes applied.

Between the trochantin and the coxa is a small sclerite *pac* called the paracoxale, which bears an internal paracoxal tendon *pat* (Fig. 5) for muscle attachment. The sclerite *pac* is either a detached portion of the marginal region of the coxa, or it was formed in the membrane between the trochantin and coxa, to bear the internal tendon *pat* for muscle attachment. Behind the coxa is an internal tendon *pt* (Fig. 5) called the postcoxal tendon, to which are attached certain muscles. A faint "impress" marks its location externally.

In the prothorax, a marginal region, the basicoxale *bc* of Fig. 1, is demarked in the basal region of the coxa. Its anterior region *cm* has been termed the coximarginale, and its posterior region *me* is homologous with the meron *me* of the other legs. An internal ridge, or endocoxa, demarks the region *bc* internally, and serves for the attachment of muscles, as described by Dr. R. E. Snodgrass. In the meso- and metathorax, the meral region *me*2 and *me*3 is much more extensive than in the prothorax (i. e. *me* of Fig. 1), and a meral ridge, or endomeron *mr* of Fig. 5, serves to demark the meral region internally—and it also serves as a ridge for muscle attachment. The parts of the leg of a roach, together with their tendons, method of articulation, etc., have been described in a paper by Crampton, 1923 (Can. Ent. LV, p. 126), and need not be further discussed here, since the appendages of the thorax will be described more fully in a paper dealing with the legs and wings of the roach.

The spiracle *st* between the pro- and mesothorax (Figs. 1 and 5) is mesothoracic in origin, and should therefore be spoken of as the meso-thoracic spiracle, despite the fact that it is very closely associated with the prothoracic region. The second spiracle is metathoracic, and the third one is the first abdominal spiracle. The mesothoracic spiracle is usually located in the membranous region continuous with that containing the spinasternite *ss* (Figs. 1 and 5), particularly in larval forms, and this may indicate that the supposed prothoracic spinasternite is mesothoracic rather than prothoracic. In any case, this sternite may be referred to as the spinasternite, although if it belongs to the mesothorax (as its association with the spiracle in other insects seems to indicate) the term poststernellum, applied to it by some investigators, is hardly applicable, since it would then be the anteriormost mesothoracic sternite, instead of the posteriormost prothoracic sternite (as the name "poststernellum" would indicate). The relation of the spiracles to the thoracic sclerites, the mechanism of the thoracic spiracles, and similar topics will be discussed in a paper dealing with the respiratory system of the roach, and need not be further discussed here.

As is shown in Fig. 12, the pronotal plate or "pronotum" is divided into a disk or central portion labelled *disc* and a marginal region or limb labelled *limb*, whose lateral areas are called paranota. The ventral inflexed margins of the pronotum are closely applied to the dorsal surface of the pronotum (above) and the edges of these margins apparently exert a tension, resulting in the formation of faint lines such as those indicated by the dotted lines bordering the disk of the pronotum shown in Fig. 12. In the discal region, labelled *disc*, are several muscle-scars, or myocicatrices, etc., which need not be further discussed at this time, since they will be described in a paper dealing with the muscular system of the roach. The pronotal plate probably corresponds to the eunotum (or wing bearing plate) of the other thoracic segments, in which a prescutum, scutum and scutellum are secondarily demarked in the eunotum of the meso— and metathorax, but these areas are not demarked in the pronotum. The poorly chitinized and pigmented area labelled *psl*1 in Fig. 16, probably represents the postscutellum of the other thoracic segments (in which the postscutellum is formed behind the eunotum or wing-bearing plate). The small anterior margin of the mesonotum bearing the label *pm* in Fig. 16 may be considered as a posterior portion of the prothorax, since, as Dr. Snodgrass points out, the phragmas represent the lines of demarcation between the segments dorsally, and the area *pm* of the mesonotum (Fig. 16) lies in front of the phragmas (or internal structures for muscle attachment, whose location is indicated by the pits *ppt* of Fig. 16) and should therefore be reckoned to the prothoracic region, although it is borne on the anterior margin of the mesonotum.

In the meso- and metanotal region, the wing bearing plate, or eunotum, is divided into the following regions. The anteriormost sclerite, or pretergite,*prt* of Fig. 16, is an ill-defined region bearing the phragmal pitts *ppt* which mark the location of the internal ridges or phragmas *ph* of Fig. 13, for example, and these phragmas or phragmal ridges delimit the segments dorsally, so that the anterior marginal region *pm* of the pretergite being anterior to the phragmas, belongs to the segment in front, as was mentioned above. In the mesonotum of the roach (Fig. 16) the prealar sclerite *pra* becomes detached from the lateral region of the pretergite *prt*, while in the mesonotum of the mantid shown in Fig. 6, the region *pra* forms an incomplete prealar bridge, which is well developed in such insects as the Plecoptera, etc. In the metanotum of the roach (Fig. 16) the prealar sclerite *pra* does not become detached (as it does in the mesonotum) but it bears a pit like that labelled *pp* in the prealar sclerite *pra* of the mesonotum. The anterior margins of the sclerites *prt* and *pra* apparently become involved in the formation of the postscutellum of the segment in front, when the postscutellum is enlarged through further chitinization and pigmentation of the "intersegmental" membrane to form the large postscutellar plate of other insects

The faintly demarked median region labelled *psc* in the mesonotum of the roach (Fig. 16) corresponds to the prescutum of the mantid shown in Fig. 6, and represents the second important area demarked in the eunotum (or wing-bearing plate). The regions labelled *pn*2 and *pn*3 in the meso- and metanotum of the roach (Fig. 16) are probably secondarily-formed areas demarked by a rather faint suture *pns*, with its corresponding internal ridge *epn*2 of Fig. 13. These structures are extremely faint in the metanotum (Fig. 16).

The scutellum of the mesothorax *sl*2 is greatly elongated and extends to the prescutal area *psc* of Fig. 16. In the metathorax, however, the scutellum *sl*3 is shorter and a suture-like structure *mds* of Fig. 16 connects it with the prescutal region. The scutellum *sl*2 (Fig. 16) is a demarked area of the eunotum bounded laterally by the scutellar sutures *sls* with their corresponding internl ridges etc., labelled *esl*2 in Fig. 13

Behind the scutellum *sl*2 (Fig. 16) is the posttergite *pot*, which is formed by a posterior fold, or reduplication, of the wing-bearing plate, or eunotum. Behind this are the postscutellar plates *psl* (Fig. 16), which encroach upon the membranous region, in other insects, and finally incorporate the marginal region *pm*, in front of the phragmal pits *ppt*, to form the large postscutellum of higher insects, in which the postscutellum may appear to bear the phragma. The postscutellum of the roach is but feebly developed and is represented by the small plates bearing the label *psl* in Fig. 16. These plates are formed behind the wing-bearing plate, or eunotum, whose post. erior margin is continuous with the posterior margin of the wing.

In the eunotum, or wing-bearing plate, the scutum *sc* (Fig. 16) is very large and it occupies the greater part of the eunotum. It bears an anterior wing process, or suralare *sur* (which may be a lateral portion of the region *prt* in some insects), and a posterior wing process, or adanale *ad* (Figs. 16, 6 and 10), in front of which is an important incision *ni*, serving to divide the scutum into an anterior region and a posterior region, the latter being practically equivalent to the region called the parascutellum in other insects. The incomplete sutures extending mesad from the incision *ni* in Fig. 16, correspond in a general way to the transscutal sutures, dividing the scutum into an anterior and posterior region in certain insects.

A tegular incision *ti* of Fig. 6, usually separates the prealar sclerite *pra* from the suralar sclerite *sur*, and the tegula *tg* is located at the mouth of the incision in most insects (Figs. 6, 10, 13, 16, etc.). The tegula *tg* (Figs. 6 and 16) is probably formed by the deposition of chitin and pigment in the membrane near the tegular incision *ti*, but the parategula, or basicostale *ptg*2 (Figs. 6 and 16), is probably a detached basal portion of the costal region (or vein) of the wing.

Behind the suralar sclerite *sur* of Figs. 6, 10, 16 etc., is the suralar incision *si* and the alar ossicle labelled *n* in these figures, which is called the notale, or notopterale, is located in the neighborhood of the incision *si*. The alar ossicle *n* appears to be a detached portion of the notum. It is prolonged anteriorly into a neck-like, slender portion, whose "head" abuts against the end of the sclerite *scc*. The sclerite *scc* is a demarked "head" of the subcostal vein, and is the dorsal portion of the subcostale *d* (Figs. 1, 13, etc.) located on the under surface of the wing.

The medialia, or median ossicles *a*, *b* and *c* of Figs. 6, 10, 16 etc., intervene between the ossicle *n*, and the base of the wing-veins radius and media. The proximal mediale *a*, is separated from the ossicle *n* by the cleft *nm* of Fig. 16, and ossicle *a* sends down a ventral prolongation *ia* of Fig. 14, to form the ossicles labelled *ia* in Fig. 1, which are located just above the alifer *o* (the wing-bearing process of the pleuron). The incision *in* of Figs. 6 and 16 separates the ossicle *a* from ossicle *b*, which is usually, closely associated with the ossicle *ba* of Figs. 6, 10 and 16. The suture (or cleft) *im* of Figs. 6, 10 and 16, separates the intermediate median ossicle *b* from the distal median ossicle *c*. Ossicle *c*, in turn, is separated from the head of the vein labelled *mca*, by the suture labelled *ms* in Figs. 16, 6 and 10.

The basanal ossicle *ba* of Figs. 16, 6, 10 etc., usually articulates with the posterior notal wing process, or adanale *ad*, at one end, while at the other end, it is associated with the ossicle *a*, and is usually united more or less closely with ossicle *b* (see also Fig. 14). The anale, or anal ossicle *an* of Figs. 6, 10 and 16, intervenes between ossicle *ba* and the base of the anal region in the fore wing of the roach, mantid and termite here figured. Faint traces of a postbasanal ossicle may be seen behind the ossicle labelled *ba*, in the metanotum of the roach shown in Fig. 16.

In the fore wing of the roach shown in Fig. 16, the mantid shown in Fig. 8, and the termite shown in Fig. 10, the anal, or claval, area *aa* of the tegmen (fore wing) is connected with the notum by a region called the alula, or jugalula *ja* which may be involved in the formation of the jugum etc., of higher insects. An axillary ridge, or a crack-like rima *po* (Figs. 6 to 10), separates this region from the anal or claval region *aa* (Figs. 6, 7, 8, 9, 10, 16 etc. and the veins which are located behind this line of demarcation (i .e. such as those labelled *ax* in Figs. 8, 9, etc.) should be referred to as the axillaries or axillary veins. The faintly chitinized and pigmented areas labelled *ju* in Figs. 6, 10 and 16, are formed in the basal region of the alula; and the sclerite behind the metathoracic ossicle *ba* of Fig. 16, may be associated with these areas of the fore wings. The sclerite *pju* of the hind wing of the roach (Fig. 16), however, seems to be formed behind the area containing the region *ju* in the fore wing (Fig. 16), and is connected with a different portion of the notum by a narrow neck as is shown in Fig. 16. The relation of these parts to the calypteres of Diptera, etc., will be discussed in another paper.

In studying the fore wing of the roach I noticed a basal, ridge-like fold *bp* and a deep "marsupium" or basal sinus *bsi* (best seen after boiling the parts in caustic potash to spread them apart more readily), such as that shown in the tegmen (modified fore wing) figured in Fig. 16 These structions are very prominent, but have been apparently overlooked before, although they occur in a great many of the insects descended from the ancestral types included in the common Protorthop teron-Protoblattid stem—e. g. in such insects as those shown in Figs. 11, 16, 7, 8, 9, and 10. I do not find this basal fold and sinus in such insects as the ephemerids and Odonata which cannot lay their wings back along the top of the abdomen in repose, while the descendants of the groups which can do this (see division of insects into two groups on this basis in Vol. 16 p. 33 of the Journal of Ent. and Zoology for 1924, or papers in the Transactions of the Amer. Ent. Society,,LII, 1926,p. 239) show distinct traces of the fold and sinus (as I have also pointed out in the Bull. Brooklyn Ent. Soc., 1927, XXII, p. 1) so that the presence of these structures is of considerable importance from the standpoint of phylogeny, and these structures likewise serve as landmarks in determining the location of certain veins, areas etc., of the wing. The basal fold *bp* and pocket-like sinus *bsi* are very prominent in the fore wings of roaches, termites, the Hemiptera with coriaceous fore wings, etc., and it is very probable that these structures were developed in order to facilitate the folding back of the fore wings, when these are laid along the top of the abdomen in repose (see Bull. Brooklyn Ent. Soc., 1927). I shall again refer to these structures in a paper dealing with the basal region of the wings of insects in general, so that it is not necessary to discuss the matter further at this time.

As was mentioned above, a postanal, or postclaval ridge (or in some cases a rima, or crack-like line) labelled *po* in Figs. 6, 7, 8, 9, 10 and 16, demarks the axillary, or alular region, from the anal, or claval region of the fore wings. A preanal, or preclaval rima *cl* demarks the anal area of the wing from the median region of the wing, and the rima *cl* may be regarded as a "rima dividens" paralleling the "vena dividens" described by Comstock and others, in this region of the wing. A median rima, in front of the rima labelled *cl* in Figs. 10 and 16, demarks the median area of the wing from the radial area, in some insects, and a costal area *ca* of Fig. 16, is frequently demarked by the subcostal vein *Sc* in roaches, termites etc.

On the under side of the fore wing of the roach, as shown in Fig. 2, there is an important ventral ridge, the subcostal crista or plica *scr*, extending along the subcostal vein, and the condition exhibited in this region of the fore wing of the roach is of considerable interest from the standpoint of phylogeny, since the tegmen (fore wing) of the roach offers a very suitable startingpoint for tracing the modifications in this area of the elytra of beetles and the fore wings of other insects descended from roach-like forebears in the common Protorthopteran-Protoblattid stem.

When the fore wing of the roach is laid back in repose, it assumes the position shown in Fig. 2; and a protuberance *m* of the epimeron *em* 2 fits into a cavity in which the sclerite *d* at the base of the subcostal vein (or subcostal ridge *scr*) is located. The subcostal ridge *scr* lies above, and mesal to, the projecting areas of the epimeron *em*2 and meron *me*2 in repose, and the subcostal ridge may have been developed in connection with holding the wing in place when at rest. When the hind wings are folded back in repose, the sclerite *x* of Fig. 4, projects into a pocket between the structures labelled *ptg* 3 and *d* in Fig. 4, and the costal edge of the hind wing lies above the process *m* of the epimeron *em* 3. Much of the anterior region of the wing lies on top of the area labelled *w* in Fig. 3, and this area was apparently developed in connection with holding the wing up in repose.

A more detailed description of the folding of the wings, the basal structures of the wings, the areas of the wings, the interpretation of the veins (indicated in Fig. 16), and the mechanism of flight, etc., will be given in a paper dealing with the thoracic appendages of the roach, and need not be further discussed here.

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Abbreviations

a......Proximal median ossicle (proximediale)
aa.....Analarea or clavalarea
ac......Antecoxale (laterosternite?.)
ad.....Adanal process (adanale)
aei.....Anepisternal incision
aes.....Anepisternum
an.....Anal ossicle (anale)
ap.....Apodeme of endopleuron
atn.....Antetrochantin
ax.....Axillary vein
b......Intermediate median ossicle (intermediale)
ba.....Basanal ossicle (basanale)
bc.....Basicoxale or basicoxa
bi......Subcostal incision or sinus
bp.....Basoplica or basocrista
bs......Basisternite or basisternum
bsi.....Basosinus
btn....Basitrochantin
c.......Distal median ossicle (distimediale)
ca......Costalarea (embolium)
cf......Coxafer
cg......Cephaliger
cl......Rima dividens (preclavorima)
cm.....Coximarginale
Cu.....Cubital vein
cx......Coxa
d......Subcostal sclerite (subcostale)
disc....Disk of pronotum
dtn....Distitrochantin
e.......Endoprealare
ea......Endoalifer
eb.....Endobasalare
ec......Anterior lateral cervical plate (eucervicale)
ecf.....Endocoxifer
ecx.....Anterior coxal region (eucoxa)
em.....Epimeron
en.....Tumulus of endopapilla
ep.....Endopleuron
epn....Endoprenotum
es......Episternum
esa.....Endosuralare
esl.....Endoscutellum
et......Tergal tendon (endotergite)
etn.....Endotrochantin
f.......Point on precoxa for muscle attachment
fp......Furcal pits (furcacavae)
fs......Furcasternite or furcasternum
fu......Diapophyses or furca
g......Antecoxal suture
i.......Prepectal impress
ia......Intraalar ossicle (intralare)
ic......Intermediate cervical plate (intercervicale)
it......Intertergite
im.....Intermediate surure or incision
in......Submedian suture or incision
is......Intersternite
ja......Alula (jugalula)
ju......Jugale
lc......Laterocervicale
limb...Limb of pronotum
M.....Media or median vein
m......Epimeral process
ma.....Interarea of wing
mc.....Medicervicale
mca....Head of Media (mediacaput)
me.....Meron
mds....Middorsal suture
mr.....Meral ridge (endomeron)
ms.....Median suture or cleft
n......Notale
ni......Scutal incision
nm.....Notomedian suture
o......Alifer
occ.....Occipital condyle
p......Trochantino-pleural suture
pac....Paracoxale
pat.....Paracoxal tendon
pc.....Precoxale
pes.....Preepisternum
pgu....Postgulare
ph.....Phragmal ridge and process
pju.....Postjugale
pm.....Notomarginale
pn.....Prenotum
pns....Prenotal suture
po.....Posterior rima (postrima) or ridge
poc....Postcervicale
pot.....Postergite
pp.....Prealar pit
ppt....Phragmal pit (phragmacava)
pr......Precervicale
pra.....Prealare
prt.....Pretergite
ps......Pleural suture
psc.....Prescutum
psl.....Postscutellum
pt......Postcoxal tendon
ptg.....Parategula or basicosta
ptn....Posttrochantin
R......Radial vein
r.......Anepisternal suture

s	Preepisternal suture	ss	Spinasternite
sa	Subalare	st	Spiracle
san	Subanale	su	Subspiraculare
sb	Subcostale	sur	Suralare
Sc	Subcostal vein	t	Prepleurite
sc	Scutum	tg	Tegula
scc	Subcostal head (subcostacaput)	ti	Tegular incision
scr	Subcostal crista (subcrista)	tn	Trochantin
si	Suralar incision	ttn	Trochantinal tendon
sl	Scutellum	u	Anterior basalare
sls	Scutellar suture	v	Subcostal incision
sp	Spinal pit (spinacava)	w	Wing imprint on epimeron
spi	Spina or monapophysis	x	Posterior basalare

Explanation of Plates I, II, III.

Fig. 1. Ventral view of sternal and pleural region of the thorax of the roach, spread out as though lying in one plane.

Fig. 2. Ventral view of the mesothoracic wing-base, pleural region and meral region of the leg of the roach.

Fig. 3. Ventral view of basal region of the metathoracic wing folded back in repose.

Fig. 4. Ventral view of metapleural region and base of hind wing spread out slightly.

Fig. 5. Internal processes of the sternal and pleural region of the thorax of the roach seen from above (i. e. from within).

Fig. 6. Lateral portion of the mesonotum and the base of the fore wing (extended) of the mantid Mantoides.

Fig. 7. Postero-basal region of the hemielytron of a Pentatomid.

Fig. 8. Postero-basal region of the fore wing of Panorpa (seen from above).

Fig. 9. Postero-basal region of fore wing of the sawfly Pteronidia.

Fig. 10. Basal region of the fore wing of the termite Mastotermes.

Fig. 11. Basal region of the fore wing of the beetle Calopteron.

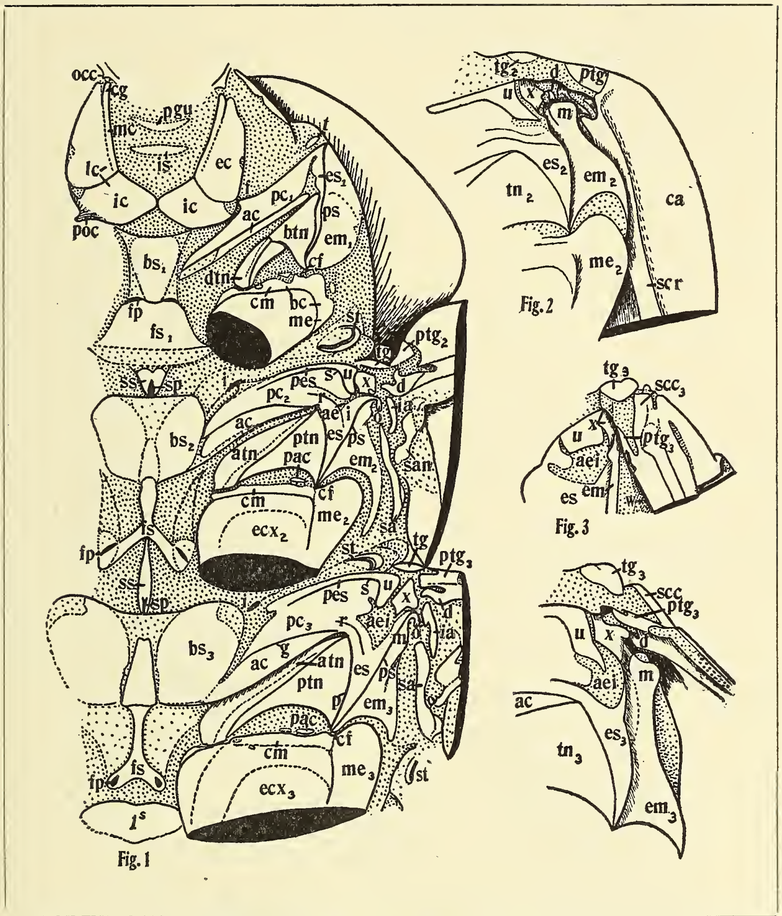
Fig. 12. Pronotal plate of the roach (dorsal view)

Fig. 13. Mesonotum of the roach seen from within.

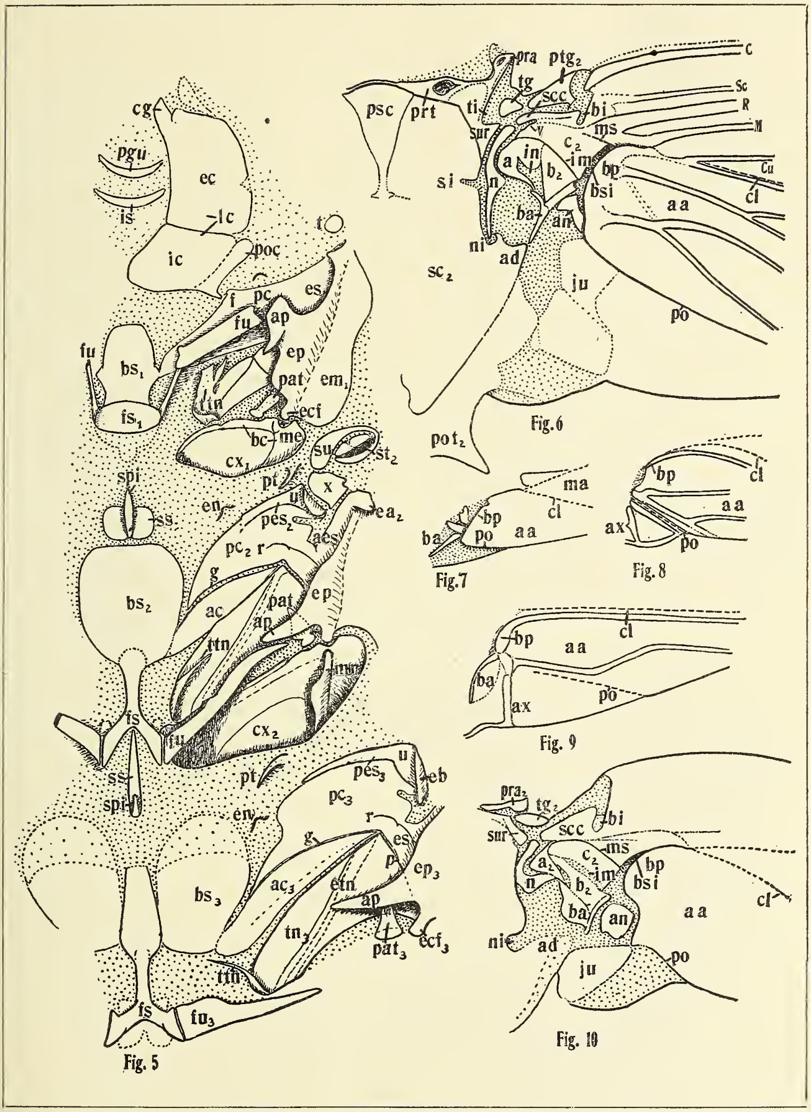
Fig. 14. Lateral portion of metanotum and wing base of the roach seen from within.

Fig. 15. Mid-dorsal region of the neck of the roach seen from within.

Fig. 16. Dorsal view of meso- and metanotum, with basal regions of the wings of the roach.



CRAMPTON—PERIPLANETA AMERICANA.



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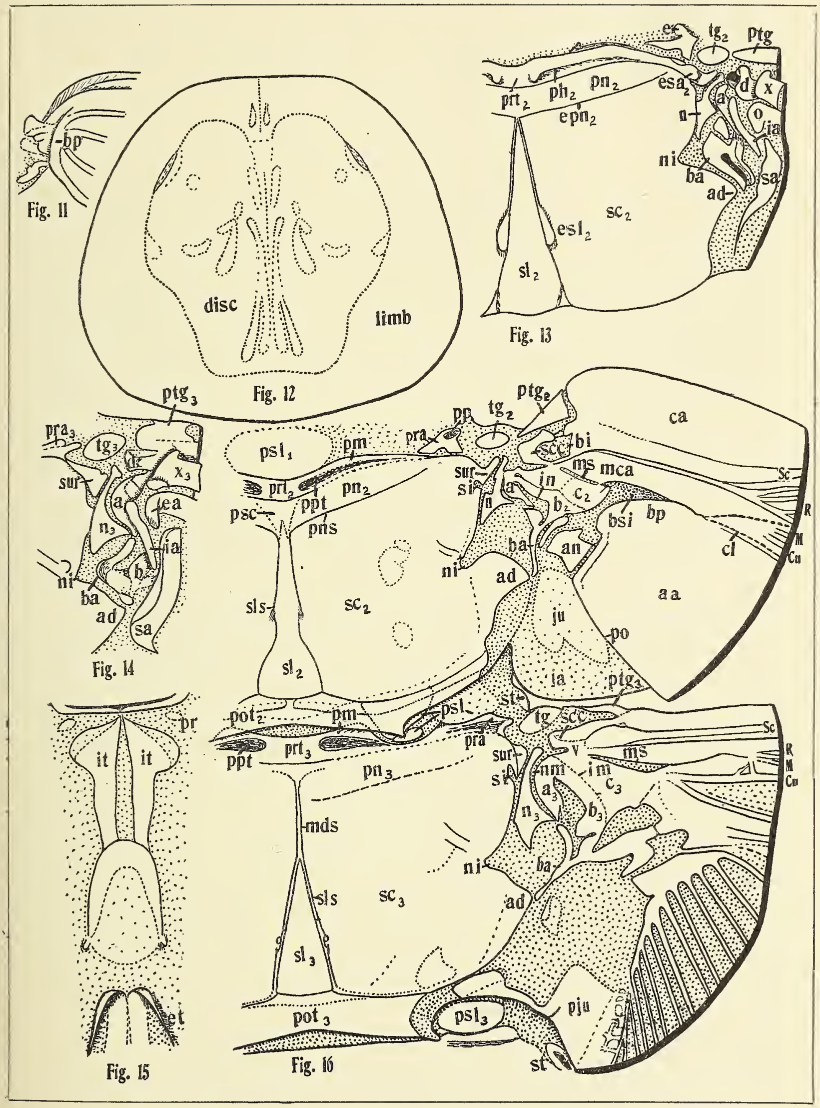

CRAMPTON—PERIPLANETA AMERICANA.

OBSERVATIONS ON WOOD-BORING INSECTS, THEIR PARASITES AND OTHER ASSOCIATED INSECTS.[1]

By Charles T. Brues

During the course of many years' interest in the several groups of Parasitic Hymenoptera the writer has frequently been struck by the preponderance of primitive types which prey upon wood-boring insects. Not only this, but several of the most primitive families of phytophagous Hymenoptera develop mainly within the tissues of woody plants and an exceptionally large proportion of the leaf-feeding sawflies subsist upon the foliage of trees. These facts suggest that the early phylogenetic history of the Hymenoptera was in some way bound up in the deveopment of the woody flora and that this early association has persisted to the present time without sufficient change to destroy the earmarks of past history in the modern hymenopterous fauna.

The immediate occasion for the present discussion is a small, but quite varied collection of insects made during the past summer at my summer home in Petersham, Mass. Early in the season the attention of my wife was attracted by a considerable number of flying insects that had congregated upon the panes of a window in a room where the stove wood for the household is stored. This room contains an assortment of wood of various sizes and varieties, principally oak, chestnut, white pine, red maple and birch. The wood is cut in the nearby woodlot one year, allowed to season and then sawed, split and stored away the next year. Before storage, it has therefore an opportunity to be attacked by various wood boring insects and fungi together with the insects that are attracted to the latter.

So many specimens appeared on the first day that collections were made daily upon the window from early July to late September and by the end of the season we had amassed a considerable collection. After sorting and identification, the fol-

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 275.)

lowing list was compiled which includes practically all of the species taken.

Coleoptera

Nearly all of the members of this order have been identified by one of my students, Mr. P. J. Darlington, Jr.

Family Rhipiphoridæ

Pelecotoma flavipes Melsh. Twenty-one specmens of both sexes of this rare species, July 13-28. This has been reported emerging from beech wood, but the present specimens came from that of some other tree, probably red maple. The habits of the larvæ appear to be unknown, although the genus is undoubtedly parasitic.

Family Pyrochroidæ

Dendroides bicolor Newm. Three males July 13 and 18. This species breeds commonly in various deciduous trees such as oak, maple, beech and birch

Dendroides concolor Newm. One female July 13. This species is known to feed upon the same trees as the foregoing.

Family Elateridæ

Melanotus trapezoideus Lec. One specimen, July 20.

Melanotus pertinax Say. One specimen, July 13. Members of this genus are commonly taken beneath the bark of various trees.

Family Melasidæ (Eucnemidæ)

Isorhipis ruficornis Say. 245 specimens representing both sexes in the proportion of 127 males to 118 females. This species was the most abundant insect in the present collection. It was taken first on July 13 and was still appearing when the last collections were made late in September although present in greatest numbers late in July. The species has been found in beech and soft maple and most if not all of the present series emerged from red maple.

Family Buprestidæ

Dicerca lurida Fabr. One specimen, July 13. This species breeds commonly in hickory, although the present one came probably from an oak log.

Chrysobothris femorata Oliv. One specimen, July 13. This is a common enemy of apple, but the larvæ occur in several other deciduous trees.

Family Dascyllidæ

Eucinetus morio Lec. One specimen, July 20. This has been taken beneath oak-bark and on fungi on oak.

Family Dermestidæ

Attagenus piceus Oliv. Two specimens, July 26-28. This is the well known "carpet beetle" which develops in woolen materials, feathers and other articles of animal origin. Weiss and West (Proc. Biol. Soc. Washington, vol. 33, p. 6 1920) record it from a fungus *Lenzites betulinus* so that its occurrence in the present series is probably not accidental. In country houses the larvæ find food in the many flies and other insects that enter the walls, window casings, etc. for hibernation, many of them to die before the advent of spring.

Family Ostomatidæ (Trogositidæ)

Thymalus marginicollis Chev. Two specimens, July 20. This species breeds in the common shelf-fungus of birch, *Polyporus betulinus.*

Family Nitidulidæ

Epuræa sp. One specimen. The members of this genus feed on fungi.

Family Mycetophagidæ

Mycetophagus flexuosus Say. One specimen, August 23. A common fungus-beetle.

Family Endomychidae

Endomychus biguttatus Say. One specimen, August 23. This is another fungus-beetle.

Family Tenebrionidæ

Diaperis maculata Oliv. One specimen of this abundant species which occurs in fungi, especially in the shelf-fungus of birch.

Upis ceramboides Linn. One specimen, August 8. This is a northern beetle with circumpolar distribution; it occurs under the bark of logs of various kinds.

Family Melandryidæ

Synchroa punctata Newm. Six specimens, July 13 to 20. This species occurs under the bark of various trees, particularly pine and maple.

Family Anobiidæ

Hadrobregmus carinatus Say. Eleven specimens, July 13-17. This species breeds commonly in maple logs and more rarely in those of other trees, such as beech.

Ptilinus ruficornis Say. 18 specimens, July 13-20. This small beetle has been bred from dead branches and logs of various deciduous trees.

Family Cerambycidæ.

Thirteen species of this large family were collected. Practically without exception all members of the group are wood-borers.

Hypermallus villosus Fabr. One specimen, July 19. This is the common "twig-pruner" of oak which occurs occasionally in maple also.

Brachyleptura rubrica Say. One specimen, July 20. The host tree of this tree has apparently never been recorded. It probably occurs in oak.

Brachyleptura canadensis Fabr. One specimen, August 8. The larva develops in the wood of several conifers.

Phymatodes testaceus Linn. One specimen, July 13. The larvæ occur in oak and are commonly bred from cord-wood.

Xylotrechus colonus Fabr. Seven specimens, July 13 to September 26. This is a common species, usually bred from oak but found less abundantly in logs of other deciduous trees.

Xylotrechus undulatus fuscus Kirby. One specimen, August 18. This occurs in the wood of conifers.

Neoclytus acuminatus Fabr. Eight specimens, July 17 to September 26. This is an abundant species which develops in a great variety of deciduous trees.

Anthoboscus ruricola Oliv. Five specimens, July 13-18. This is known to feed in hickory and elm; these specimens may have come from the latter.

Monochamus scutellatus Say. One specimen, July 19. This is an abundant species in New England feeding in white pine logs which are soon ruined if allowed to remain unsawed during the warmer part of the year.

Microgoes oculatus Lec. One specimen, July 19. The larva bores in oak and hickory.

Lepturges querci Fitch. One specimen, July 20. This small form develops in the wood of oak, hickory and other trees.

Hyperplatys maculata Hald. Three specimens, July 14 to 20. The larvæ develop in oak and the wood of other deciduous trees.

Urugraphis fasciata. Two specimens, July 19. The larvæ of this species feed commonly in the bark of oak, but occur also in that of other deciduous trees and even in pine.

Family Platystomatidæ

Euparius marmoreus Oliv. Two specimens, August 23 and September 26. This is a fungus-beetle.

Choragus zimmermanni Lec. One specimen, July 28. This is a wood-boring species that has been bred from sweet-gum, but which must have other hosts.

Corrodentia

Family Psocidæ

The four species listed below were examined and named for me by Mr. Nathan Banks.

Psocus leidyi Aaron, two specimens.

Psocus variabilis Aaron, two specimens.

Myopsocus sparsus Hagen, seven specimens.

Peripsocus permadidus Walsh, one specimen.

The members of this interesting group are said to feed mainly upon lichens and fungi and many species are consequently associated with trees and old wood.

Thysanoptera

Two species were taken which have been very kindly identified by Dr. J. D. Hood.

Family Phlæothripidæ

Hoplothrips karnyi major Hood, two females, July 20 and 26.

Trichothrips sp. One male, July 20. This is probably an undescribed species known to Dr. Hood from Illinois also.

Hymenoptera

Family Xiphydriidæ

Xiphydria maculata Say. 147 specimens of both sexes, July 13 to September 26. The great majority of the specimens emerged during the third week in July. The females are extremely variable in size ranging from 8 to 20 mm. in length while the males range from 7-12 mm. This species is known to breed in maple and most if not all the individuals in the present series emerged from red maple logs.

Species of Xiphydria are commonly parasitized by members of the Aulacid genus Pammegischia of which two species were obtained as noted on another page, without question from this wood-wasp.

Family Aulacidæ

Pammegischia pallipes Cresson. Four females and a male, July 13 and 17. The abdomen of two females is black, except the first and second segments; and the others agree with the description given by Bradley ('08) of *P. xiphydriæ* Ashm. The male taken with them is typical of *P. pallipes* and Bradley is undoubtedly right in regarding these two as sexes of the same species. *P. xiphydriæ* has been bred from *Xiphydria provancheri* living in birch twigs according to Viereck and Champlain reared *P. burquei* Prov. from another species of Xiphydria.

Pristaulacus stigmaterus Say. Two females and one male, July 13 and 16.

Gasteruption tarsatorium Say. Two females, July 13 and 17.

Gasteruption incertum Cresson. Two females and two males, July 13 and 17.

Family Braconidæ

Spathius simillimus Ashmead. One female, July 17. This species has been bred from the small Buprestid beetle, *Agrilus bilineatus*, a well known enemy of chestnut and oak. The members of the genus are parasites of small wood-boring beetles, principally bark-beetles of the family Ipidæ.

Helcon ligator Say. Three females and one male, July 13 and 19. This has been bred from several Cerambycidæ, including *Neoclytus acuminatus* Fabr. which is abundant in the present collection.

Blacus longicaudis Prov. Five specimens of both sexes, July 18—September 5.

Ascogaster carpocapsæ Viereck. One male, July 13.

This species, described by Viereck as a Chelonus was bred from the codling moth *Cydia* (*Carpocapsa*) *pomonella* and has since been reared by Wilcox (Psyche, vol. 25, p. 17, 1918) from the Oriental moth (*Cnidocampa flavescens*).

Apanteles consimilis Viereck. Seventeen females and two males, July 14-Aug. 23. According to Muesebeck this is not a common species, or at least has been only rarely taken.

Family Ichneumonidæ

Rhyssa canadensis Provancher. Three females, September 27. As members of this genus are known to parasitize Xiphydria, these probably came from the abundant *X. maculata.*

Arotes amœnus Cresson. Two females, July 13. Species of Arotes are parasites of cerambycid beetles.

Lissonota insita Cresson. Nine specimens of both sexes, July 13—August 22.

Polysphincta texana Cresson. This is a widely distributed parasite of spiders that has been bred by Cushman from the common *Steatoda borealis.*

Family Vanhorniidæ

Vanhornia eucnemidarum Crawford. Thirteen females and seven males, July 13—September 26, all but one taken during July.

This most remarkable insect was made the type of a new family by Crawford in 1909 when he first described it. The types were bred by Van Horn from larval cells of an unidentified Melasid (Eucnemid) beetle and the species has since been recorded by Champlain (Psyche, vol. 29, p. 100, 1923) as a parasite of *Isorhipis flavicornis.* The present series are undoubtedly from the same host, which is abundantly represented in the collection at hand.

Crawford makes no reference to the systematic relationships of Vanhornia except to note that the wing-venation resembles that of Helorus. On account of its exodont mandibles one would naturally compare it with the family Alysidæ and the somewhat dubious insect, Lysiognatha, placed by Ashmead as an Alysiid. It is very evident, however, from the other characters that Vanhornia has no affinities with any Alysiid. The antennæ are not multiarticulate and the wing is provided with a costal cell, both of which are fundamental differences. Also the structure of the abdomen which is heavily chitinized below, and forms a carapace above is entirely dissimilar to that of any Alysiid although in one genus, Symphya of the latter family the tergites are fused. This similarity is however purely superficial. Considering the wide divergence between the two groups we must conclude that the reversed mandibles are of independent origin and that this peculiarity has developed more than once in the order Hymenoptera.

The similarity in venation between Vanhornia and Helorus is very great and in fact there is no difference except that Helorus has lost the upper section of the basal vein which is still present though weak in Vanhornia. Ashmead speaks of the basal vein as bent down to form a discoidal cell in Helorus but this vein is a combination of the lower section of the basal and the first section of the cubitus which form together an arc as is readily seen by comparison with Vanhornia or Ropronia. Ropronia was placed by Ashmead as a part of the family Heloridæ and I think correctly so although Bradley has disputed this. Ropronia again agrees closely with both Helorus and Vanhornia in venation. Aside from the peculiarities of the head associated with the greatly enlarged mandibles, the complete reduction of the abdominal petiole and the greatly developed ovipositor, Vanhornia is clearly similar to Helorus and the Jurassic genus Mesohelorus and the two families must be placed near together in the group Serphoidea. Handlirsch following Viereck has placed Vanhornia next to the Alysiidæ and the strange genus Gnathobracon. This position appears to be clearly untenable as noted above.

Family Chrysididæ

Chrysis verticalis Patton. One female, September 26.

Omalus iridescens Norton. Four specimens, July 17-26. Species of Omalus are parasitic upon wasps that nest in wood *O. corruscans* has been bred from *Stigmus americanus* which is probably the host of the present specimens.

Family Eumenidæ

Odynerus cristatus Saussure. Nine specimens, July 18-28. This is a common species nesting in burrows in wood.

Family Crabronidæ

Solenius (*Crabro*) *interruptus* Lepeletier. One specimen, July 17. Nests in wood.

Blepharipus nigricornis Provancher. Five specimens, doubtfully of this species, July 17-September 26. This nests in wood also.

Family Trypoxylonidæ

Trypoxylon frigidum Smith. One specimen, July 18. Nests in wood.

Family Pemphredonidæ

Pemphredon tenax Fox. Two specimens, probably this species, July 26.

Pemphredon angularis Fox. One specimen, September 26.

Stigmus americanus Packard. Two specimens, September 26.

Passalæcus annulatus Say. Four specimens, July 20-26. This and the preceding three species all build their nests in wood.

Family Hylæidæ

Hylæus (*Prosopis*) *modestus* Say. Two specimens, July 18-August 8.

Family Megachilidæ

Megachile relativa Cresson. One specimen July 17. This and the preceding bee nest in wood.

Diptera

Sixteen species were collected, distributed in a number of families. My friend, Professor A. L. Melander, has been so good as to identify all of these except the Phoridæ.

Family Itonididæ

One specimen, July 16. Not in good enough condition for more accurate determination, but probably a xylophagous form.

Family Mycetophilidæ

Sciara sp. One specimen, July 17. Some species of this genus are mycetophagous, developing in fleshy fungi.

Family Chironomidæ

Culicoides sp. One specimen, July 16. Accidental; this is a phlebotomic type with aquatic larva.

Family Scatopsidæ

Reichertella femoralis Meigen. One specimen, July 17.

Family Scenopinidæ

Scenopinus fenestralis Linne. Three specimens, July 20-28, September 26. This is the common "window-fly" frequently seen in houses. The larva is carnivorous and has been reared from the preparatory stages of the clothes-moth.

Family Phoridæ

Aphiochæta pulicaria Fallen. Eight specimens of both sexes, July 14-August 23.

Aphiochæta agarici Lintner. One female, July 17. The larvæ live in various fleshy fungi.

Aphiochæta sp. One female, July 28. This is probably an undescribed species with swollen, heavily chitinized proboscis.

Aphiochæta sp. Eight specimens, July 18-August 23. Similar to *A. iroquoiana* Malloch, but probably an undescribed species.

Family Muscidæ

Muscina stabulans Linn. Two specimens, August 8. The larvæ of this fly are predatory upon other dipterous larvæ.

Family Trypetidæ

Pseudotephritis vau Say. Two specimens, July 23 and August 23. The larvæ occur beneath bark.

Family Oscinidæ

Oscinis nitidissima Meigen. One specimen, July 17. The larvæ of Oscinis develop in the stalks and roots of various plants, particularly grasses.

Family Drosophilidæ

Drosophila quinaria Loew. Two specimens, July 20 and August 22. The larvæ have been found in fruit, but the species may also develop in fungi.

Drospohila affinis Sturtevant. One specimen, July 26. Sturtevant has bred this species from fruit and has found the adults attracted to exuding sap.

Drosophila sp. One specimen, July 26.

Hemiptera

Family Miridæ

The two species were kindy identified by Professor H. H. Knight.

Plagiognathus politus Uhler. One specimen, July 18. This leaf-bug feeds on various plants, including apple foliage.

Pilophorus uhleri Knight. One specimen, July 28.

Family Anthocoridæ

Xylocoris cursitans Fall. One specimen, kindly identified by Professor H. M. Parshley.

Family Reduviidæ

Reduvius personatus Linn. One specimen, July 14. This is a predatory species, often found beneath loose bark where it feeds upon other insects.

Homoptera

Family Aphididæ

Melanoxantherium medium Baker. A few specimens of aphids were seen and one taken on July 16th proves to belong to this species which occurs on poplar.

CONCLUSIONS.

The size of the present collection is of course very small but it allows one to draw several conclusions relating to the composition of the insect fauna that is associated with the wood of dead trees; conclusions, it may be added, which are substantiated and supplemented in detail by the vast array of accumulated literature relating to forest insects.

a) In the first place, there are many species, particularly Coleoptera and phytophagous Hymenoptera which develop directly in the wood or beneath the bark of logs.

b) Among the parasitic Hymenoptera there is a series of species which prey upon these xylophagous beetles and other Hymenoptera. Very similar to these are certain predatory forms, especially beetles which depend upon particular host species for food.

c) There are further many mycetophagous species, mainly beetles, which develop in the several types of fungi regularly associated with decaying wood. These likewise support a series of parasitic forms.

These three ethological groups we may regard as constituting a primitive fauna which has long been characteristic of wood. A small proportion occur in living trees, but such a great majority live in the wood of moribund or dead trees that we must believe the latter habitat to present the most primitive one. In the case of the mycetophagous types this is still more evident.

d) A secondary fauna includes first a number of predatory insects which are not like the parasites and predators previously referred to, associated with particular hosts, but find simply a convenient source of food supply in the xylophagous fauna.

e) Other members of the secondary fauna include various insects, such as wasps and bees that find suitable nesting sites in burrows in the wood. Although such habits are firmly fixed in one or two families, they are clearly not of primary general significance.

f) Finally, as in any biocœnose there are forms on the borderland whose occurrence is either wholly chance, or at least very occasional and due to sporadic combinations of circumstances that do not occur with sufficient regularity to support species unable to breed elsewhere. An example of this condition is seen in the species Drosophila listed above which breed under bark only where the latter is wet and fermenting due to the presence of yeasts.

Three of the more extensive orders of holometabolous insects, the Coleoptera, Hymenoptera and Lepidoptera are very generally associated with trees although by no means exclusively so. This is particularly true of the Coleoptera which is of the three without question the oldest from a geological standpoint. As was hinted at the outset it seems quite apparent that the Hymenopterous fauna gives evidence of long association with trees and as will be shown in a moment the same appears to be true of the other orders. This implies a rather lasting and unchanging environment.

Contributory to a continuity of fauna is the uniformity of conditions within the woody tissue. The material composition of the wood and bark varies only to a very limited extent and these offer the same food materials, supplied with water in far more constant proportions than food materials that are temporarily or permanently affected by drought or superabundant moisture. Aside from climatic changes and seasonal fluctuations the temperature variations of such an environment are of quite different order from those to be encountered in the course of a free and active existence in the open. In all, the conditions of life in wood are conducive to conservatism as they offer few incentives for progressive adaptations. There is no question that these facts have had a profound influence upon the rapidity of evolution of the insects concerned. Consequently, we find at the present day many primitive types persisting as relicts of an earlier xylophagous fauna still associated with woody tissue and still retaining a primitive series of parasitic enemies, at least among the Hymenoptera. With this fauna are other insects that have adopted this habitat more recently and some of these very patently represent acquisitions derived from other habitats.

These points may be readily clarified by the citation of examples taken from several orders of insects. Indeed, a very representative series might be drawn from the present small collection without having recourse to other well known instances. Among the several extensive and diversified modern orders of insects, including the Coleoptera, Lepidoptera, Hymenoptera and Diptera, all of which are traceable to an origin from an earlier Mecopteroid type the occurrence of dendrophily is well marked in several of the primitive families. Among the Trichoptera wood-boring larvæ are of rare occurrence, no doubt by reason of the fact that the developmental stages are almost without exception aquatic. However, in the other orders there are numerous and widely scattered examples of xylophagous habits, and with the exception of the Coleoptera, the wood-boring forms are mainly members of the more primitive families. A reason for the general absence of the more primitive beetles in this habitat is not far to seek since this group is the oldest of the series. It is represented by several types in the Upper Permian and in the Upper Trias had become quite prevalent, so that if the association of beetles with trees dates from this time or later there were various types of Coleoptera extant. The oldest Hymenoptera known have been found in the Upper Jurassic and are very similiar to living members of the archaic family Siricidæ[1] Whether the order existed in the Upper Permain appears very doubtful, as the only insects so far discovered which appear to be in any way related to the modern Hymenoptera are the order Protohomoptera found by Tillyard in the Upper Permian of Kansas. Insects supposed to be Lepidoptera have been reported from the Middle Jurassic but these have been shown without question to be Homoptera, so that no Lepidoptera are actually known earlier than the Tertiary. This is obviously due to incomplete knowledge and to judge from their food relations at the present time as outlined in the present account, it seems probable that the Lepidoptera were present in the Liassic and probably in the Triassic. This order is thus apparently older than the Hymenoptera but of more recent origin than the Coleoptera. The Diptera are well represented in the Upper Liassic,

[1]Since the above was written I have received a paper by Martynov (Bull. Acad. Sci. Russie, vol. 19, 1924) in which several remarkable Hymenoptera are described from Jurassic deposits in Turkestan. These include a very primitive type of sawfly, an oryssid-like genus and a member of the family Heloridæ. These discoveries offer strong confirmation of the views expressed in the present paper.

but only by clearly primitive nematocerous types (except for one typical Xylophagid). We may therefore safely conclude that this order had its origin after the Permian in the Liassic.

With these facts in mind, as gleaned from the paleontological data so far accumulated, we may inquire more in detail concerning the occurrence and distribution of xylophagous habits in these several orders.

In the Lepidoptera there are several very generalized families which form the suborder Homoneura. Of these the small but widely distributed family Hepialidæ includes large moths most of which develop in burrows that they excavate in wood, while others are subterranean and feed upon the roots of trees. Although not entirely lignivorous, it is interesting to note that the most primitive of all families belonging to the Homoneura, the Micropterygidæ includes species that mine in the leaves of trees as well as forms that feed upon more primitive plants such as mosses and liverworts.

Another primitive family, the Cossidæ, includes large moths which are xylophagous as larvæ, and as typified by members like the Leopard Moth (Zeuzera) and Carpenter Moth (Prionoxystus) are notoriously destructive to certain deciduous trees. Likewise the related family Sesiidæ (Aegeriidæ) restrict their diet to the wood of trees except in rare instances where a few species have become secondarily associated with herbaceous plants. These several families are all internal feeders and true wood-borers, but even in the case of one family which feeds on foliage, the leaf-rolling Tortricidæ, the selection of trees rather than herbaceous plants is very marked. Another series which exhibits the same predilection for trees is the enormous family Geometridæ. These are however not so important from the present standpoint,for although quite generalized they are by no means so primitive as the other families mentioned.

Among the Hymenoptera the case is still clearer for the most primitive groups not only of phytophagous types but of parasitic ones as well are definitely associated with the woody flora. There is some ground for a difference of opinion in selecting the most primitive living type of Hymenoptera and also in indicating the probably phylogeny of the lower groups. On the basis of wing venation and many anatomical structures it seems probable that the families Xyelidæ and Pamphiliidæ represent the most primitive type related to forms from which the present-day Sawflies (Tenthredinidæ *et al.*) have been derived. They as well as the sawflies are typically associated with trees although they are leaf-feeders and not xylophagous. From them also probably have come the wood-wasps, typified by the very generalized Xiphydriidæ and the Siricidæ. From a paleontological standpoint the Siricidæ might appear to be the oldest Hymenoptera as the only clearly preserved members of the order known before the Tertiary are some upper Jurassic Siricidæ that occur in the Solenhofen lithographic stone.[1] This is very scant evidence, however, and indicates only a lack of knowledge as the early Tertiary, especially the Lower Oligocene sees the Hymenoptera as diversified and almost as modern in type as at the present day. Nevertheless, the Siricidæ clearly represent the remnants or offshoot of a group which gave rise to an important and extensive series, the Parasitic Hymenoptera, which include a considerable number of families and a vast number of genera and species. The parasitic habit is first manifest in the entomophagous Oryssidæ and in them we find still an association with wood boring insects, as Oryssus is known regularly to live in wood and has recently been found to be an ectoparasite of beetles belonging to the family Buprestidæ. The Oryssidæ have been considered as forming an independent superfamily, but most hymenopterists agree in associating them with the Siricidæ. There can be no reasonable doubt that they have arisen from the siricoid stem, as well as that they represent the most primitive parasitic group in the order. Among the other parasitic Hymenoptera, the Aulacidæ (exclusive of Evania and its allies) show a number of similarities to the Oryssidæ of such nature that we must consider them related, and as the Aulacidæ are the most primitive of the Ichneumonoidea we find this vast group clearly brought forth by xylophagous ancestors. The only other group of Icheneumon-flies that retains the costal cell which disappears in the higher forms, is the Stephanidæ. Little is known of their habits, but their association with trees leaves

[1]See footnote on page 87.

little doubt that they are parasites of wood-boring insects. The same is true of the peculiar family Megalyridæ known only from Australia and South America and representing an archaic type most likely another derivative of the Siricoids. Among the two dominant present day families of ichneumon-flies, the Ichneumonidæ and Braconidæ we find the more primitive smaller groups of each to be parasites of wood-boring insects, e. g. the *Rhyssini* of the former family and the Spathiinæ, Hormiinæ and Helconinæ of the latter. Several other families have similar habits but these are much more highly specialized types, except perhaps the remarkable genus Ibalia. This is usually considered to be an aberrant Cynipid but it shows affinities with the Siricidæ, upon which it is parasitic, and is without question a relict of some primitive group.

From the foregoing it is evident that the association of the orders Hymenoptera and Lepidoptera with trees, especially with the wood of the latter is clearly marked in the most primitive families, in fact we may be almost satisfied without further evidence that these two large and diversified orders arose as lignivorous forms. This can hardly be true of their earlier ancestral type, the Mecoptera, nor of the more primitive Mecopteroid derivatives, the Trichoptera. This forms strong contributory evidence that the Hymenoptera and Lepidoptera had an origin coincident with that of the modern ligneous flora. The origin of the Coleoptera at an earlier time before this flora had developed resulted not in an association of the more primitive adephagous beetles with trees, but in the appearance of the lignivorous habit in some of the most highly specialized Celeoptera such as the Cerambycidæ and Ipidæ (Scolytidæ). Some other families like the Buprestidæ have similar habits, but they represent by no means the most generalized members of the order. With the Diptera the rather sparse occurrence of wood boring forms offers little suggestion that the earlier types may have been associated with trees. Obviously the degenerate mouthparts of the larval dipteron are not well suited to chewing wood, even in the more primitive nematocerous forms and only occasional types have become dependent upon the woody flora.

FOUR NEW HELMIDÆ FROM CUBA, WITH NOTES ON OTHER WEST INDIAN SPECIES[1]

By P. J. Darlington, Jr.

In common with all but the most thoroughly worked parts of the world the West Indies have yielded to entomological collections only a very small fraction of their probable Helmid fauna, indeed only one species of the family is at present recorded from that entire series of islands. It was with particular pleasure, therefore, that four apparently undescribed species of *Helmis* were collected during the eight weeks which I was privileged to spend, during the fall of 1926, at the Harvard Biological Laboratory on the Soledad sugar "central", near Cienfuegos, southern Santa Clara, Cuba. The genus was first noted on Oct. 19, when two specimens were taken on a stone secured from the bed of the Arimao River. The same locality was visited again on Dec. 3, and two hours of back-breaking work in from six to eighteen inches of swiftly flowing water, just above the point where the current broke into a series of minor rapids, yielded twenty-nine specimens, including all the species obtained. Finally, a single specimen was discovered in going over alcoholic material collected Nov. 24, along a gravel bar of one of the larger tributaries of the Arimao.

These species have definite affinities with others occuring in the southern United States, notably in Texas, but all have equally definite distinguishing characters of specific value. As far as I can judge from the descriptions and plates in "Biologia," none of the described Mexican and Central American species are very closely allied to the Cuban ones, a finding which is in agreement with the general conclusions reached by Leng and Mutchler in their preliminary list of West Indian Coleoptera. In order to establish relationships, specimens or descriptions of all the species listed from America north of Mexico by Mr. Leng have been examined.

The Cuban species are only moderately closely related

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 283.

among themselves, but are mutually congeneric according to the characters in use at present. There is considerable variation in the width of the prosternum between the coxæ, but this seems to have no generic value, and is often at least partly due to superficial lateral dilation of the sternum over the edge of the coxa rather than to a change in the insertion of the latter. In *Helmis simplex*, here described, which has a very broad prosternal process, no pubescence is apparent inside the front tibiæ, and, if the form were not almost exactly that of *H. ferruginea* Horn, the species might be referred elsewhere. The four species agree in having eleven-jointed antennæ with the second joint moderately and regularly enlarged, in having the last joint of the maxillary palpus moderately elongate, and in having the last ventral segment of all specimens curiously emarginate, the emargination having removed a narrow, semi-circular strip from the edge of the apex of the segment, leaving the actual apex unchanged in form but causing the sides to appear lobed or toothed. This character is variable from species to species, but the difficulty of describing it has rendered its use inadvisable at present. An attempt has been made to select only the more useful characters for mention in the descriptions, and to avoid the repetition of statements which have been made in the discussion.

For comparative purposes the key which precedes the descriptive portion of the paper has been constructed to include *Helmis smithi* Grouvelle, which I know only from the literature, and the two Texas species *H. cæsa* Lec. and *H. ferruginea* Horn, of which I have seen the type and authentic specimens, respectively, in the Museum of Comparative Zoölogy. I must express my thanks to Mr. Banks and the authorities of the museum for permitting me to examine these and many other specimens, and I must also thank Dr. Thomas Barbour and Dr. W. M. Wheeler for arranging my Cuban trip, and Mr. R. M. Grey and other friends at Soledad for helping to make my stay profitable and enjoyable.

Key: Cuban and related species.

1. Pronotum with a pair of sublateral, elevated carinæ paralleling the lateral margins; palpi pale; intercoxal portion of prosternum about half as wide as that of mesosternum. 2

Pronotal disk without carinæ or definite impressions; palpi infuscate; intercoxal portion of prosternum nearly as wide as that of mesosternum. . . . . *Helmis simplex* n. sp.

2. Pronotum strongly, transversely impressed at middle.. . 3
Pronotum longitudinally, not transversely, impressed.. . 4

3. Basal half of pronotum granulate, opaque. . . . . *H. minima* n. sp.
Pronotum entirely shining, not granulate; prothorax more narrowed at base; size a little larger; (Texas). . . . . *H. cæsa* Lec.

4. Elytra together nearly twice as long as wide; pronotum darker than elytra. *H. filiformis* n. sp.
Elytra together about one and a half times as long as wide; pronotum never darker than elytra. 5

5. Sublateral carinæ reaching anterior edge of pronotum.. . 6
Sublateral carinæ abbreviated anteriorly; (Grenada). *H. smithi* Grouv.

6. Ferrugineous; larger and proportionately broader; prothorax more narrowed at base; prosternum broader between the coxæ; (Texas). . . . . *H. ferruginea* Horn.
Elytra usually slate-colored. . . . . . . *H. quadrata* n. sp.

Helmis minima n. sp.

Elongate, parallel, slightly depressed; piceous black, pronotum and front darker; abdomen, antennæ, legs, and labrum rufous; palpi pale yellow. Head moderately shining, faintly punctured and pubescent. Prothorax subquadrate, hardly as wide as long, slightly and regularly narrowed at apex and, very slightly, at base; sides otherwise nearly parallel; lateral margins finely crenate; disk with complete, transverse median impression, and with a pair of fine sublateral carinæ paralleling the side margins from base to apex, the distance between them being somewhat more than half the discal diameter; area before transverse impression shining, finely and sparsely pubescent; area behind impression dull, granulate. Elytra together a little less than twice as long as wide, very little wider than the thorax, the sides straight and very slightly divergent from just back of humeri to apical fourth; outer margin obsoletely crenate; disk sparsely punctured and pubescent; fifth interval with a fine carina from base nearly to apex; third interval not prominent at base; basal two thirds of four inner striæ represented by irregular series of punctures; a faint alutaceous sculpture visible near the larger ones. Length 1.3-1.4 mm. Width 0.45 mm. Holotype and three paratypes, Arimao River, Soledad, Cienfuegos, Cuba, Dec. 3, 1926.

One specimen, from the gravelly bank of a large brook, Nov. 24, has the head less shining, the thoracic and elytral margins more clearly crenate, and the elytral striæ longer; I have referred it to this species, but not as a paratype. With this exception, there seems to be no noteworthy variation. The form is almost exactly that of *H. cæsa* Lec. from which it differs chiefly as indicated in the key. In this, as in all the following species, no sexual characters have been noted, and the size is really remarkably constant. The holotype, with the three of the other species, is in my private collection, and at least one paratype of each form described will be retained to lend to established students. Paratypes of all species will be deposited in the Museum of Comparative Zoölogy and the National Museum; of *filiformis* and *simplex*, in the American Museum.

Helmis filiformis n. sp.

Elongate, parallel, slightly depressed; dilute brown, with slaty tinges below and on elytral disk; head and pronotum dull black; antennæ, tarsi and palpi yellowish rufous. Head opaque, moderately punctate and pubescent. Prothorax subquadrate, about as long as wide, widest one third from base, slightly narrowed at base and apex; side margins slightly crenate; pronotum longitudinally impressed on median third, the impression indicated at base by a pair of minute carinæ; pronotum also with a pair of complete, sublateral carinæ paralleling the side margins anteriorly, but sinuate and slightly approaching the margins posteriorly, the distance between them being more than half the discal diameter; disk alutaceous or finely granulate, more distinctly so posteriorly, sparsely punctate and pubescent; elytra together nearly twice as long as wide, very little wider than the thorax, with the margins straight and very slightly divergent from just back of the humeri to apical fourth; outer margin finely crenate; fifth and seventh intervals elevated to about apical fourth; third interval more prominent basally than second or fourth; four inner striæ represented by stripes of irregular, dense alutation, obsolete on apical fourth; disk dull, sparsely pubescent. Length 1.8-1.9 mm. Width 0.6 mm. Holotype and six paratypes with same data as preceding species. Two paratypes from same locality, Oct. 19.

There is some variation in the degree of infuscation of the elytra. The general habitus is that of the preceding species, though perhaps a trifle more elongate.

Helmis quadrata n. sp.

Moderately stout, subparallel; slate-gray, abdomen and particularly pronotum with a reddish brick-colored tinge; tarsi and antennæ rufous; palpi yellowish rufous. Head dull, with small scattered black granules. Prothorax subquadrate, barely wider than long, widest about a third from base; slightly narrowed behind, more narrowed in front; lateral margins crenate; pronotum with a median longitudinal groove from base nearly to apex, the groove limited by two short carinæ at base; pronotum also with a pair of complete, sublateral carinæ parallel with the sides in the apical half but sinuate and slightly approaching the margins toward the base; distance between carinæ more than half the discal diameter; disk dull, finely and sparsely pubescent, not evidently granulate. Elytra together about a half longer than wide, a little broader than the thorax; margins inconspicuously crenate; intervals five and seven with granulate, elevated costæ reaching to about apical fourth; third interval prominent at base; four inner striæ represented by narrow, irregular grooves; first at least indicated to apex; disk dull, finely and sparsely pubescent. Length 1.9-2.1 mm. Width 0.8-0.9 mm. Holotype and four paratypes with same data as *H. minima*.

This species, too, is very constant in essential characters. In one specimen the reddish shade of the pronotum is diffused over the elytra, enhancing the resemblance to *ferruginea*, from which it differs principally as indicated in the key. The prosternum seems to be slightly broader between the coxæ in that species, and the median groove of the pronotum is much less distinct at base.

Helmis simplex n. sp.

Moderately stout, subparallel; dull black, with a pinkish-gray tinge below; tarsi, trochanters, and antennæ rufous, latter a little paler toward the base; palpi infuscate. Head dull, with scattered dead-black granules on a uniformly muddy background. Pronotum barely wider than long; sides subparallel, slightly more narrowed in front than behind; disk regularly convex, without carinæ, and with the barest trace of a longitudinal impression at base; disk evenly, sparsely, and finely punctate and pubescent. Elytra together about one half longer than wide; four inner striæ almost completely obsolete; third interval not prominent; disk finely and sparsely pubescent, opaque, smooth near the suture, with several rows of granules externally the most prominent on the seventh interval. Length 1.9-2.0 mm. Width 0.8 mm. Holotype and twelve paratypes with same data as *H. minima*.

The most distinct and perhaps the most constant of the four species described. The affinities are probably toward *H. quadrata*, the general form of which is closely imitated, but the relationship is not very close in other ways.

After the preceding portion of the paper had been completed, a small lot of West Indian *Helmis* was received for study through the kindness of the authorities of the United States National Museum. Of the three species involved, one, represented by three specimens labeled "Grenada, W. I., Aug. Busch Collector" is undoubtedly *H. smithi* Grouvelle, described from the same island in 1898 (Notes fr. Leyden Mus., XX, p. 47). This insect is closely related to *H. ferruginea* Horn, but is separable as previously indicated. The difference in the thoracic carinæ is not very marked, but is supplemented, as Grouvelle said, by one in the median, longitudinal groove of the pronotum, which is longer in *smithi*. The two other species are both from Jamaica collected by H. G. Hubbard, and are very close to the species described above as *minima* and *filiformis*, of which they seem to be at best no more than geographical varieties. The form near *minima* is represented by a single specimen, 1.5 mm. long, which seems almost exactly typical in shape and sculpture, though the latter is slightly obscured; that near *filiformis*, however, seems subspecifically distinct.

Helmis filiformis jamaicensis n. subsp.

Almost precisely as in typical *filiformis* except as follows: the color above is practically uniform, ranging from dull rufous in the holotype to piceous in the darker paratype. In the latter there are vague rufous areas near the humeri, but these do not suggest the straw-colored elytral ground of typical *filiformis*. The median longitudinal groove of the pronotum is slightly finer and not as abbreviated as in the Cuban form. The size is slightly greater, the three specimens being between 1.9 and 2.0 mm. in length. The holotype and two paratypes belong to the collection of the National Museum. The type is No. 40350 in the collection of the U. S. National Museum.

ÆGIALIA ARENARIA MULS. IN NEW ENGLAND, WITH LOCAL RECORDS FOR OTHER SPECIES[1]

By P. J. Darlington, Jr.

On Apr. 4, 1925, the writer took over three hundred specimens of the European *Aegialia arenaria* Muls. crawling on the sun-heated sand of the dunes and, especially, of the beach near Ipswich, Mass., where it was evidently thoroughly established. In general form this species resembles *A. opifex* Horn, but is stouter and much larger, about five mm. in length. It may be at once distinguished from all our previously known species by its virtually impunctate pronotum and greatly reduced inner wings, which are not over half the length of the elytra and which are thin and unsuited for flight. Later in the season, notably May 22, 1926, it was found on the sand more sparingly, and was taken under deeply buried logs a little above tide line. The species was more common on the beach proper than on the adjacent higher dunes, while the exact opposite seems to be true of the functionally winged *A. opifex*, a species which has been taken in numbers at the same locality in May, but not at all in April. The first difference may be explained as a specific ethological preference or by the fact that the awkward, flightless *arenaria* is blown off the heights which its more active relative easily attains The ethological explanation is the more satisfactory, for all our other New England species range inland, while this is apparently unwilling or unable to leave the coast. *Arenaria* is, however, frequently seen rolling along the sand before the wind, and is occasionally blown into the ocean and washed into the local drift.

Whether this species, now locally so common, is introduced or native it is impossible to say at present, but it is difficult to see how a flightless species of its habits could have crossed the Atlantic to such a comparatively remote point as Ipswich. The species seems to be quite absent on the beaches near Lynn, which is much nearer Boston than is the region in which it occurs, though I have searched as thoroughly in one place as the other. It seems significant that the range of the species in Europe, the entire northern area and Great Britain, is similar to that of

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 284.

many plants which are known to be native both there and in America, and it is notorious that maritime species are wide ranging. It is not easy to see, however, how our many enthusiastic local collectors, past and present, could have entirely missed the species, though perhaps the facts that the spring flight, so called, is exceptionally early, that the insect is less conspicuous later in the year, and that it is flightless and not apt to straggle into more frequented regions may have contributed to its invisibility. The larva, of course, must inhabit the same region as the adult, and must be buried in the sand to escape the heat of the sun, so that it is even less likely to be discovered or transported than the adult. Several other beetles more or less common at Ipswich are poorly represented in local collections, and the few representatives are usually from localities to the south. If it can be shown that *arenaria* exists at more northern stations and if it does not turn up further south, we shall be able to see how it at least might have been overlooked in the past. Botanical evidence indicates that, if the species is naturally of transatlantic distribution, it should occur in the Gulf of St. Lawrence region.

The determination of the Mass. specimens depends on comparison with one from Europe in the Museum of Comparative Zoölogy and on reference to the literature. There seems to be no other European species with which the present one could well be confused.

In addition to *A. arenaria*, five species of the genus occur in New England, one of which appears to be at present unrecorded. *A. blanchardi* Horn, *spissipes* Lec., *opifex* Horn, and *rufescens* Horn are all found in eastern Mass., while the last two have been taken in central N. H. as well. A single specimen of *A. lacustris* Lec. was taken at Paris, Me., July 9, 1915, by Mr. C. A. Frost, and has been compared with the type. Another unique, also of *lacustris*, but leaning a little toward *cylindrica* Esch., was taken by the writer under a stone in Tuckerman's Ravine, Mt. Washington, N. H., Sept. 10, 1926, at about 4,000 ft. elevation. For the final determination of this specimen I am indebted to Mr. H. C. Fall. The previously known range of *lacustris* includes Nfld. and Mich.

NEW SPECIES OF SCATOPHAGIDÆ.

By Charles W. Johnson

Boston Society of Natural History.

Amaurosoma Becker.

This genus is characterized by having three sternopleural bristles, the first vein without bristles; arista slightly pubescent and the fore femora armed with a series of closely placed bristles on the anterior and antero-ventral surfaces.

The following is a table of the New England species. The three species described by Malloch from Alaska in 1920 (Ohio Jour. Sci., XX, 284), and later tabulated (Bull. Brooklyn Ent. Soc., XVII, 77, 1922) are omitted.

Table of species.

1. Thorax and abdomen black, grayish pollinose, propleura hairy.?..2.
   Thorax, head and abdomen yellow, propleura nude.........
   nuda Mall.
2. Wings uniformly hyaline. ....3.
   Wings with the anterior half brownish...*brunneicosta* sp.nov.
3. Antennæ black, abdomen subshining with hairs partly black, ventral part of the genital armature black, legs yellow, tarsi brownish..................*acuticornis* Loew.
   Antennæ with the first and second joints yellowish, abdomen dull, with white hairs on all the segments, ventral part of the genital armature yellow, legs entirely light yellow....
   pallidipes Mall.

Amaurosoma brunneicosta sp. nov.

Face and cheeks yellowish white, lower half of the front yellow, the upper part black, orbits, vertex and occiput grayish pollinose, three orbital and two small frontal bristles; antennæ black, the base of the third joint yellowish, basal half of the arista thickened, proboscis black, palpi white, slender. Thorax and abdomen black, covered with a grayish pollen, hairs black, lower part of the pleura with long white hairs, scutellum bearing two bristles. Legs yellow, the anterior femora with a row of five bristles on the anterior surface. Costa and all the veins to and including the fourth, together with that portion of the wing brown, the posterior portion of the wing hyaline and the veins light yellow, Squamæ and halteres light yellow. Length 4 mm.

Echo Lake, Mt. Desert, Me., June 27, 1922. Holotype in the collection of the Boston Society of Natural History.

Amaurosoma acuticornis (Loew).

Cordylura acuticornis Loew, Cent. IX, 94, 1869.

Specimens agreeing with the type have been collected by the writer at Jaffrey, N. H., May 14-20, and June 3; also at Rutland, Mass. June 5. Mr. S. A. Shaw has taken the species at Hampton, N. H., May 12 and 18.

Orthacheta Becker. (*Orthochæta* as amended).

This genus has three sternopleural bristles, the first vein bristly on the outer half, hairs of the arista short, scutellum with four bristles. The following is a table of the New England species, based on the males, with the exception of *O. strigipes* based on a female from Colorado.

Table of species.

1. Front black, middle and hind coxæ black, abdomen subshining with a slight bluish gray pollen . . *dissimilis* Mall.
   Front partly yellow, all the coxæ wholly or partly yellow, abdomen with a dull gray pollen. . . . . 2.
2. Wings and veins brown except at the base, lower third of the front yellow. *brunneipennis* sp. nov...
   Wings and veins yellow, front yellow, the upper third black 3.
3. Coxæ of the middle and hind legs dark, a stripe on the posterior side of the front and middle femora black. . . . . *strigipes* sp. nov

Coxæ and femora entirely yellow. . . . .

4. Abdomen entirely black, the genitalia partly dark brown, the ventral genital armature black, hairs of the legs long. *hirtipes* sp. nov.

Abdomen black above, lateral margins of the segments venter and genitalia reddish brown, hairs of the legs short. *cornuta* Loew.

Orthacheta brunneipennis sp. nov.

Face, cheeks and lower part of the occiput white, the lower third of the front yellow, the remainder black, frontal orbits white, bearing five bristles, upper part of the occiput black covered with a grayish pollen; antennæ black, the tip of the second joint yellowish, proboscis black, palpi white. The thorax and abdomen black and covered with a grayish pollen, on the dorsum of the thorax slightly brownish, the rows of fine dorsocentrals give the appearance of two narrow dark lines; genitalia black, legs yellow, the posterior tarsi entirely black, the fifth joint of the fore and fourth and fifth of the middle tarsi black. Wings brownish, the extreme base a little lighter. Halteres yellow. Length 6 mm.

The female differs in having the wings yellowish with the vein brown; abdomen black with the last segment sometimes brownish at the tip; hind coxæ slightly darkened at the base.

Holotype and allotype taken near the "Ark", Jaffrey, N. H., May 18, 1925, and six paratypes from the same locality, May 16-June 5 in the collection of the Boston Society of Natural History. One paratype Hull, Quebec, June 6, 1923, (C. H. Curran) in the Canadian National Collection, Ottawa; two Jaffrey, N. H., May 21 and June 5, in Museum of Comparative Zoology and two Jaffrey, May 21, in the author's collection.

Orthacheta strigipes sp. nov.

Face white, front yellow, the upper third and sides blackish, orbits narrow, white, margined with dark gray, bearing seven bristles; occiput black grayish pollinose; antennæ black, the tip of the second joint narrowly margined with light yellow, palpi light yellow. Thorax and abdomen black, dark grayish pollinose. Legs yellow, the front and middle femora with a black stripe on the posterior side, on the middle femora confined to the outer half, base of the middle and posterior coxæ, and the middle and posterior coxæ, and the middle and posterior tarsi black, the front tarsi yellow the fifth joint black. Halteres and wings yellow, Length 6 mm.

One female, Colorado, in the author's collection. This species closely resembles *Cordylura vittipes* Loew and may be confused with that species unless the generic characters are closely studied. The New Mexican record for *C. vittipes* may refer to this species.

Orthacheta hirtipes sp. nov.

Face and cheeks white, front yellow, the upper third brownish black, orbits gray the lower part white, six orbital bristles, vertex and occiput black, grayish pollinose, antennæ black, outer half of the second joint yellowish, palpi light yellow, hairs black. Thorax and abdomen black, grayish pollinose, upper part of the genitalia dark brown, the ventral genital armature black. Legs yellow, the posterior tarsi brown, the fifth joint of all the tarsi black, the hairs on the legs longer than in the other species, hairs on all the coxæ black. Halteres yellow, wings yellow, hyaliue, veins brown. Length 6 mm.

On male, Mt. Washington carriage road, 2500 ft., June 14, 1916, (C. W. J.). Type in the collection of Boston Society of Natural History.

Orthacheta cornuta (Loew)

Cordylura cornuta Loew, Cent. III, 48, 1863.

This species has been taken at the following places in New England. Bar Harbor, Me., June 13; Framingham, Sherborn, Auburndale and Arlington, Mass. May 16 to June 18.

NEW MEGACHILID BEES.[1]

By Theodore B. Mitchell,

The species which are described below were found in two series of unidentified material, one in the collection of Professor W. M. Wheeler at the Bussey Institution, and the other in the collection of the Museum of Comparative Zoology at Cambridge.

Lithurgus bruesi n. sp.

♂. Head broader than long, the eyes converging slightly below, pubescence entirely greyish-white; supraclypeal plate shining, almost impunctate medially, with scattered punctures laterally; clypeus impunctate medially except for a few scattered punctures, but closely punctate laterally, practically rugoso-punctate, the apical margin smooth and entire; labrum very peculiar and distinctive, having a deep longitudinal impunctate channel or concavity, which has on either side midway a strong triangularly pointed spine, the distance from the bottom of the concavity to the tip of the spine being equal to about half the length of the labrum; mandibles ordinary, with three subequal teeth; cheeks about as broad as width of eye, the posterior margin above quite sharp but hardly carinate, closely and finely punctured; vertex slightly rounded, closely and rather finely punctured, the punctures between the eyes and ocelli large, deep and distinctly separated; lateral ocelli very slightly nearer edge of vertex than to nearest eye; antennæ shining above, dark, the joints more ferruginous apically, dull brownish-red below, the joints slightly longer than broad, the first joint of the flagellum and the basal half of the second joint, below, blackish.

Thorax with pubescence entirely greyish-white, longer at sides and behind; mesonotum and scutellum extremely densely and quite finely punctured, the punctures of the pleura also

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being very close and quite fine; propodeum with minute close punctures laterally, more sparse behind, the surface tessellate, basal triangle not definitely demarked; tegulæ ferruginous, impunctate, white pubescent anteriorly; wings lightly and rather uniformly fuliginous, slightly paler apically, nervures piceous to black, basal nervure well beyond transverse median, the recurrent nervures entering the second submarginal cell at about equal distances from base and apex; legs black, with long white pubescence, the tarsi tinged with red, the metatarsi very long and slender; spurs pale testaceous; claws ferruginous, darker apically, deeply cleft, pulvilli distinct.

Abdomen black, tinged with red basally, the basal segments almost impunctate, the apical segments finely punctured, segment 6 quite closely so; pubescence pale on segments 1 and 2, short and fuscous on segments 3-5, long and fuscous on 6 and 7; segments 2-6 with apical fasciæ of white pubescence, widely interrupted on 2 and 3, slightly so on 4, entire on 5 and 6; ventral segments 2-5 also with distinct entire white apical fasciæ and with long white pubescence on the discs. Length 12 mm.

Type: Male (Type No. 15710, Mus. Com. Zool.); Austin, Texas (C. T. Brues, collector).

With the mandibles closed this would be easily mistaken for *L. echinocacti* Ckll., but with the labrum exposed it is easily distinguished. This distinguishes this species at once from all the other North American species.

Megachile austinensis n. sp.

♀. Head broad, eyes subparallel; supraclypeal plate shining, very sparsely punctured medially, closely so at sides and above; clypeus almost impunctate in center, with a few widely scattered minute punctures, the surface polished, punctures coarse and quite close on extreme sides, apex entire, deeply impressed just before the edge which is slightly grooved; mandibles reddish above, black on the three inner teeth, with scattered, coarse, striate punctures above, 4-dentate, the two outer teeth broadly rounded, the third one acute and the inner one subacute; cheeks quite broad, finely and closely punctured, the punctures rather shallow below, deeper above, pubescence quite thin and short, white; vertex quite finely punctate, the punctures well separated, surface finely tessellated between the punctures, pubescence long and thin, pale, with some short inconspicuous black hairs intermixed; lateral ocelli about equally distant from eyes and edge of vertex; front below ocelli well punctured, but the punctures not crowded; antennæ apparently reddened (both are broken, only the stub of one flagellum left); pubescence below anterior ocellus white and quite dense, clypeus nearly bare, with some inconspicuous yellowish hairs at sides.

Thorax white pubescent except above, mesonotum with at least some dark pubescence (rubbed), and apparently also the scutellum; mesonotum rather dull, punctures quite small, close laterally and somewhat so anteriorly, sparse in center, the surface finely tessellated; scutellum with fine, widely separated punctures; pleura with crowded, rather fine punctures above, becoming coarser below; propodeum tessellate, with numerous fine and indistinct punctures, basal triangle granular; tegulæ dark ferruginous, minutely but fairly closely punctured; wings faintly infuscated, darker apically, nervures piceous to brownish, second recurrent nervure entering second submarginal cell slightly nearer apex than the first does to base; legs dark red, white pubescent, yellow on tarsi beneath, middle and hind metatarsi not quite as broad as their tibiæ, the middle ones with rather long stiff whitish pubescence exteriorly, front metatarsi with a thin but long fringe posteriorly; spurs reddish-testaceous; claws reddish-testaceous basally, brighter red apically, with short and sharp basal setæ, almost toothed.

Abdomen cordate, apical segments shining, punctures fine, quite close on basal segments, rather sparse on apical ones except the sixth; pubescence short and black, entirely white on segment 1 and white basally on segment 2; segments 1-5 with entire conspicuous apical white fasciæ, narrow on segments 1 and 2, broader on 3-5; segments quite deeply impressed apically at sides, but slightly so medially; segment 6 quite broad, closely and finely punctured, slightly but distinctly concave at sides when viewed from above, straight in profile, with an obscure median longitudinal ridge on which the pubescence is black and appressed and best seen in profile, on either side of this the the surface is covered with subappressed white pubescence, while the extreme tip is clothed with dense appressed fuscous pubescence, segment with erect black hairs across the base, conspicuous at sides; scopa yellowish-white, black on segment 6, and with a small tuft of black hairs at extreme sides of segment 5. Length 13 mm.

Type: Female (Type No. 15707, Mus. Comp. Zool.); Austin, Texas, May 8, 1901 (C. T. Brues, collector).

Megachile wheeleri n. sp.

♀. Head broad, eyes subparallel, pubescence greyish-white on face, thin and white on cheeks, long and black or fuscous on vertex, extending down on cheeks for a short distance; supraclypeal plate quite closely punctured, shining spaces between the punctures medially; clypeus with punctures close above and laterally, more separate in middle where the surface is shining, apex entire, smooth and impunctate, thickened on the edge which is slightly grooved; mandibles broad, reddened apically, sparsely punctate above, 4-dentate, the three apical teeth subequal in size and rounded, the inner one acute, a slightly incurved bevelled edge between the two inner teeth; cheeks about as broad as eye, shining, the punctures rather large but shallow, quite close, finer, closer and deeper above; vertex shining, nearly flat, with punctures well separated in general, close along edge behind ocelli; lateral ocelli slightly nearer edge of vertex than to nearest eye; front below ocelli densely punctured; antennæ black above, obscurely reddened below, middle joints but slightly longer than broad.

Thorax white pubescent at sides and behind, largely black on mesonotum and scutellum, whitish on mesonotum anteriorly and on scutellum posteriorly; mesonotum quite deeply and closely punctured, but the punctures well separated in center where the surface between them is shining; scutellum closely and finely punctate; pleura very closely and finely punctate above, the punctures larger and not so much crowded below; sternum with large, rather close punctures; propodeum with minute indistinct punctures, closer posteriorly, surface rather shiny, basal triangle tessellate; tegulæ ferruginous, yellowish in front, rather closely punctured, the punctures small but distinct; wings subhyaline, clouded apically, nervures piceous to brownish, second recurrent nervure entering second submarginal cell slightly nearer apex than first does to base, but both rather distant; legs black, white pubescent, yellowish on tarsi beneath; middle metatarsi almost as broad as the tibiæ, densely yellowish-white pubescent without; hind metatarsi almost as broad as the tibiæ also; spurs pale yellow; claws pale ferruginous basally, somewhat deeper red apically, basal teeth distinct.

Abdomen ovoid, shining; segments 1 and 2 entirely white pubescent, and segment 3 narrowly white pubescent at base; segments 3-5 with rather long erect black pubescence on discs; segments 1-5 with dense, entire, white, apical fasciæ, very broad on the apical segments, narrow on the first two; punctures fine, close on basal segments, very sparse on the fifth which is highly polished; segment 6 rounded apically and straight at the sides in dorsal view, straight in profile, shining, finely and rather closely punctured, with white appressed pubescence which is dense apically, thinning out basally, and with numerous long, erect, stiff black hairs; scopa white with a very faint yellowish tinge, black on segment 6 and on the apex of segment 5 medially. Length 12 mm.

Type: Female (Type No. 15708, Mus. Comp. Zool.); Alta Meadow, California, altitude 9000 ft., Aug. 23, 1917 (W. M. Wheeler, collector). Paratypes: 4 females, topotypical; 2 females, Calgary, Alberta, Aug. 26, 1925 (Geo. Salt, collector).

This is very close to *M. chrysothamni* Ckll., but in the latter the punctures of the mesonotum are much closer and there are no black hairs on the scutellum. The fifth abdominal segment is much more closely punctured also than in this species. Both of the species described here may be separated from *chrysothamni* by the following key:

1. Clypeus almost impunctate in the center, with very minute widely scattered punctures, but deeply punctate at sides. . . . . *austinensis*
   Clypeus closely and strongly punctured throughout. . . .2.

2. Pubescence of scutellum entirely light; punctures of mesonotum very close throughout. . . . .*chrysothamni*
Scutellum with some long black hairs; punctures of mesonotum distinctly separated in center. . . . .*wheeleri*

Megachile inimica jacumbensis n. subsp.

♂. This resembles *M. sayi* Cress. except that the front tarsi are much shorter, the first joint being definitely shorter than the tibia and inclined to blackish along the anterior border; the lateral ocelli are about equally distant from the eyes and from each other; the clypeus has a quite definite though small median emargination; the legs except the front tarsi are black and the pubescence is white.

Type: Male (Type No. 15709, Mus. Comp. Zool.); Jacumba, California, Aug. 17, 1917 (Coll. W. M. Wheeler). Paratypes: 6 males, topotypical; 1 male, Warren, San Diego Co., California, Aug. 13, 1917.

This has been made a subspecies of *inimica* rather than of *sayi* because of the fact that *inimica* was described in 1872 (Trans. Am. Ent. Soc. Vol. 4), and *sayi*, which has been considered the typical form, was not described until 1878 (Trans. Am. Ent. Soc. Vol. 7). In *sayi* s. str. the tarsal scale is much more produced above than in the form here described, and the scale at the anterior margin is fully as long as the tibia. There is also a tendency in *sayi* toward shortening the distance between the lateral ocelli, this being usually somewhat shorter than the distance from the ocelli to the nearest eye or to the edge of the vertex, and the clypeus is not so definitely emarginate medially in the specimens which have been compared.

Megachile spokanensis n. sp.

♂. Head broad, eyes subparallel, pubescence entirely pale ochraceous, with no black hairs, nearly white on cheeks; clypeus closely and finely punctured, apex entire, completely covered with long dense pubescence; mandibles 3-dentate, the middle tooth small, outer margin rounded in the dorsal view, inferior tooth very large, occupying about two-thirds of the inferior margin of the mandible, the outer margin of the tooth long, the inner margin from the apex of the tooth to the base of the mandible much shorter, fringed with short yellowish pubescence, the apex being submedian with reference to the upper surface of the mandible; cheeks fairly broad, shining, finely punctured, the punctures close below, well separated above, lower angle with a rather small bare concavity, but with a robust tooth which is densely pubescent on the apex; vertex slightly rounded, closely and quite finely punctured, the punctures deep, pubescence long and erect, much thinner than on face; lateral ocelli about equally distant from eyes and edge of vertex; antennæ piceous above, somewhat paler below, rather short, the middle joints but slightly longer than broad, the apical one flattened and considerably dilated.

Thorax with pubescence entirely pale, ochraceous above fading to white below, quite long and dense on mesonotum, but not hiding the surface which is deeply and closely punctured throughout; scutellum closely and rather more finely punctured pleura also finely and closely punctured; mesosternum concave, shining, almost impunctate, with two anterior, broad, transversely flattened spines which are rounded apically, one behind each front coxa; propodeum finely punctate, with long, rather dense pale pubescence; tegulæ pale ferruginous, finely and rather closely punctured, pubescent anteriorly; wings subhyaline, clouded apically, nervures brownish, basal nervure slightly beyond transverse median, second recurrent nervure entering second submarginal cell nearer apex than first does to base.

Legs black to piceous, pubescence white, pale yellowish on four posterior tarsi beneath; front coxæ broad, bare, polished, with long, very broad and much flattened spatula-like spines, these incurved on inner apex, the apex narrowed and rounded, no red bristles on the coxæ, the spines long white pubescent behind; anterior femora very strongly keeled, the posterior face being very wide, dark, rather closely and finely punctate, but nearly bare of pubescence, upper face also dark, the antero-inferior face polished testaceous, ferruginous basally and along upper margin; outer face of front tibiæ dark, punctate and white pubescent, testaceous apically, the two inner faces polished ferruginous, the margin between them with a very thin fringe of long pale hairs directed posteriorly; front tarsi moderately dilated, pale yellow, the first joint very deeply hollowed out in front, the outer anterior margin with a short yellowish fringe, the inner one with a longer, more brownish fringe, the scale produced apically over the second joint, looking like the bow of a boat from without, the second joint narrowly produced apically, extending slightly beyond the apex of joint 1, the third joint but very slightly dilated, the fourth not at all, fifth joint somewhat reddened apically, tarsal fringe white, rather yellowish within and tipped with fuscous or black, this evident at the edge of the fringe without; middle and hind legs entirely dark, the middle tarsi not much modified, with basal joint densely white pubescent exteriorly and with a long white hair fringe, middle tibiæ with a bare impunctate area on outer face apically; hind tarsi rather peculiar, the basal joint short and thick, the following ones parallel-sided, hardly at all narrowed at base or widened apically, outer surface strongly convex, the inner surface flat; spurs pale testaceous; claws reddish testaceous basally, piceous apically, rather deeply cleft on the four anterior legs, not so deeply on the hind legs.

Abdomen quite broad, pubescence pale ochraceous, with no black hairs, segments 2-5 with dense apical fasciæ of somewhat more whitish pubescence, punctures fine and close on basal segments, more sparse on the apical segments, which are shining; segment 6 shining, rugoso-punctate above the carina, neither emarginate nor produced medially, but the margin coarsely irregularly and rather sharply denticulate, a median rather deep concavity on the lower surface of the segment, rather coarsely rugoso-punctate on either side of this, the apical margin with two large teeth, one on either side of the middle, these widely separated, sublateral in position, close to the inconspicuous angles which represent the true lateral teeth; segment 7 large and conspicuous, closely and finely punctured, rather evenly rounded, but the apex drawn out into a rather long slender spine; four ventral segments visible, these finely and closely punctured along their bases, the margins shining and impunctate, the fourth segment broadly membraneous and transparent on the apical margin. Length 11 mm.

Type: Male (Type No. 15717, Mus. Comp. Zool.); Little Spokane, W. T., Washington Territory July 26, 1882 (Samuel Henshaw, collector). Paratypes: 1 male, Camp Umatilla, W. T. (across the Columbia River from Umatilla, Ore.), June 26, 1882; 2 males, Alta Meadow, California, altitude 9000 ft., Aug. 23, 1917 (W. M. Wheeler, collector).

This is quite near *M. manifesta* Cress. but in the latter species there are no spines on the mesosternum, the apical spine of segment 7 is much longer, and the hind tarsi are more nearly normal. The inferior mandibular teeth, the front tarsi, and the carina of segment 6 are almost exactly alike in the two species. It is quite possible that this is the male of *M. wheeleri*, since two of these males were caught in the type locality of that species.

Megachile pseudonigra n. sp.

♀. Head broad, eyes parallel, pubescence fuscous, hardly black; supraclypeal plate finely punctured, somewhat sparsely so in center; clypeus very finely and closely punctured above, sparsely and more coarsely so on apical two-thirds, apex entire, with a raised or thickened impunctate edge; mandibles broad, black, obscurely reddish apically, with a very few scattered punctures above, doubly punctate on outer face at base, distinctly 4-dentate, the two apical teeth truncate, the third and fourth acute, a bevelled cutting edge between the latter; cheeks fairly broad, closely punctured above and below, shining above; vertex slightly rounded, punctures close medially, rather widely separated laterally; lateral ocelli about equally distant from eyes and edge of vertex; front below ocelli densely and finely punctured; antennæ black above, obscurely reddish below, middle joints but slightly longer than broad.

Thorax with fuscous pubescence, apparently blacker on surface of mesonotum (specimen somewhat rubbed); mesonotum sparsely punctate medially, closely so laterally and behind, the surface finely tessellated; scutellum closely and finely punctate, and the pleura very finely and closely punctate above, more coarsely so below; propodeum with numerous fine indistinct punctures, tessellate, the basal triangle tessellate or granular; tegulæ bronze-piceous, minutely punctured; wings subhyaline, faintly clouded apically, nervures brownish-testaceous, basal nervure beyond transverse median, second recurrent nervure entering second submarginal cell nearer apex than the first does to base; legs black, pubescence fuscous, tinged with red beneath tarsi and on middle metatarsi without, black on the outer faces of the tibiæ, middle and hind metatarsi fully as broad as their tibiæ; spurs yellowish-brown; claws reddish-testaceous basally, darker apically, with indistinct basal teeth.

Abdomen cordate-ovoid, shining, finely punctate, closely so on basal segments, sparsely so on the apical ones except the sixth, pubescence black, entirely fuscous on segment 1, and segments 2-5 with inconspicuous apical fuscous fasciæ; segment 6 very slightly, if at all, concave at sides in the dorsal view, straight in profile, shining, finely and rather closely punctured, with subappressed fuscous pubescence and numerous erect black hairs; scopa fuscous, shorter and deeper black on segment 6. Length 10.5 mm.

Type: Female (Type No. 15718, Mus. Comp. Zool.); Umatilla, Oregon, June 24, 1882 (Samuel Henshaw, collector).

This would appear to be near *M. vandykei* Ckll., but in that species the pubescence is entirely black, and the clypeus is described as being "densely rugoso-punctate, with a polished shining spot at middle of upper edge, and a median band in which the surface is shining between the punctures, lower margin thickened, slightly emarginate in middle." The clypeus in this species does not answer to that description at all, and the pubescence is fuscous rather than black, with definite though inconspicuous fuscous fasciæ. It may be possible that this is a melanistic form of some light haired species.

Megachile mendica snowi n. subsp.

♀. Head with eyes slightly converging below; supraclypeal plate shining, sparsely punctate medially; clypeus closely and rather coarsely punctured in general, but with the punctures well separated in the center, apical margin entire, the edge thickened and slightly grooved; mandibles black, broad, with a few scattered punctures above, 4-dentate, but the margin between the two inner teeth with a slight angular protuberance, approaching the 5-dentate condition; cheeks quite narrow and quite closely punctured, with short, rather dense, white pubescence; vertex very slightly rounded, the punctures distinct and well separated, surface shining between the punctures, pubescence black, erect, and quite long; lateral ocelli about equally distant from eyes and edge of vertex; front below ocelli densely punctate; antennæ piceous below, somewhat darker above, length of middle joints about one and a half times their breadth; pubescence of face below anterior ocellus white, slightly mixed with black above antennæ, very thin on clypeus.

Thorax with pubescence largely white, but mostly black on mesonotum posteriorly, mixed with white in the middle, and largely replaced by white anteriorly, with some shorter whitish pubescence in the scutello-mesothoracic suture, but this not conspicuous; mesonotum with punctures quite close, more or less separated in center, the surface between them tessellate; scutellum closely punctured, the punctures separated medially, with long black hairs and shorter, softer, white pubescence; pleura with punctures fine and crowded above, larger and distinctly separated below; propodeum tessellate, the punctures very fine and indistinct, basal triangle tessellate below, granular or subrugose above; tegulæ piceous, obscurely testaceous anteriorly, with fine shallow punctures; wings subhyaline, faintly clouded apically, nervures yellowish-ferruginous, second recurrent nervure entering second submarginal cell very near the apex, the first rather far from base; legs piceous to dark red, white pubescent, yellow on tarsi beneath; middle tarsi slightly narrower than the tibiæ, densely pale pubescent without, the following joints but slightly narrowed; hind metatarsi slightly narrower than the tibiæ; spurs pale yellow; claws with distinct basal teeth, darker apically, pale basally.

Abdomen cordate, short black pubescent, but the pubescence entirely white on segments 1 and 2, and segments 2-5 with white apical fasciæ, these entire but rather narrow; segment 6 slightly concave at sides viewed from above, the apex rather evenly rounded, slightly concave in profile also, but so slightly as to be hardly noticeable, with no erect hairs visible in profile, finely and closely punctured, pubescence appressed, yellowish-white, more or less reddened medially to apex, hiding the surface on apical half, thin basally, with scattered inconspicuous erect black hairs at sides; scopa entirely yellow, but with a few lateral dark hairs on segment 6. Length 13 mm.

Type: Female (Type No. 15719, Mus. Comp. Zool.); Oak Creek Canyon, Arizona, 6000 ft. altitude, Aug. (F. R. Snow, collector). Paratype: 1 female, topotypical.

In *mendica* s. str. the pubescence of segment 2 is black on the disc, and that on segment 6 is entirely dark, while in this form the pubescence of segment 2 is pale, and segment 6 is covered over most of its surface with whitish appressed pubescence. Otherwise the two forms are very similar.

Megachile laurita n. sp.

♀. Head broad, eyes subparallel; supraclypeal plate closely and finely punctured, with some shining impunctate spaces medially; clypeus rather coarsely punctured, the punctures more separate medially, crowded above and at sides, apex thickened medially, the upper margin slightly but broadly produced medially; mandibles broad, reddish apically, coarsely striately punctate above, very closely and finely punctate on outer face at base, striately punctate medially, 3-dentate, the apical tooth bluntly rounded (apparently worn), the subapical tooth subacute, the cutting edge long, with an upper and an under carinate margin, but not much hollowed out between the two, the upper one broadly incurved, the under one more nearly straight; cheeks broad, closely punctured above, sparsely so below where the surface is finely tessellated; vertex slightly rounded, punctures mostly well separated, very fine and close between ocelli; lateral ocelli about equally distant from eyes and edge of vertex; front below ocelli densely punctured; antennæ dark above, reddish below, somewhat flattened, short, the middle joints fully as broad as long; pubescence fuscous on cheeks and vertex, some pale hairs intermixed on the vertex, and occiput largely fringed with pale hairs, pubescence of front and of inner orbits largely whitish with some black hairs intermixed, pubescence entirely black on clypeus and on orbits below.

Thorax with pubescence whitish above, at sides, and behind, fuscous on sternum and on pleura below; mesonotum with punctures well separated, almost sparse medially, close laterally and behind; scutellum closely punctured except for an indefinite median longitudinal impunctate line; pleura with punctures close and fine above, rather coarse and well separated below; propodeum with scattered, fine, indistinct punctures laterally, basal triangle finely granular; tegulæ somewhat bronze colored, varying in different reflections, closely punctate anteriorly and posteriorly,sparsely so medially; wings subhyaline, faintly dusky apically, nervures brownish, basal nervure beyond transverse median, second recurrent nervure entering second submarginal cell nearer apex than the first does to base; legs piceous, with fuscous pubescence, purplish ferruginous on tarsi beneath; apical projections of front and middle tibiæ piceous, of the same general color as the legs, quite prominent; spurs testaceous; claws testaceous basally, ferruginous to piceous apically, with no basal teeth.

Abdomen ovoid, shining, punctures very sparse and fine apically, closer basally, pubescence black, white on basal segment and slightly so at base of second; segments 1-5 narrowly white fasciate, the fasciæ somewhat thinner medially but conspicuous because of the otherwise black pubescence; segment 6 short and broad, shining, sparsely punctate, but very slightly concave at the sides when viewed from above, and straight in profile, pubescence entirely black and erect, subappressed apically; scopa entirely black. Length 11.5 mm.

Type: Female (Type No. 15711, Mus. Comp. Zool.); Umatilla, Oregon, June 24, 1882 (Samuel Henshaw, collector).

Megachile laurita semilaurita n. subsp.

♀. Very close to the preceeding species, and answers to the description except for the following differences:

Much larger (14 mm.); mandibles but slightly reddish above;

clypeus thickened apically, but hardly produced medially, the thickened edge grooved; cheeks sparsely punctate below and polished between the punctures, not tessellate, the pubescence mostly white, with short black pubescence around the posterior orbits; tegulæ rather closely punctate throughout; pubescence on outer faces of tibiæ pale; abdominal fasciæ broader, more dense and more conspicuous.

Type: Female (Type No. 15712, Mus. Comp. Zool.); Utah

Megachle laurita sublaurita n. subsp.

♀. Very close to the preceeding two forms from which it differs only in the following characters:

Smaller than *laurita* (10 mm.); clypeus with a broad, rather prominent median produced area on apical margin, which is shining and impunctate; lateral ocelli considerably nearer the edge of the vertex than to the nearest eye (distance subequal in the two preceeding forms); cheeks with pubescence largely white, black around posterior orbits, punctures on lower cheeks shallow, not widely separated, somewhat shining, but hardly tessellate; some black hairs in center of the mesonotum (apparently entirely white in the two preceeding forms, but *laurita* is somewhat rubbed); tegulæ rather sparsely punctured medially; pubescence of hind tibiæ more whitish, of the front and middle tibiæ rather ochraceous; fasciæ broad dense and conspicuous.

Type: Female (Type No. 15713, Mus. Comp. Zool.); Utah.

These three forms closely resemble *M. anogræ* Ckll. in form and structure but are totally different in color of pubescence, the entirely black scopa at once distinguishing them. They were at first taken to be the same species but the disparity in size made this seem somewhat doubtful, and there seems to be enough difference other than size to separate them at least into subspecies. The males would possibly show even greater differences. The study of additional material may show whether or not these should be separated as distinct species. The following key will serve to distinguish them:

1. Hair of cheeks entirely blackish. . . . . *laurita*
   Hair of cheeks white in part. . . . . .2.

2. Larger (14 mm.); apex of clypeus thickened and shallowly grooved. . . . . *semilaurita*
Smaller (10 mm.); apex of clypeus with a broad median produced area which is shining and impunctate. *sublaurita*

Megachiloides umatillensis n. sp.

♂ Head broader than long, eyes somewhat converging below, densely covered with ochraceous pubescence in front, of the same general color but thinner above, short, thin and white on the cheeks, somewhat longer below; clypeus closely punctured, apex beneath beard entire; mandibles obscurely reddish apically, strongly 3-dentate, rather thickly covered with whitish-ochraceous pubescence, inferior tooth subbasal, slender, acute, the pointed apex curved slightly back; cheeks broad, only slightly narrowed above, very closely and uniformly punctate throughout, the lower angle with a very slight hollow and tooth, these largely obscured by the pubescence; vertex very slightly rounded, punctures close between ocelli and along the posterior margin, rather widely separated between eyes and ocelli; lateral ocelli about equally distant from eyes and edge of vertex; antennæ black above, piceous below, the middle joints hardly twice as long as wide, the terminal joint longer, somewhat flattened but not dilated; tongue extremely long, the second joint of the labial palpus almost three times as long as the first.

Thorax with entirely light pubescence, ochraceous above fading to whitish below; surface of mesonotum almost hidden by the pubescence, punctures fine and indistinct, the surface between the punctures coarsely tessellate or granulate; scutellum densely pubescent, punctures close and fine; pleura very closely punctate, with long dense pubescence; propodeum largely bare laterally, with long dense pubescence behind, punctures fine any indistinct; tegulæ piceous, densely pubescent anteriorly, closely and minutely punctate; wings subhyaline, faintly clouded apically, nervures testaceous, basal nervure beyond transverse median, second recurrent nervure entering the second submarginal cell very near the apex, the first rather distant from the base.

Legs with entirely pale pubescence, yellowish on middle and hind tarsi beneath; front coxæ dark, with stout spines, the apices of which are rounded and with a small patch of golden pubescence, a patch of reddish bristles at the base of the spines on the outer side; front femora somewhat keeled apically, posterior face very closely and finely punctured along the edge of the keel, densely pubescent, that and the upper face reddish-piceous, antero-inferior face polished testaceous; front tibiæ dark on outer face, testaceous apically, punctate and white pubescent, the other two faces reddish-testaceous, the ridge between them with some short dense pubescence and a long, thin, posteriorly directed fringe of white hair; front tarsi dilated but not widely so, ivory-yellow, dark along posterior border of the first three joints, this more noticeable beneath, the first joint hollowed out in front and both anterior margins fringed with short yellowish pubescence, the second and third joints less widely dilated, the fourth not at all, the fifth joint yellow basally, ferruginous apically, tarsal fringe fairly long, white exteriorly, dark brown beneath; middle and hind femora considerably swollen, the mid tarsi not much modified, but with a white posterior fringe and densely white pubescent without on the first joint; spurs reddish-testaceous, those on the front legs somewhat paler; claws reddish-testaceous basally, ferruginous apically, deeply cleft, without basal teeth.

Abdomen broad, gradually narrowed apically, pubescence entirely ochraceous except for some short black hairs on disc of segment 5, segments 1-5 with dense broad whitish apical fasciæ, that on segment 1 narrow and inconspicuous; punctures very fine and close on basal segment, more coarse and well separated on apical segments; segment 5 with a median longitudinal ridge at base; segment 6 very closely punctured above carina, broadly triangular, and somewhat downcurved in profile, very coarsely punctured beneath and with a ventral longitudinal furrow, around and in which the punctures are very fine and close, apical margin of the segment conspicuously carinate on either side of the middle, each carina narrowing to the lateral minute teeth, abrupt on the inner side; segment 7 quite conspicuous, very closely and finely punctured, somewhat excavated above, triangularly pointed apically; four ventral segments visible, these shining and sparsely punctate, the fourth with a broad membranous margin. Length 13 mm.

♀. Head broad, eyes subparallel, pubescence entirely ochraceous except for some short black hairs on the vertex, intermixed with long pale pubescence, that on the cheeks whitish; supraclypeal plate sparsely punctured medially, closely so laterally; clypeus with punctures rather sparse apically, closer and finer laterally and above, apical margin entire, smooth and impunctate; mandibles bright ferruginous apically, upper face rather coarsely striately punctate, outer face at base closely and finely punctate, polished and impunctate in region of the teeth, 4-dentate, the apical tooth very long and acute, the second tooth shorter but acute, the third minute, the upper margin of the mandible strongly and rather broadly incurved between the two inner teeth, the lower margin or cutting edge nearly straight; cheeks fairly broad, closely and finely punctate above and along the posterior orbits, more coarsely and sparsely punctate below, rather shining; vertex almost flat, the punctures close medially, well separated laterally, becoming close again on cheeks; lateral ocelli about equally distant from eyes and edge of vertex; antennæ piceous above, more reddish below, middle joints slightly longer than wide; tongue as in the male, the second joint of the labial palpus being fully three times the length of the first.

Thorax with pubescence entirely pale, ochraceous above fading to whitish below; mesonotum dull, tessellate, the punctures small, separated medially, close elsewhere; scutellum closely and finely punctured; pleura closely punctured, the punctures fine above, coarser below; propodeum rather bare and shining laterally, with long dense pubescence posteriorly where it has fine and rather close indistinct punctures, basal triangle granular; tegulæ ferruginous, closely and minutely punctate, densely pubescent anteriorly and rather thinly covered with short pubescence elsewhere; wings subhyaline, faintly clouded apically, nervures brownish-testaceous, basal nervure beyond transverse median, second recurrent nervure entering second submarginal cell almost at extreme apex, the first being rather distant from the base; legs piceous, pubescence whitish, reddish-brown on tarsi beneath, the middle and hind tarsi not greatly broadened, the middle tarsi densely whitish pubescent without; spurs reddish-testaceous; claws testaceous basally, ferruginous apically, without distinct basal teeth.

Abdomen broad, sides subparallel, rather suddenly narrowed apically, pubescence ochraceous except for some short inconspicuous black pubescence on discs of segments 4 and 5; segments 1-5 with entire, dense, whitish apical fasciæ, broad on apical segments, narrowed medially on the basal segments; punctures fine and close in general, well separated on discs of segments 4 and 5; segment 6 slightly concave at sides viewed from above, straight in profile, closely punctured, pubescence entirely light, largely subappressed, with scattered erect hairs basally; scopa white with a faint yellowish tinge, entirely black and short on segment 6. Length 13 mm.

Type: Male (Type No. 15714, Mus. Comp. Zool.); Camp Umatilla, W. T., Washington Territory June 26, 1882. Allotype; topotypical. Paratypes: 3 males, topotypical; 1 male, Little Spokane, W. T., July 26, 1882 (Samuel Henshaw, collector).

This interesting species is quite similar to the type species of the genus, *M. œnotheræ* Mitch., but is considerably larger and the pubescence is almost entirely ochraceous. In *œnotheræ* the pubescence is white, with a patch of black hair on the mesonotum and the length is 9-10 mm. *M. œnotheræ* ♀ was described as being 3-dentate, with a notch on the inner side of the second tooth. In *umatillensis* this notch is represented by a distinct though small tooth, and the apical tooth is much longer than in *œnotheræ*. In the male the front tarsi are more dilated and hollowed out in this species and are distinctly pale in color, whereas in *œnotheræ* they are but slightly dilated and hollowed out and are black in part.

NOTES ON THE NESTING HABITS OF SOME OF THE LESS COMMON NEW ENGLAND BUMBLE-BEES.[1]

By O. E. Plath,
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In the fall of 1922, I published a short paper (1922b) on the nesting habits of several of our North American bumblebees. The data recorded were obtained from the study of about 50 nests, most of which were taken in the vicinity of Boston during the summers of 1921 and 1922. Since that time, this number has been increased to over 250 nests, of which more than 200 were examined. Several of these nests belonged to some of our less common New England species, about whose nesting habits—in most cases—comparatively little is known. Among the data presented in the following pages I have included some observations which Dr. Joseph Bequaert and Professor O. A. Stevens were kind enough to communicate to me. Unless otherwise stated, the nests referred to in this paper were taken within the city limits of Boston, either on, or near the grounds of the Arnold Arboretum, or the Bussey Institution.

Terrestris Group.

1. *Bremus terricola* Kirby.

Practically nothing was known concerning the nesting habits of this species before the appearance of my first paper (1922 b) which contained data concerning two nests, one taken in the Arnold Arboretum, and the other at Washington, Me. Since then I have been so fortunate as to discover 16 additional nests of this species. One of these was found near the skeleton of a dead rat in a nest which had been built—possibly by this same rat—among some old straw in a box left in the basement of an abandoned greenhouse. The other fifteen were subterranean, and of these, eleven were dug up. These were situated from 6 to

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 280.

18 inches below the surface of the ground, and had entrance tunnels ranging from about 6 inches to 3 ft. in length. Most of the colonies did not average over 50 individuals; four, however were considerably larger; one, taken on July 12, 1923, consisting of the old queen, about 50 young queens, and over 150 workers, besides a large number of cocoons. Interspersed with the latter were about a dozen pollen cylinders, similar to those frequently found in the nests of *Bremus affinis.* These cylinders contained more than a quarter of a pound of pollen.

In an earlier paper (1922a) attention was called to the fact that *Psithyrus laboriosus* is parasitic on *Bremus vagans,* while *Psithyrus ashtoni* is a parasite of *Bremus affinis.* In a letter, dated March 24, 1923, Professor O. A. Stevens, of North Dakota Agricultural College, makes the following comment on the above statement: "I have supposed that *Ps. laboriosus* must be parasitic on *B. vagans* here. Both species seem especially characteristic of the wooded area along the river. *Ps. ashtoni* is even more common, but *B. affinis* is rare, so some other host must be sought. I suspect *B. terricola,* but have no direct evidence as yet." As in the case of Dr. Frison's prediction in regard to the host of *Psithyrus laboriosus* (cf. 1922a, p. 29), I am pleased to be able to confirm Professor Stevens' surmise. On August 8, 1924, I took a nest of *Bremus terricola* which contained 3 workers, 3 young females of *Psithyrus ashtoni,* and several males and females of the latter species which had died in their cocoons before hatching. This is the only one of the fourteen nests of *Bremus terricola* in which young of *Psithyrus ashtoni* were reared, while 11 of the 36 *Bremus affinis* nests which have been examined were parasitized by this Psithyrus.

In the summer of 1922, I took two nests of *Bremus affinis,* one of which 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.* The other contained (1) 23 workers of *Bremus affinis*; (2) 9 workers of *Bremus affinis* var. *novæ-angliæ*; and (3) 1 worker of *Bremus terricola.* The heterogeneous nature of these two colonies led me to surmise that *Bremus affinis* var. *novæ-angliæ* might be a hybrid between *Bremus affinis* and *Bremus terricola,* these two species being closely related. Since then, however, four more mixed colonies of these two species have been taken, two of which contained a much greater proportion of *terricola* workers than the two nests found in 1922. The first of these four mixed colonies was taken July 3, 1923. It consisted of the old queen and 6 workers of *Bremus affinis*, and 1 worker of *Bremus terricola*. The second was taken on August 9, of the same year, and contained the old queen and about 75 workers of *Bremus affinis*, and 1 worker of *Bremus terricola*. The remaining two were both discovered in 1926, one being taken July 5, and the other July 8. The first of these consisted of (1) the old queen and 29 workers of *Bremus affinis*, (2) 7 workers of *Bremus terricola*, and (3) a female of *Psithyrus ashtoni* and a considerable quantity of Psithyrus brood in various stages of development. The other consisted of 15 workers of *Bremus affinis*, 3 of *Bremus terricola*, and some brood of *Psithyrus ashtoni* which hatched later. No additional workers of *Bremus terricola* hatched from any of these six nests, the first four producing only young of *Bremus affinis* and, the last two nothing but *Psithyrus ashtoni*.

As was suggested recently in a joint paper with Dr. Bequaert (1925), the difference in coloration between the typical form of *Bremus affinis* and its variety *novæ-angliæ* is probably due to environment rather than hybridism. The presence of the workers of *Bremus terricola* in 6 of the 36 *affinis* nests is easily explained by "natural requeening," a subject which I discussed in a recent paper (1924), the only difference being that in this case, as with *Bremus lucorum* and *Bremus terrestris* in Europe (cf. Sladen 1912), requeening is accomplished by a closely related species.

To these data may be added some observations of Professor O. A. Stevens, who informs me that he found a populous nest of *Bremus terricola* under the floor of a shed, the bees entering by a hole in the roof.

Pratorum Group.

I. *Bremus perplexus* Cresson.

What is known about the nesting habits of *Bremus perplexus* we owe to Franklin (1912-13) who took two nests in Vermont, early in August. Both were situated in the walls of houses, and were made of wool, one containing 5 queens, 1 male, and 9 workers, and the other 8 queens and 33 workers. I was fortunate enough to discover two nests of this rather rare New England species during the summer of 1925. One of these was taken on July 3, under a large root near the base of a tree, the nest being about a foot below the surface of the ground, with a tunnel 2 ft. long. In it were found 22 workers, 1 male, and some brood, from which additional males hatched later. The second nest was taken on July 23. It was situated 6 inches below the surface, and, like the first, had a tunnel about 2 ft. long. It contained 9 young queens, two of which had recently died, 1 dead male and 357 empty cocoons, showing that this must have been a prosperous colony earlier in the year.

II. *Bremus ternarius* Say.

Very little is known concerning the nesting habits of this species. In 1863 Putnam (1864) took a nest at Bridport, Vt., which was situated either under an old stump or under the clapboards of a house.

Early in September, 1923, Professor C. T. Brues called my attention to the fact that a nest of *Bremus ternarius* had been discovered on his summer estate near Petersham, Mass. Through the kindness of Professor and Mrs. Brues it was possible for me —after much digging—to secure the nest of this handsome but vicious species on September 15. The nest was situated among some trees near a red clover field, and was about 2 ft. below the surface of the ground, with a tunnel 6 ft. long. This colony consisted of 23 young queens, 16 males, over 100 workers, and a large quantity of brood, with more than 75 young queens still in their cocoons. The colony was transferred to the Bussey grounds where it prospered for over a month. Probably as a result of this transfer, *Bremus ternarius*, which is rarely found in the vicinity of Boston, was fairly common in the Arnold Arboretum in 1924 and 1925 from early April to October.

Fraternus Group.

I. *Bremus separatus* Cresson.

The only thing known concerning the nesting habits of this species is Putnam's (1864) statement that *Bremus separatus* builds its nests "under old stumps and in other situations similar to those in which the nests of *B. fervidus* are found."

I discovered two nests of this species on the surface of a grassy bank on Moss Hill, adjoining the Arnold Arboretum. One of these was found on July 26, 1923, after having been destroyed, probably by a skunk. Among the scattered debris were found three living workers, and the dead bodies of the old queen, two young queens and a fourth worker. The marauder had also left behind over 90 empty cocoons, to which were attached two egg cells, containing 2 and 5 eggs respectively.

The second nest was taken on June 23, 1924. It contained the queen, ten cocoons, a considerable number of larvæ and eggs, and two honey-pots with a common wall (cf. fig. 1). Two

Fig. 1. Double honey-pot of *Bremus separatus* Cresson.
Fig. 2. Single honey-pot of *Bremus impatiens* Cresson.

other peculiarities of the double honey pot found in this nest were, (1) that its walls were about twice as thick as those of the single pot (cf. fig. 2) usually found in incipient nests of *Bremus impatiens* and *Bremus vagans*; and (2) that it was completely closed at the time the nest was taken, whereas the other two species mentioned apparently never close their honey-pot.[2] The nest was transferred to one of the windows of the Bussey Dormitory, where other observations were made on this rare species during the remainder of the summer.

Dr. Joseph Bequaert has been kind enough to furnish me with data concerning a nest of this species which he took on July 12, 1918, at Orient, Long Island. The nest was situated in

[2]Since writing the above, I have discovered the following note by the late F. W. L. Sladen (cf. Root, 1923, p. 172): "The queen's honey-pot in a nest of *B. fervidus* examined at Ottawa, Canada in 1915, was found to be completely closed, possibly a protection of nature, preventing ants, etc., from discovering the honey when the queen is absent from the nest."

a log on the seashore and, in addition to the comb, contained the old queen and about a dozen workers.

Dumoucheli Group.

I. *Bremus americanorum* Fabricius.[3]

Bremus americanorum is one of the most common bumblebees in the central and southern plains of the Middle West, and hence we probably know more about its nesting habits than those of any other of our North American species, chiefly through the work of Franklin (1912-13), Howard (1918), Frison (1916, 1917, 1918, 1921), and Rau (1922, 1924). However, since *Bremus americanorum* is rare, if not completely absent, in a large part of New England, it seems desirable to record the taking of a nest of this species in the Arnold Arboretum on July 30, 1923.

The nest was discovered in an open field and was about 6 inches below the surface of the ground with a tunnel more than a foot long. In it were found, the old queen, 37 workers, and a considerable quantity of brood. The queen of this colony had only one antenna, but this apparently did not interfere greatly with her duties, since she was seen to oviposit on several occasions during the month of August.

According to Frison (1917, 1918), Ranslow (cf. Howard, 1918), and Rau (1924), *Bremus americanorum* is rather vicious, a fact which was painfully impressed upon several of my friends shortly after the colony was transferred to the grounds of the Bussey Institution. In fact it was necessary to remove it to another place, since the workers attacked anyone venturing within twenty-five feet of the nest.

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[3]Dr. Joseph Bequaert and the writer have recently studied De Geer's description and figure of *Bremus pennsylvanicus*, and, like Frison (23), have come to the conclusion that it is better to use the name *americanorum* until the type specimen of De Geer is located.

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THE REACTION OF DATANA LARVÆ TO SOUNDS.

By Cyril E. Abbott,

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A considerable amount of discussion has been devoted to the possibility of the presence of an auditory sense in insects. Unfortunately, much of this discussion has been purely theoretical. At one time it was generally supposed that all or most insects could hear. This argument was based upon two facts: the possession, by insects, of sensory organs which have a structure indicating a possible auditory function, and the insect production of sounds. For what other purpose, it was argued, can stridulating organs be used, if not for that of impressing other insects?

Fabre fired two mortars in close proximity to a number of Cicadæ without affecting their songs. He concludes, "If any one were to tell me that the Cicadæ strum on their noisy instruments without giving a thought to the sound produced and for the sheer pleasure of feeling themselves alive, just as we rub our hands in a moment of satisfaction, I should not be greatly shocked." Lutz (1926) is of the same opinion. He writes: "When we can explain the purpose of a man's snoring or the rattling of a Ford car, we may know why this beetle grub rasps. Having slept with a man that snored and having driven a Ford, I believe that the sounds in question are unintentional and quite incidental to the structure of the man and of the machine. May not the same be true of the beetle grub?"

In spite of such incomplete considerations of the subject, there is evidence that certain insects have an auditary sense.

Radl (1905), arguing in part from structure, and in part from experiment, concludes that insects have auditory powers of a primitive and limited kind.

In 1914 Turner and Shwarz tested the auditory powers of various Catacola moths, and found that from 80 to 100 percent of the insects gave positive responses to notes of the pitches C,4 A,4 and B4 from a Galton whistle. In the same year Turner conducted a number of similar experiments, using the adults of the large Saturnidæ as subjects. A majority of the insects gave positive responses to a wide range of notes sounded on various wind instruments.

In 1925, Kroning tested the auditory sense of bees with a siren. His extensive experiments lead him to the conclusion that, "die Bienen konnten keine Tone wahrend des Fliegens horen, wohl aber in Marsch oder wahrend des Sitzens."

Minnich (1925) brings forth positive evidence in support of the presence of an auditory sense in the larvæ of Vanessa antiopa. His experiments were extensive and complete. He found that these larvæ, when stimulated by sounds, quickly elevated the anterior third of the body. Minnich was very careful to eliminate other possible sources of stimulation. The larvæ of all instars responded; even headless individuals, and parts of the body were capable of response. Minnich also removed the spines; in other cases he loaded them with water droplets or dry flour. Larvæ so treated failed to respond to sounds. The larvæ were tested with a wide range of notes. Mature larvæ responded to notes between C '' (1024 vibrations) and C3 (32 vibrations.)

Original Experiments

The experiments of Minnich suggested to me the possibility of similar reactions in Datana larvæ. These insects are the caterpillars of certain moths. They feed in groups, and give very definite responses to various external stimuli. Air currents, sudden jars, and certain sounds cause each larva to elevate the anterior and posterior thirds of its body; contact with the substratum is maintained by means of the four middle pairs of prolegs. If the stimuli are continued, the insects may throw their heads from side to side.

The larvæ of *D. perspicua* feed on sumac. Just prior to metamorphosis they measure about two inches in length by one-fourth of an inch in width. Their general color is black, but they are marked by several longitudinal yellow stripes. The body is covered with long grayish hairs, so sparsely that the surface of the body is easily visible, but plentiful enough to constitute a marked anatomical feature. The larvæ of *D. ministra* feed on various species of Cratægus. They resemble the larvæ of *D. perspicua* very closely; the most striking difference is due to the orange color of the prothoracic segment. The responses of the two species are similar, but those of *D. ministra* are not as marked as those of D. perspicua.

Preliminary tests demonstrated that these larvæ give marked responses to only two notes: middle C (512 vibrations) and F sharp above middle C (728 vibrations). The responses were very distinct. The instrument used in making the tests was a closed pipe with a movable plunger. Eleven larvæ were used in each test. The number was purely arbitrary. They were taken from a large cage in which they were kept, and placed on a vertical stick. The tests were made after the caterpillars started to creep. In every case, efforts were made to protect the insects from air blasts from the pipe.

In the critical series of tests, normal larvæ of *D. perspicua* were used only as controls, but a complete set of tests was made with normal larvæ of *D. ministra*.

Attention was chiefly directed toward the rôle of the hairs in the detection of sounds. The methods employed were similar to those used by Minnich in 1925; the hairs were "loaded" with water or shellac. The liquids were sprayed on to the hairs with a nasal "atomizer." As the water had a tendency to run off, it had to be frequently renewed. The shellac was the commercial orange product diluted with an equal volume of ethyl alcohol. Its value lay in its stability; the alcohol soon evaporated, leaving the droplets of shellac fixed on the hairs. These methods of treatment did not seriously injure nor inconvenience the larvæ. Some specimens of *D. perspicua* were bathed with a 2 percent solution of procain. Although this inhibited responses, it was more or less injurious, and several of the insects so treated subsequently died.

Ten trials were made with each group of larvæ; five for each set of vibrations. Four specimens of *D. perspicua* were tested after removing the hairs from their bodies by clipping. Normal insects were also tested with a piano and a mandolin. The results of the experiments are tabulated as follows:

Table I *Datana perspicua*

Vibration	Water	Shellac	Procain
512	—	—	—
728	slight	—	slight
512	—	—	—
728	—	—	—
512	—	—	—
728	—	—	—
512	—	—	—
728	—	—	—
512	—	—	—
728	—	slight	—
Control	+	+	+

Table II *Datana ministra.*

Vibration	Normal	Water	Shellac
512	+	—	—
728	+	—	—
512	+	—	—
728	+	—	—
512	+	—	—
728	+	—	—
512	+	—	—
728	+	—	—
512	+	—	—
728	+	—	—

Discussion.

The results of these experiments are startling. In only three were even slight responses elicited after treatment. That the responses are actually due to the sound is evident from the following facts: the response of normal larvæ is given when the insects are protected from all air currents, it can be elicited when the larvæ are several feet away from the source of the sound, it was given to any one of three different musical instruments, and finally it was elicited when all possibility of vibrations of the substratum were eliminated.

These facts are supported by the results obtained when the hairs were loaded or removed, or when the body surface was anæsthitized.

What is the significance of this peculiar sense? The larvæ give marked responses to only two notes, which, even if they were frequent under natural conditions (which they certainly are not), could hardly be considered of importance to the caterpillars. They are, therefore, not adaptive. It is probable that we are here in the presence of a "secondary" sense, developed as a result of the adaptation of certain organs to more significant stimuli.

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ANOTHER VAGRANT GRASSHOPPER.

By Albert P. Morse,
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On December 17, 1926, a curious green, wingless, grasshopper-like creature was brought to me alive from Tassinari's fruit store, Salem, the same place where other wanderers have been found (see Psyche, April, 1926, p. 53). This one proved to be Davis' Short-winged Conehead, *Belocephalus davisi* S. D. H. ♀ undoubtedly brought in with garden truck from Florida.

The European House-Cricket, *Gryllus domesticus* L., has been found in considerable numbers in a schoolhouse at Salem this winter, making its presence known by its loud and persistent singing in the basement.

THE BOWDITCH COLLECTION OF CHRYSOMELIDÆ.

The Museum of Comparative Zoology has receivied from the family of the late Mr. F. C. Bowditch his very extensive collection of Coleoptera. The main part is an arranged collection of the Chrysomelidæ of the world in double boxes equal to more than five hundred Schmitt boxes. This contains between 2500 and 3000 types, mostly of Martin Jacoby. Mr. Bowditch had purchased Mr. Jacoby's first collection (including a set of the Biologia), part of the second Jacoby collection, the 70,000 specimens of the Tring Museum (containing some Jacoby types) and several smaller collections. In recent years he had bought from dealers and collectors in all parts of the world. There is about an equal amount of duplicate Chrysomelidæ, partly named, and containing the Hispinæ and the Cassidinæ which are not included in the general collection. There is also a large collection of North and South American Coleoptera based on the famous G. D. Smith collection. The material is all in excellent condition. During his life Mr. Bowditch presented to the Museum tens of thousands of duplicate Chrysomelidæ, partly named, the whole doubtless making the greatest mass of material in this family ever accumulated anywhere.

N. Banks.

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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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A STUDY OF THE MALE ABDOMINAL APPENDAGES OF THE NAIS-GROUP OF APANTESIS WALKER. (LEPIDOPTERA ARCTIIDÆ)

By Elmer T. Learned, M. D.
Fall River, Mass.

The genus Apantesis is composed of moths well known for their variability, a character especially marked in the four forms: *nais* Drury, *vittata* Fabricius, *radians* Walker, and *phalerata* Harris. The close relationship of these moths suggested that it would be interesting to examine the male abdominal appendages in a series, to see to what extent these organs vary, and whether constant structural differences exist between the forms as separated by superficial characters. Before considering the genitalia I propose to summarize briefly what is now known about these moths.

The range of variation in these insects is so wide that it is impossible to give a description which will always serve to distinguish one form from all its allies. Each tends toward a certain characteristic type, however, and in spite of the similarity in markings the moths are readily separable into the four forms. With a knowledge of the habitus of each form and appreciation of the factors which are apt to vary it in one or another direction, only old or worn specimens and occasional extreme variations should cause confusion.

Nais includes specimens predominantly yellow in color, comparatively robust thorax with rough vestiture, the collar most often immaculate, the pattern of the forewings usually complete or nearly so, always with black costal edge; the hind wings sometimes tinged with red, the black spots discreet, rarely fused or absent.

In *vittata* the pattern of the fore-wings usually lacks the W mark, and the costa is pale. A character sometimes useful is a tendency to a more evenly rounded outer margin of the fore-wings, giving them a broad and stumpy appearance. The hind-wings are usually red, sometimes yellow, the black spots often fused. The dorsum of the abdomen may or may not be broadly black.

A brood of *vittata* which I reared recently thru two generations appears to be a mutation. All the moths of the first generation had a black costal margin on the fore-wing, instead of the pale one usual to *vittata*, and the male appendages showed a constant difference from the normal form thruout both generations.

Radians is closest to *phalerata* in appearance, but the pattern of the fore-wings is usually abbreviated as in *vittata*, with pale costa. The hind-wings are typically yellow tinged with red, exactly as in *phalerata*, and similarly the red may be entirely lacking, or may predominate. I include under *radians* the form *floridana* Cassino, and regard this name as a synonym. The female *floridana* does not differ from the form which has always been regarded as *radians*, and the male agrees with the description and figures of the male which Seifert first associated with *radians* by breeding.

Phalerata is the most protean of the four forms. While in most cases easily recognized, its variations may almost exactly resemble any of the other forms. The pattern of the fore-wings is usually complete, but is often more or less abbreviated and the costa may be either black or pale. The fore-wings tend to be comparatively narrow, particularly as compared to *vittata*, with the outer border more oblique with well marked apex. The hind-wings vary from the typical yellowish tinged with pink at the inner margin, to pale yellow or red. The abdomen is more frequently tinged with reddish on the sides than in the other forms.

There is a form of *phalerata*, apparently common in Florida, and which I also have from Alabama and Arkansas, which has the pattern of the fore-wings complete, and the hind-wings immaculate (except for black along the costa) and varying from the bright pinkish to pale yellow in color. This form is particularly mentioned because of its resemblance to both *nais* and *radians*.

The females of three of the four forms are even more similar than the males. *Nais* is distinguished from *vittata* by its black costal margin, while *vittata* and *radians* differ only in the extent of the markings of the fore-wing, and grade into each other. The female *phalerata* stands apart with a more complete pattern on the fore-wings and a broken border on secondaries. I find, moreover, a small but constant difference from the other three forms in the female genitalia.

Life histories of *nais* and *radians* have been published by Seifert, and of *phalerata* by Gibson. So far as I have been able to discover, no life history of *vittata* has been published; brief descriptions of the adult larva occur in papers by Dyar, and by Gibson. A few descriptions of larvæ were published by earlier writers, but are too generalized to be of much value, for the larvæ of this group are so similar that descriptions must be minute to be of use for comparisons. The larvæ are as variable as the moths, and in the same brood may vary in the presence or absence of a dorsal line or other marking, in their color, and in the color of the lateral setæ. Gibson could see no difference between the larvæ of *nais* and *phalerata*. Other descriptions, however, imply that the larvæ of all the forms differ. They are probably not yet well enough known to permit definite conclusions in regard to them.

The similarity of the moths of the *nais*-group has caused some difference of opinion as to whether they are all forms of one species or four distinct species. I have found nothing in the literature to show that one form has ever been bred from another, aside from statements unsupported by evidence, and one instance where it appears that mistaken identification has caused confusion. On the other hand, reports of observers with experience of several broods indicate that the forms breed true. Seifert reared a number of broods of *nais* and experimented with temperature effects on the pupæ. He also reared *radians* thru two generations, and attempted to mate females by exposing them in localities about New York where *vittata* was known to occur, but without success. This appears significant, but the possible effect of climatic difference on fertility must be considered. Marchand concluded that *nais*, *vittata* and *phalerata* were distinct species; he reared several broods of *nais* and *phalerata* which always bred true. His attempt to cross these moths was unsuccessful as would be expected from the genitalic differences, which he notes.

It is not necessary to assume that interbreeding must occur to explain occasional extraordinary resemblances between these forms. Variability is inherent in living organisms, and since the characters which vary in these moths are the same in all, any departure of a form from its normal mean makes it approaach one of the other forms. Also, in closely related forms apparently recently differentiated the occurrence of atavism may explain some of the intergrading individuals.

There is nothing in the literature on the genitalia of Apantesis with the exception of a brief paper by Dyar in which he figures the claspers and tegumen of *nais*, *vittata*, and *phalerata*. Dyar concluded that *phalerata* was a good species, but later placed it as a variety of *vittata* in his catalog.

The species of Apantesis as a whole show a wide range in the form of the male abdominal appendages. The moths of the *nais* group differ in common from the other species which I have examined. The ædoeagus in other species than those of the *nais* group is evenly and moderately chitinized thruout, except for occasional thickening near the orifice, and is unarmed. In the *nais* group this organ has a part of the circumference of the distal half thickened and heavily chitinized, and armed with one or more stout spines. I find no name in the literature which seems to apply to this localized area of thickened chitin in the ædoeagus, and will refer to it as the *callum* ("thickened skin"). In this thickening and armature this group resembles other Arctiidæ, in some of which the ædoeagal armature is highly developed.

The claspers are inwardly concave, roughly quadrilateral in shape, with an arm arising from the upper edge and projecting inwardly toward that of the opposite clasp. The distal portion of the clasper is composed of two distinct layers of chitin; the free edge of the inner layer is sharply defined. The lower border of the clasp is excavated near its middle, proximal to which it curves inward. This inward curve becomes more marked in prepared specimens, and as it is impossible to flatten the clasp without distorting it, the drawings show this part of the lower edge upturned.

The uncus consists of a broad basal part which joints the tegumen, and distally becomes spear-shaped as seen from above, beak-like laterally. There is a deep groove where the broad base of the uncus joins the tegumen, which is hardly noticeable from above. The ventral half of the tegumen shows no characteristic differences in the group, except that it is narrower and more pointed in *radians* and *phalerata*. The juxta in the *nais*-group as seen from below appears cone-shaped, and projects from the manica. In other species of the genus it consists of a thickening of the manica which remains closely apprest to the ædoeagus.

The organs are so curved, especially the claspers that great care is necessary in making comparisons, for a slight difference in orientation will make a great difference in the apparent shape of the organ. For this reason the usual balsam mounts were found unsatisfactory in this study, and after preparing the genitalia in the usual way and studying the structures as a whole the componene organs were dissected apart and compared unmounted. Before beginning the study of the genitalia the specimens were sorted into the different groups on superficial characters. The genitalia of seventeen specimens of *nais* were examined, twenty-one of *vittata*, (besides seventeen of the aberrant brood), eight of *radians*, (including *floridana*), and fifty of *phalerata*. All the *radians* were from Florida; the other series included moths from various localities. Each series included specimens showing wide variations in maculation.

A. nais (Figs. 1-7). The usual form of the clasper is shown in Fig. 2. Variations occur in the relative length and width of the part, the length of the rounded apex, and the degree of curvature of the posterior (distal) edge. Fig. 3 shows a clasper in which all these variations appear. In all the species variations occur in the size and shape of the costal arm, the extent of the

the lower border, and are of no significance. The basal part of the uncus tends to be a little rounded at the sides, but this varies, as does its width. Fig. 5 shows an average specimen; in others the spear-head may be shorter and broader, or it may be narrower. The juxta resembles a bisected cone, the flat surface against the manica, and varies much in length and breadth; in most specimens it is evenly tapered to a rounded point, but in two the end is broad and blunt. Figs. 6 and 7 illustrate two extremes.

The ædœagus is similar in shape to *vittata* and *radians*, consisting of an irregular chitinous tube with a slight double curve in the sagittal plane, the duct entering thru its dorsal surface just distal to the base. Size and details of shape and curvature are subject to individual variation in all the species. On the right lower lateral and extending partly onto the ventral aspect of the distal portion is the area of heavy chitinization which I have called the callum. Distally it is produced into a stout, hook-like spine, which points at right angles to the axis of the ædoeagus, and the whole hook-like structure is sharply bent laterally. The callum tapers proximally, and the proximal part becomes twisted nearly at right angles to the distal portion due to the upturning of the lower edge, and is often curved toward the dorsum. This peculiarity is particularly well marked in the specimen selected for Fig. 1. The distal edge of the callum forms part of the boundary of the orifice, and the vesica is attached to it; elsewhere the callum blends into the normal chitin. Wide variations are found in the length and width of the callum, and in the size and shape of the spine; in all the specimens examined, however, the proximal portion showed the characteristic twist. One aberration was found with small callum and a bifurcate spine (Fig. 4). *Nais* showed a much smaller range of variation in the genitalia than the next species.

A. vittata (Figs. 8-16) bears an exceedingly close resemblance to *nais* in the genital structures. The variations in claspers, uncus, and juxta in each species grade into each other so that it is often impossible to tell from one organ alone to which species it belongs. The claspers of *vittata* vary along the same lines as those of nais, but the range of variation is greater. The average form of clasp is shown by Fig. 13. Its close similarity to that of *nais* is seen by comparing Fig. 2. A more definite angle at the junction of the posterior and upper margins in *vittata* is the only difference, (the shape of the costal arm and of the lower border is of no importance) and sometimes serves to distinguish them, but is not constant. The specimen in Fig. 9 (which happens to be from a large moth) has as evenly curved a posterior edge as has *nais*. The other extreme is shown in the clasp with flattened, oblique, posterior margin (Fig. 16). The uncus is similar to that of *nais* and varies to the same extent. The basal part tends to be less rounded in *vittata* with the sides more sloping, but Figs. 5 and 12 were selected to show the different forms, and are not intended to imply a constant, specific difference. The usual form of the juxta is shown in Fig. 10. It varies in length and in three specimens was as long as in *nais*, (Fig. 11).

The ædoeagus is similar to *nais*, but thruout the series a constant difference was found in the callum. It differs from *nais* in the proximal end, which flattens out and blends into the normal chitin, while in *nais* this end becomes twisted. There is more variation in *vittata* in the shape of the spine, several variations of which are shown (Figs. 8, 14, 15); one specimen was found with a long, bifurcated spine. Fig. 15 shows the closest approach to *nais* found in the series, in the short, broad callum (the shape of the spine is not important) but the proximal end shows the difference noted.

Figs. 17-21 are from specimens of the aberrant brood of *vittata* mentioned above. The same peculiarities were found in two generations. The claspers are not distinctive. Tho relatively long and narrow, with an unusually broad arm, they are probably within the range of variation of *vittata*. The uncus is remarkably different, having the spear point nearly twice as long as in any other form, and with prominent rounded "shoulders" on the basal part. It was the same in all the specimens examined. The juxta has a broad, blunt end. The ædoeagus differs from the normal *vittata* in the absence of the lateral bend of the distal portion of the callum, and has two diverging, nearly equal spines. Two specimens were exceptional in having but one spine, thus resembling normal *vittata*. The occurrence of a double or bifurcate spine as an aberration in both *nais* and *vittata,* is interesting as showing a tendency which has become fixt in the next two forms.

In *radians* (Figs. 22-28) the claspers show a strong tendency to a very oblique posterior margin (Fig. 23.) This resembles an extreme form of *vittata* (Fig. 16), but the obliquity is greater in *radians.* One specimen, however, (Fig. 28) is similar to both *nais* and *vittata.* The uncus does not differ much, if at all, from *nais* and *vittata.* The slight difference is found in a shorter and broader spear-head. The juxta has a flat, broad tip, and resembles that of the aberrant form of *vittata,* a form also found in *nais.* The ædoeagus shows a characteristic peculiarity in having multiple spines—two specimens had four spines (Fig. 22), five specimens had three spines (Fig. 27), and one had but two, (Fig. 26). The callum resembles that of *vittata,* but the distal part is broader, and lacks the lateral bend, being drawn out into a strong spine; above this main spine are smaller ones, diminishing in size dorsally. In the specimen with only two spines, they are nearly equal, the second one abnormal in being directed posteriorly.

A. *phalerata* (Figs. 29-38) differs remarkably from other members of the group, and is unique in the form of the claspers and ædoeagus. The clasper is of unusually large size and exceeds that of the largest species of the genus, *A. virgo.* Individual variations are slight, and consist in differences in length and shape of the terminal projection, and in the degree of angulation of the upper edge; Fig. 32 shows an extreme form in which one angle is completely flattened out. A slight asymetry is sometimes found between the clasps of opposite sides. The uncus differs from the other species in the longer and narrower spear-head, with evenly curved edge, and the basal portion is also relatively long and narrow. The juxta, seen from below (Fig. 33), is flattened at the base while the distal part is comprest laterally more narrowly than in the other moths, so that it forms a keel-like projection. There is little individual variation in either uncus or juxta.

The ædoeagus is distinctive. The thick, heavily chitinized area covers nearly the whole of the right side of the distal half, curving onto the ventral side and over the distal end, forming a sort of three sided investment. At its apical angle it is produced into two slightly diverging stout conical spines; proximally it tapers into a narrow ridge. In the figure a large portion of the callum is obscured, being overlapped by other parts. The ædoeagus of *phalerata* is unique not only in external structure, but the vesica also differs in form from that of the other moths of the group. The ædoeagus was found to be variable in regard to the terminal spines, about one out of every four specimens examined showing some departure from the normal evenly bifid structure; such variation ranged from a slight irregularity in size of the spines to complete absence of a spine on one hand, and on the other the addition of a third spine; the presence of a third spine appears to be due to the bifurcation of one of the existing spines, rather than the production of a new one. Several such aberrations are shown in Figs. 35-38.

The moths used in this study were sorted into four groups before beginning the study of the genitalia and the structural differences were found to correspond with the separation on superficial characters, with two exceptions. One specimen was included under *phalerata* which structurally proved to be *radians*, and a specimen of *vittata* was also found under *phalerata*. Each of these specimens was atypical in maculation and represented a borderline variation; the genital structures, however, were perfectly typical. It is worth noting that while *phalerata* is the most protean of the forms and most apt to cause confusion by the similarity of its variations to the other forms, it differs the most in structure. In making determinations it is necessary only to remove a few hairs to expose the long narrow terminal projection of the clasper characteristic of *phalerata*. With *phalerata* eliminated, of the remaining three forms *nais* is recognized by its black costa, while *vittata* and *radians* usually differ in the coloration of the hind wings.

Nais and *vittata* are found to be very similar structurally but a constant tho slight difference occurs in the ædoeagus. *Radians* differs from them in the multiple spines of the ædoeagus, and for the most part the claspers are characteristic tho they may resemble *vittata*. Study of a larger series of *radians* would be desirable. *Phalerata* shows a surprising degree of divergence from its allies, all the genital structures being unique, including the vesica. The variations of the genitalia which occurred within each form were found to be independent of variations in maculation, nor did they bear any relation to locality.

No one factor, structural or otherwise, can determine a species, and more knowledge of the early stages, bred thru more than one generation, is essential to a thoro knowledge of any form. As our knowledge stands at present, however, I believe the evidence indicates that all of the forms are species. We have four forms readily separable on superficial characters and with corresponding structural differences, no one of which is known to have been bred from the other. It seems more logical to regard such forms as distinct until proved otherwise, than to lump three of them under one species as at present.

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Explanation of Plates IV and V.

The left clasper is shown, as seen from its inner surface. The uncus, attached to the dorsal half of the tegumen, is seen from above; the uncus is more heavily outlined. The juxta is seen from below. The right lateral aspect of the ædoeagus is shown, the dorsum to the right. Drawings were made with camera lucida; all are to the same scale.

Figs. 1-7, *A. nais.*

1, ædœagus. 2, clasper. 3, clasper, variation.
4, ædœagus, aberration. 5, uncus. 6-7 juxta, variations.

Figs. 8-21. *A. vittata.*

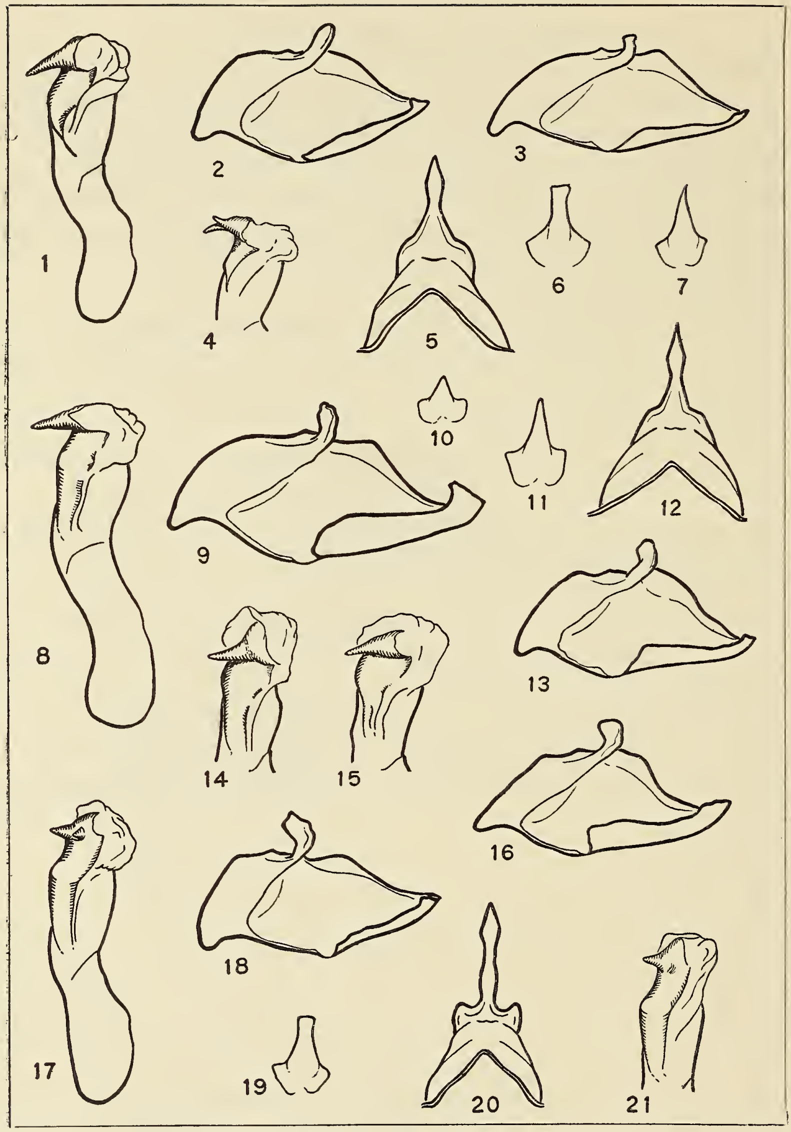
8, 14, 15, normal forms of ædœagus. 10, 11, juxta.
12, uncus. 13, clasper. 9, 16 claspers, variations.
17, 21, ædœagus of aberrant form. 18, 19, 20, clasper, juxta and uncus of aberrant form.

Figs. 22-28, *A. radians.*

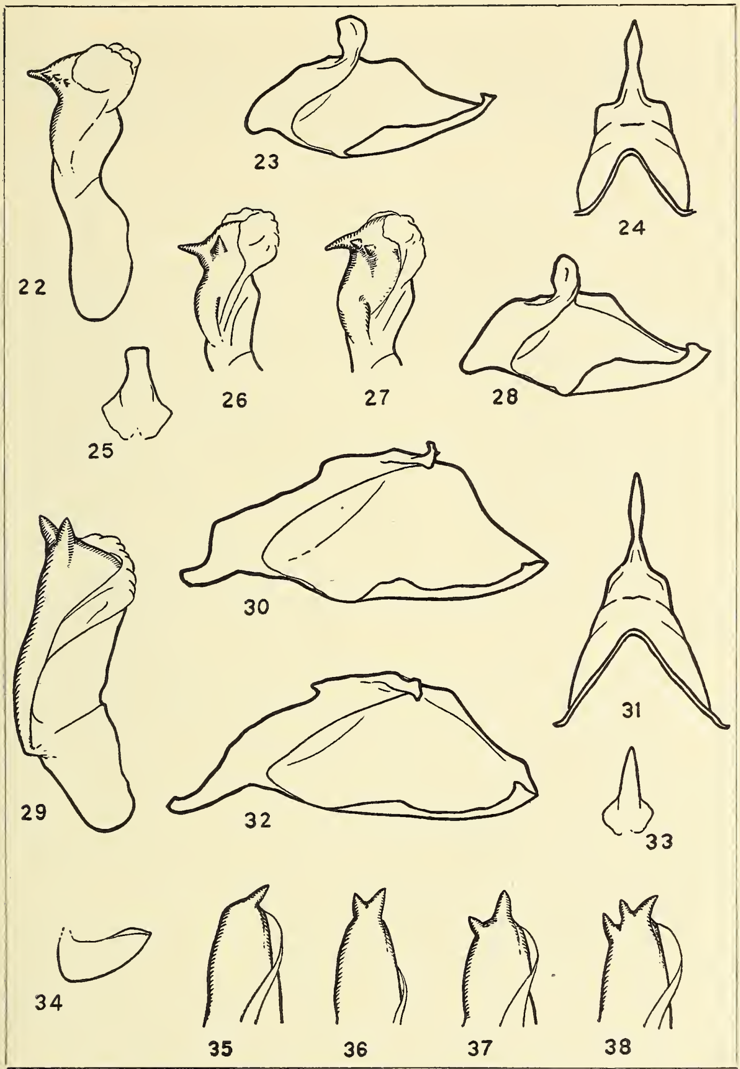
22, 26, 27, forms of ædœagus. 23, 28, claspers.
24, uncus. 25, juxta.

Figs. 29-38, *A. phalerata.*

29, ædœagus. 30, normal clasper. 31, uncus.
32, clasper, variation. 33, juxta. 34, lateral view of juxta. 35-38, variations of ædœagus, (ventral aspect).



LEARNED—NAIS - GROUP OF APANTESIS



LEARNED—NAIS - GROUP OF APANTESIS

PRELIMINARY EXPERIMENTS FOR THE CONTROL OF CERTAIN EUROPEAN VINE-MOTHS BY FUMIGATING WITH CYANOGAS CALCIUM CYANIDE.[1]

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In western Europe there is no fruit cultivated as extensively as the grape. Travelers there are at once impressed by its general culture. Vineyards are exceedingly common in Portugal, Spain, Italy, France, Switzerland and western Germany, the parts of Europe with which the writer is familiar. It is natural, of course, to assume that a plant as common as the grapevine must have a large number of insect enemies. And it has. There are more than a dozen insects which may be considered of economic importance. The most notorious of them all, however, are two small Tortricids, commonly known in Europe as Cochylis (*Clysia ambiguella* Hb.) and Eudemis (*Polychrosis botrana* Schiff.).

Records show that for more than two centuries these two pests—and they are pests in the full significance of the word—have been present in the vineyards of Europe. Over a period of many years the annual loss to the vineyardists in each of the countries mentioned above has been millions of dollars. Owing to this enormous damage they have been the subjects of study by various noted entomologists in these countries, but till now no effective method of control has been discovered.

The investigations of the writer in the winter of 1925-26 brought forth the interesting information that thse two insects are unable to survive a dry season. While he was in Spain during the spring and summer of 1924 he was witness to a severe drought lasting from mid-April to late that autumn. This dry spell had reduced their numbers more than 95% for the season of 1925. The month of January, 1926, was spent in an exhaustive

[1] In November, 1925, the American Cyanamid Sales Co. of New York, sent the writer, who was then in their employ, to Europe to investigate the possibilities of Cyanogas calcium cyanide being used for the control of the vine pests mentioned in this article.

survey of the country for an infestation where methods of control with calcium cyanide could be studied, but without success, for the infestations throughout the country had been reduced to a minimum.

European entomologists have uncovered a formidable array of natural enemies during their constant studies of these two pests. There are recorded some forty hymenopterous parasites of the eggs, larvæ, and pupæ common to both pests. They are also frequent victims of several fungi and bacterial diseases. The annual loss occasioned by the two pests, despite these natural enemies, has always been enormous, for which reason many efforts at artificial control have been attempted.

One of the most promising artificial control measures was that attempted on a small scale by Dr. Friedrich Stellwaag of Neustadt a/d Haardt, Germany, in 1917-1918.[2] He conceived the idea of fumigating the vines with HCN gas by the use of sodium cyanide and sulphuric acid under cover, because of the success this method had produced in the California citrus groves. His preliminary experiments, well planned and thoroughly executed, were carried on between April 24 and June 12, 1917. In April the fumigations were made on the leafless vine stalks (winter condition) and in June they were fumigated in their summer condition. The results obtained in Dr. Stellwaag's experiments may be briefly summarized as follows: 1. Fumigation of the plants in their leafy (summer) condition, even when only small quantities of the gas are used, cause damage to the foliage without completely killing the pests. 2. On the other hand the vines in their leafless (winter) condition are able to withstand larger quantities of the gas, sufficient (under the conditions of the experiment) to kill the cocoons found under the tent in which the fumigation was done.

The results of his 1918 tests[3] checked substantially with those of the previous year, except that more injury to the vines was noted due to rapid formation of the gas. Furthermore, Dr. Stellwaag believed that this form of fumigation was "too fussy,

[2]"Der Weinbau der Rheinpfalz," No. 8, August 1917.
[3]"Der Weinbau der Rheinpfalz," No. 1, January, 1919.

too expensive and unreliable." Therefore he discontinued further experimenting along these lines.

With the development of calcium cyanide during recent years, it was believed that these objections were eliminated. It is a product convenient to handle, easy to apply, less dangerous, and much more economical. Its greatest asset, how-ever, is that the gas is not evolved suddenly and turbulently. When normal dosages are applied the chance of injury to living plant tissues is at a minimum, for the gas evolves gradually, the peak being reached some little time after the plant tissues have received small amounts of the gas produced soon after application. In the firm belief that calcium cyanide would succeed where the old process of sodium cyanide plus sulphuric acid had failed, the writer was sent to Europe in December, 1925, to investigate the possibility of control of Eudemis and Cochylis with Cyanogas calcium cyanide.

As mentioned above, no adequate location could be found in Spain, due to the scarcity of the pests in that country. However, two suitable sites were found, the first being near Bordeaux, France, the other in Lausanne, Switzerland. Dr. J. Feytaud, director of the Station Entomologique de Bordeaux, very kindly co-operated in the undertaking by allowing the use of his laboratory facilities and also permitting us to experiment in vineyards under his charge. Similarly, Dr. H. Faes, director of the Station Fédérale d'Essais Viticoles de Lausanne, courteously extended the use of laboratory and vineyards. Both thus facilitated the experimental work.

Life Histories of the Pests.

Before proceeding with the details of the experiments it is well to mention briefly the salient features in the life histories of these insects. Essentially they are alike, the only variation being that *Clysia ambiguella* (Cochylis) has two annual generations, whereas *Polychrosis botrana* (Eudemis) has sometimes a partial and sometimes a full third generation. Both insects pass the winter as pupæ within rather thick cocoons spun by the larvæ. The cocoons are ordinarily attached to the vine stalks, although at times they have been found on rocks, fences, the wooden supports placed beside the stalks, and other similar objects. In seeking locations for hibernation the fullgrown larvæ instinctively select such sheltered and secluded spots, in which to spin their cocoons, as will insure complete protection against the elements during the long hibernating period. Consequently the cocoons are to be found in the folds of the bark, in crevices, holes, fissures, cracks, etc. The newly formed cocoons of Eudemis are clean and snow-white; whereas those of Cochylis are invariably covered with dirt, dust and debris of all sorts, making them difficult of detection.

The adult moths emerge late in April or early May, simultaneous with the bursting of the buds, and are present thereafter until early in the fall. The Cochylis adults are nocturnal in habit, while those of Eudemis are more active at dawn and at dusk of day. The females, after fertilization, commence laying their tiny and solitary eggs in the flowers of the host plant. These eggs hatch in from 7 to 30 days. The larvæ of the first generation attack and destroy the flowers, while those of the following generations damage the fruits. The second generation adults of Eudemis appear about the third week of June (a cycle of 7 weeks) while those of Cochylis do so towards the middle of July (a cycle of 9 weeks). Thus it will be seen that from early May until cool weather stops their activities (late September) all four stages of these insects may be found in the field.

The Experiments

The aggregate damage caused annually by these insects is enormous. The idea was also gathered from entomologists interviewed that no difficulty would be experienced in locating heavy infestations. In view of these facts it was the original intention to experiment with Cyanogas calcium cyanide for the control of the pests by treating the infested vines without disturbing or removing the insects from their natural hibernating quarters. However, when the actual work was begun the plans were changed to suit the work to existing conditions. Bushels of bark were peeled off the vines in a number of infested vineyards within close proximity of the two laboratories, and all cocoons of the two pests were then removed from them in the laboratories. In detaching them from the bark many of the cocoons tore open, for they were attached very firmly. About 700 cocoons of the two species were recovered from about twelve bushels of peeled bark.

For their treatment with calcium cyanide, the insects (cocoons) were retained in a coarse muslin suspended on the stalks fumigated. No pupæ were used in the experiment which failed to respond to a gentle pinch with the forceps, prior to fumigation.

The vines.—The vines treated in Switzerland were of a species called "chasselas," indigenous to that country, while in France vines with American rootstock were selected. Vines of varying ages, from 5 years to 50 years, were treated in order to secure information concerning the resistance of plants of varying ages to the action of HCN gas.

In Switzerland the majority of vineyards are of the type where the vines are grown singly, trained on wooden supports about 1 meter or a little over in height, placed in the ground close to the pruned vine just as soon as growth begins in the spring. The French methods of cultivation are of three types: (1), individual vines (as in Switzerland) pruned close to the ground; (2), vines trained on a single line of wire stretched the full length of each row; and (3), taller vines trained on double lines of wire, the first line about 30-35 c. m. above the ground, and the second wire about an equal distance above the first. The wires are attached to strong wooden posts in the rows, placed about 12-15 meters apart. The majority of vineyards in France are of the third type.

The covering.—The protection afforded the insects by their heavy covering (the cocoons) and also the fact that their respiratory system is at the minimum period of functioning during this season of the year (late winter and early spring) and stage of their life, made it at once evident that open air fumigation would be futile. Consequently a canvas tent and a cylindrical galvanized iron can were used in covering the vines for the treatments. The tent, of heavy impermeable canvas, was made large enough to permit treatment of four vines together. Its dimensions were 1.25 m. x 1.25 m. x 0.65 m. On its four sides a flap 12 c.m. wide was planned to insure against leakage of gas during fumigations, by placing earth or stones or other weighty materials on the flaps. The galvanized iron can was 95 c.m. high with a diameter of 60 c.m. The galvanized iron can was originally thought of because of the certainty of its being airtight and rain proof, very important considerations for overnight fumigations. It has the further advantage in winter fumigation work over the canvas tent in that the temperature within it rises several degrees above that of the outside air. Tests made to determine this point showed an increase of 2 degrees C. after an exposure of one hour, when the outside temperature was 10 degrees C. and an increase of 5 degrees C. after an exposure of two hours with the outside temperature at 16 degrees C.

Dosages and exposures.—The cubic content of the tent was 940 litres. In order to secure a concentration of HCN gas equal to 1% of the volume of the space within this tent, it was calculated that approximately 45 grams of $Ca\ (CN)_2$ should be applied. For a dosage of 10% volume, therefore, it would be necessary to use ten times 45 grams, or 450 grams. Likewise it was found that 12.5 grams of $Ca\ (CN)_2$ would produce a 1% volume concentration of HCN gas when applied under the galvanized iron can, the cubic content of which was 270 liters. The dosages used in the 71 experiments varied from 0.275% volume to 10.00% volume, each dosage being tried at least twice with a given exposure. The exposures were varied also, these being dependent on the dosages. The exposures were for periods of 30 minutes, 45 minutes, 1, 1½, 2, 2½ and 3 hours. Some overnight exposures were also tried. In general, smaller dosages were used in the long exposures and larger dosages in exposures of short periods.

The treatments.—Dr. Stellwaag, in the experiments referred to above, found that the grapevine is an extremely delicate and tender plant and that it is unable to withstand heavy concentrations of HCN gas. In view of this, coupled with the desire to cause as little injury as possible to the plants, the dosages used in the first twenty experiments were less than 1% volume. Beginning with a dosage of 0.275% volume, with an exposure of 30 minutes, both dosage and exposure were increased to 1% volume and treated one hour, but witn no appreciable effect on the insects or on the plants. Gradually the dosages were increased even beyond that fatal to the insects up to 10% volume to note the effect of abnormally strong applications of HCN gas on the vines. It is interesting to note that even such a heavy dosage as 10% volume (450 grams to a space of 940 liters) just before the flow of sap had commenced (on March 25, 1926) did not prove fatal to the plants, merely "retarded growth" being the observation made on the following 12th of April.

In all the experiments fresh Cyanogas calcium cyanide grade "A" dust was used. The exact dosage of the dust, after being measured on balance scales, was placed in a foot-pump duster and applied under the tent or galvanized iron can. No difference was noted in the results when the nozzle of the duster was directed to the bottom of the covering or to its top. In the latter case the plants would be covered with a fine coating of the dust, whereas when the dust was directed to the ground there would be practically no dust on the vines. In either case the effect both on the insects and the plants treated was the same.

To discuss each of the 71 experiments in detail seems unnecessary, for the majority resulted in only partial kills or no kills at all. Only in nine of the experiments was complete kill of the insects exposed to treatment secured, the details of which are given in the accompanying table.

The primary object of Experiments 29, 30, 31 and 32 was to see if abnormally excessive dosages, during exposures of 30 and 45 minutes, under the tent and also under the galvanized iron can, would be fatal to *the vines.* Observations on the condition of the plants made on April 12, a short while after the leaf buds had burst, showed them to be slightly retarded in growth. No injury was caused to any of the plants in their dormant condition even with such strong applications of the poison.

Experiment 53 was conducted on a fair, warm and calm afternoon. 15 naked pupæ were exposed to 3.5% volume (45 grams of poison to 270 liters of space) for one hour, from 2:15 to 3:15 p. m., under the galvanized iron can. The nozzle of the

Exp. Number	29	30	31	32	33	53	55	57	59
Date	3–25	3–25	3–25	3–25	3–26	4–5	4–5	4–6	4–6
Hour[4]	3:03 P.M.	3:15 P.M.	3:59 P.M.	4:08 P.M.	7:32 A.M.	2:15 P.M.	3:23 P.M.	2:30 P.M.	4:33 P.M.
Sun	Yes	Yes	No	No	Hazy	Yes	Yes	Yes	Yes
Clouds	No	No	partial	partial	light	No	No	No	No
Wind	Weak	Weak	slight	slight	calm	No	gentle	calm	calm
Temperature[5]	54° F.	57° F.	55° F.	55° F.	44° F.	61° F.	63° F.	61° F.	64° F.
Relative Humidity[5]	59%	55%	54%	54%	78%	54%	54%	51%	47%
Exposure	45 min.	45 min.	30 min.	30 min.	45 min.	1 hr.	3 hrs.	2 hrs.	1½ hrs.
Dosage	450 gr.	125 gr.	450 gr.	125 gr.	225 gr.	45 gr.	25 gr.	32 gr.	38 gr.
Rate	10% vol.	10% vol.	10% vol.	10% vol.	5% vol.	3.5% vol.	2% vol.	2.5% vol.	3% vol.
No pupae treated	10	10	10	10	9	15	11	5	6
% pupae killed	100%	100%	100%	100%	100%	100%	100%	100%	100%
Effect on vines	retarded growth	growth retarded	none	much retarded	none	a little retarded	none	none	none
Covering	Tent	G. I. Can.	Tent	G. I. Can.	Tent	G. I. Can.	G. I. Can.	G. I. Can.	G. I. Can.

[4]Beginning of treatment.
[5]At start of fumigation.

foot-pump duster was directed upward, and at the termination of the treatment it was noted that the powder was very uniformly distributed over the ground and lightly over the plant. All of the pupæ were dead when examined 42 hours after fumigation.

In Experiment 55, eight naked pupæ and 3 pupæ in cocoons were treated for 3 hours (3:23 to 6:23 p. m.) on April 5. Only 25 grams of calcium cyanide was used (2% volume). The temperature at the beginning of the experiment was 63° F. and 59° F. at the end; and the relative humidity went up from 54% to 57%. There was a gentle breeze present, but really without effect since the treatment was under the galvanized iron can. There was again a uniform distribution of the dust on the vine and the ground. When examined on the 7th of April all the naked pupæ were dead and those in the cocoons were stupefied. They never recovered, for on April 10 the three pupæ in cocoons are recorded as being also dead.

Another combination of dosage and exposure, under similar atmospheric conditions and fatal to the insects treated, was found by the test under Experiment 57. Here five cocoons were fumigated under the galvanized iron can for two hours with a dosage of 2.5% volume (32 grams to the 270 liters of space). The temperature rose from 61° F. at the beginning to 64°, and the relative humidity dropped from 51% to 47%. When examined 48 hours after exposure all five pupæ in cocoons appeared stupefied, while three days later they were pronounced dead.

Perhaps what may be considered the best combination of dosage and exposure was that revealed by Experiment 59. On April 6 one naked pupa and five in cocoons were treated under the galvanized iron can from 4:33 to 6:03 p. m. 38 grams of calcium cyanide (3% volume) were used in this experiment. The temperature varied from 64° F. to 59° F. and the relative humidity was between 47% and 57%. The day was fair, clear and calm. Forty hours after the treatment the insects were found dead upon examination.

In all the remaining experiments mortality varied from none to 82%. The following chart illustrates the combinations of dosage and exposure resulting in 100% mortality to the insects when accompanied by favorable climatic conditions, as shown by these tests.

Exposures (in hours)

Dosages (in % volume)	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	
1%								
1.5%								
2%							X	
2.5%					X			
3%				X				
3.5%			X					
4%								
4.5%								
5%		X						

(Note: x signifies 100% kill of insects fumigated; e. g., a 3% volume treatment for a period of $1\frac{1}{2}$ hours resulted in a complete kill of the pupae exposed to the treatment.)

The following conclusions are presented only because they throw some light on the possibilities of the use of calcium cyanide for the control of these pests. However, it must not be forgotten that they are the results of only a few preliminary experiments.

Conclusions

1. Treatments of Cochylis and Eudemis with dosages between 2% volume and 3.5% volume during exposures of from one to two and a half hours give better kills than stronger dosages over shorter exposures, or weaker dosages over longer periods of fumigation.
2. Temperatures above 60° F. appear to be more effective.
3. High relative humidity does not appear to be so important a factor as high temperature.

4. A metal covering over the vines gives much better results in the number of insects killed than a canvas covering, under identical conditions. This appears to be due principally to two factors; (1) A metal covering is more air tight; (2) the temperature in a metal covering is higher after a certain exposure than it is under a canvas tent under a like exposure.

5. In the winter dormant condition vines are not injured by the use of Cyanogas calcium cyanide. Both young and old vines seem to withstand with safety such strong treatments as 10% volume for 45 minutes.

NOTES ON THE MITE *PEDICULOIDES VENTRICOSUS* NEWPORT.[1]

Raymond L. Taylor.

The mite *Pediculoides ventricosus* Newport, attracted my attention when it completely destroyed several hundred parasites, which I was rearing. This acarid has been described as both beneficial and noxious, but this difference of opinion appears natural when one considers its wide range and the large number of insect species which it attacks. Moreover, it has been definitely shown to cause an irritating form of dermatitis in man.

Pediculoides ventricosus was observed by Newport in 1849 in the nests of *Anthophora retusa* at Gravesend, England, and was described by him in a published record in 1853. In 1879, Geber observed in Lower Hungary an eruptive epidemic coming from barley, and his investigations showed an acarid responsible for the dermatitis. Webster says that it would seem quite probable from Geber's illustrations, that the mite involved in the epidemic might have been *Pediculoides ventricosus*. The mite was first recorded in America in 1882 by Webster, who held that it had probably not only occurred as early as 1830 in Massachusetts, but it had also, at that date, become noxious to man. Harris in the second edition of his "Insects Injurious to Vegetation" refers to an observation he made in 1844 at Cambridge, that straw bed ticks had proved very troublesome to children sleeping on them because of insect bites. Harris ascribed the bites to *Isosoma hordei*, but Webster believes that it is more likely that *Pediculoides* was the cause of the dermatitis. Since 1884, many notes on the attacks of the mite upon both man and insects, have been made.

Pediculoides is widely distributed. It has been reported throughout the United States and Canada, especially in the regions where grain is grown, in virtually all of Europe, parts of Africa, notably Egypt, and in India.

This mite feeds principally upon larvæ and pupæ of such a

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 285.

great variety of insects, that a complete list would be very difficult to give. It occurs most abundantly, however, in connection with cereal insects such as, *Sitotroga cerealella* Oliv., *Sitophylus granarius*, Linn., *S. oryza* Linn., and notably, *Isosoma* species, all of which are greatly checked. It also feeds upon the parasites of these and of other insects and would, probably, feed upon any insect that was unable to escape. Because it controls the depredations of many destructive insects, *Pediculoides* has been considered beneficial from an economic standpoint.

In contrast to this view, the mite has been considered noxious, principally, because it causes a disagreeable, eruptive dermatitis, which is accompanied by a severe itching. If enough lesions are made, the person afflicted will have other symptoms, such as a rise in temperature, an acceleration of the heart rate, intense headache, anorexia, nausea, and diarrhœa. Such cases occur in the harvest fields of the Middle West, and in grain elevators, warehouses, and farm homes that have fresh straw mattresses. Here the mite is associated, of course, with the cereal insects mentioned.

In my opinion, *Pediculoides* is noxious to a degree as yet not realized, for another reason, and that is, its destruction of parasites. It has been widely observed that parasites of a great variety of insects are attacked by this predaceous mite, but it appears that these facts have not been stressed. Parasites reared in cultures in the laboratory are very commonly completely destroyed. Lichtenstein in France in 1863 stated that he could not for six months, breed a single specimen of Hymenoptera, while Buprestids, Cerambycids, and some Lepidoptera were also completely destroyed. Berlese cites the fact that Newport was forced to abandon the rearing of hymenopterous larvæ, while Essig mentions that in the rearing of hymenopterous parasites for the control of scale insects in California, the mite not only destroyed all the parasites in some insectaries, but also attacked the attendants.

My own experience follows:—The prepupæ of *Eurytoma pissodis* Gir., a hymenopterous parasite of the white pine weevil, *Pissodes strobi* Peck, were dissected out of the larval chambers of the weevil and placed in rearing tubes of glass, closed at one end with plaster of Paris and at the other with cotton. During October and November the prepupæ showed no evidences of attack by *Pediculoides.* In the tubes there was considerable débris, consisting of wisps of wood formed by the weevil larvæ, and particles of decayed bark. Without doubt, mites were in the débris at this time but they were unnoticed. The tubes were kept outdoors until the end of December and were then placed in a greenhouse at a temperature of 60° F. or more, while the prepupæ still appeared perfectly healthy. In mid-January,

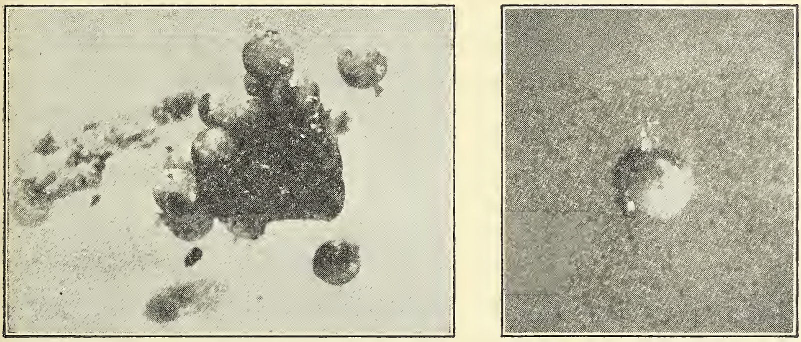

Fig. 1 At left, *Eurytoma* prepupa infested with mites; at right, gravid female of *Pediculoides ventricosus.*

when a number of the prepupæ turned lemon yellow, they were culled from the tubes and isolated. Within three or four days, there appeared upon the surface of each yellow prepupa, one or two characteristic, pale yellow spheres, the abdomens of the mites. Within a week the number had increased to three or four, and at the end of three weeks the number was ten to twenty. From this time, the prepupæ decreased in size slowly, while the number of new mites apparently did not increase as rapidly as before. The figure shows a prepupa after six or seven weeks. It has lost more than half its size and the wrinkled surface is covered with mites. The spheres in the background are the abdomens of mites that have fallen off in the preparation of the material for photographing, since they are easily dislodged when gravid. The prepupæ left in the tubes eventually passed through the same stages of infestation. The apparently uninfested prepupæ are of a creamy white appearance and often move slightly. No matter how frequently they were transferred to sterile tubes during January and February, all of them were destroyed. Thus, of several hundred prepupæ, only five reached the pupa stage and these, with one exception, died, covered with mites. The exceptional one attained the adult stage but did not live long enough to disengage the pupa skin completely.

It is probable that *Pediculoides* was able to infest a prepupa for several days without any evidence of its presence, since, although each prepupa was brushed and examined carefully before isolation, the mite invariably appeared. It is also probable that a prepupa, at the time of its transference, might have had one or several mites upon its surface which survived the brushing and escaped notice. That this acarid could remain unnoticed, is at least possible, because of its minute size, pale color, and semi-translucency when young. It is also possible that it may penetrate into the spiracles of the prepupa.

Some other parasites of the white pine weevil, namely several Braconids that pupate in pupa cases or cocoons in the larval chambers of the weevil, were not attacked by *Pediculoides*, although they were reared throughout in unsterilized tubes. Whole sections of twigs were in the tubes in this case; much frass and decaying bark was present, yet the emergence percentage was very high. In the material dissected, however, many intact cocoons were found which were shrivelled and which showed that they had been destroyed by some agency which may have been the mite. In other weevil larval chambers, groups of mites were found with remains sufficiently indefinite to defy analysis, although very probably, they were examples of *Eurytoma pissodis* which were destroyed under natural conditions, since abundant evidence, such as no weevil emergence hole in the wood, the size of the twig, and contiguous *Eurytoma* prepupæ, pointed that way. No clear cut case of mite destruction of weevil larvæ was observed, though this proves nothing, since, at the time of dissection, at least three months had elapsed since the weevil larvæ were in the shoots. Several cases of mite destruction of undetermined coleopterous larvæ were observed. The mites in the white pine terminal shoots were, in general, most abundant directly under the bark where, in this damp situation, they probably feed upon dipterous larvæ.

A brief description of *Pediculoides ventricosus* may be useful. The males and unfed females are a pale straw color and measure 1-5th mm. and less. The male remains slender, but the abdomen of the female swells enormously, assumes a spherical form, and attains a diameter of nearly 1 mm. Through the virtually transparent body wall of the abdomen, the contents, which are rather thin in consistency, appear the color of the yolk of a hen's egg or lighter, with amorphous masses of a milky white substance throughout the yellow, though these are usually more or less localized. This amorphous white substance appears to be connected with the soft, rather globular eggs, which may be readily observed and counted. From two to thirty eggs have been observed in progressive stages of development, though Webster has counted forty to fifty. In mites that have been in dry surroundings, and perhaps in general, in the case of older mites, the yellow substance is thicker on one side of the abdomen and assumes a dark brown color.

The life history of *Pediculoides* does not seem to have been completely worked out. Newport, who observed it in 1849, believed that the species was parthenogenic. Webster, in 1882, was inclined to agree with Newport, although he states later that he has noticed an occasional male. In this early paper, Webster says that the young not only hatch within the bladder-like abdomen but attain their full development there, and are liberated as they are developed. In breaking up the abdomen of the female, I have observed young mites crawling out of the fluid contents. Essig, in his text, "Insects of Western North America," adds that *Pediculoides* mates soon after birth. Under favorable conditions they increase rapidly. When feeding, they crawl about upon a larva or a pupa, often puncturing the skin within a few minutes after discovering the prey, and then they more or less continuously suck the juices. It is interesting to note that the prepupæ observed moved violently when a mite was placed upon them, but ceased the alternate curling and straightening within a minute, and then repeated this behavior several times within an hour. The females, which form a large majority of the individuals apparently tend to remain attached to the original puncture till distrubed, their abdomens swelling to a size 10 to 50 times that of the cephalothorax. If the prey is fresh, the mites are aided in their attachment by the adhesive quality of the fluid that issues from the punctured body. If brushed off they will puncture in the next place at which contact is established, although their mobility decreases, of course, with their growth. As seen in the figure, the mites appear as globular excrescences upon the surface of the infested larva or pupa, since the cephalothorax is hidden by the enlarged abdomen and may be more or less intruded into the body of the host.

Control of *Pediculoides*, natural or otherwise, has not been worked out and references to its control are very rare in the literature. That it has some natural enemies seems probable, because without some check, and with its capacities for increase and for destruction of insects, it would soon become more conspicuous. Under natural conditions in the white pine leaders, however, this acarid is not found in every part of the shoot, and in this fact lies the explanation of how a certain number of parasites may survive.

In conclusion, I offer the suggestion that *Pediculoides ventricosus* is more of a factor in economic entomology than is realized. Beneficial in checking cereal insects, it is not a completely welcome agency there, as it may seriously impair the efficiency of the harvest hands and other grain workers. Apart from this, it probably does more harm than good, all things considered, as it destroys parasites that have many times its own predatory power in controlling injurious insects. A compilation of tests for the purpose of ascertaining whether the mite prefers parasites in dead wood and straw, or whether it prefers wood-borers and stem-borers in material which is fresher or not entirely dead, and has less decaying bark, would be interesting.

Abstract.

The mite, *Pediculoides ventricosus* Newport, is beneficial in destroying cereal insects, notably *Isosoma* species, and others.

It is noxious in causing dermatitis in man. The writer has lost several hundred hymenopterous parasites of the white pine weevil—as have others in rearing various parasites. The sug-suggestion is made that the mite is more harmful than realized, as the parasites it destroys probably would kill more injurious insects than does the mite.

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THE OCCURRENCE OF THE PAVEMENT ANT (*TETRAMORIUM CÆSPITUM L.*) IN BOSTON.

By William Morton Wheeler.

The common European pavement ant (*Tetramorium cæspitum* L.) must have been introduced into the United States during colonial days, if Marlatt is correct in supposing that it is the ant referred to by Kalm in his "Travels" in 1748 as infesting houses in Philadelphia. It has certainly been established for many years in the vicinity of Philadelphia, New York City, in New Jersey, on Long Island and in Maryland (Washington and vicinity). I have often found it in Westchester County, N. Y., nesting under stones and occasionally storing small seeds in the chambers of its nests just as it does in various parts of Europe and North Africa. (See Donisthorpe's "British Ants, 2nd Ed. 1927, p. 195). As this ant is very common and prolific over an enormous area in the Old World, from England to Japan, and is represented by certain subspecies as far south as British East Africa and Cape Colony, it is difficult to understand why its spread in the United States has been so slow. This may be due, perhaps, either to the animosity of our native ants or to the enmity which seems so commonly to exist between any two *cæspitum* colonies as to lead to frequent deadly battles between them.

Apart from a few specimens taken in Springfield, Mass. and sent me by Mr. George Dimmock, I have seen no record of the pavement ant from New England. More than twenty years ago I found it abundant at White Plains and Mamaroneck, N. Y., near the Connecticut boundary. Since that time it may have entered the southern portion of that state and have moved up the valley of the Connecticut River as far as Springfield.

On two successive evenings, those of Jan. 19 and 20, 1927, which were very mild and followed a cold spell, I was surprised to find the heated and electric-lighted vestibule of an apartment building (101 Chestnut St.) in the heart of Boston, alive with ants celebrating their marriage flight. They were soon recognized as males and females of *T. cæspitum*, and had issued from a crevice in the floor near their nest which was situated in the outer masonry of the building. A number of workers were still running about the crevice from which they had permitted their voluminous sexual forms to escape. The apartment building surrounds a court containing a garden. Probably the ants had lived in the soil of this enclosure till the advent of cold weather and had then migrated into the vestibule. At any rate they were here able to bring their sexual forms to maturity and to stage their nuptial flight at a most unusual season, for the normal marriage flight, according to European observers, occurs in July, or at least sometime between June and September. Since the apartment building is very near the Charles River it will be interesting to determine whether the ants may not be spreading from the parked esplanade which borders the river in that part of the city.

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THE MALE GENITAL TUBE OF SOME OF THE SPECIES OF THE GENUS SCYMNUS (COLEOPTERA, FAM. COCCINELLIDÆ)[1]

By J. W. Wilson.

The genus Scymnus is one of the largest in the family Coccinellidæ and one in which the species are very hard to determine on account of their remarkable uniformity in appearance. The adult beetles are small, ranging from 1.1 mm. to approximately 3 mm. in length, rounded to oblong-oval in shape, pubescent, with six ventral abdominal segments showing, and the legs free. The color markings are quite constant, "Color characters have their utility in the separation of species of Scymnus, but some care and no little experience is required in their use" (Horn 1895). Casey (1899) in his revision of the Coccinellidæ used color to a great extent in the separation of the species. The prosternal carinæ and the abdominal plates or metacoxal lines are other characters which are very useful in this group. The secondary sexual characters of the male are quite distinct in most of the species, but have been mentioned in the description of very few of the species.

Leng (1920) lists one hundred and nineteen species from North America, sixty-five of which were described by Casey, seventeen by Leconte, fourteen by Horn, ten by Mulsant, four by Fall, three by Crotch, three by Melsheimer, one by Blatchley, and one by Say. Casey believed that the number of species would be increased in the future instead of decreased. Nothing has been done with the genus Scymnus since Casey's "Revision of the American Coccinellidæ," except the description of four species by Fall and one by Blatchley.

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 276

The genitalia of the male are usually accepted as being the final criteria for species about whose validity there is any doubt. A study of the genitalia will also show the degree of relationship between species in a group. With these facts in view the present study was undertaken in the hope that significant variations might be found in the œdagus of species having only slight external differences.

Since it is very easy to make erroneous determinations in this group, the present paper includes only that material which was compared with the types. All the species were described by Lecont except five, and the specimens were carefully compared with the Leconte types in the Museum of Comparative Zoology at Cambridge. The other five species were identified by Leconte, and were included in his collection. As my identifications agree with his, I felt safe in using these species in my investigation.

I wish here to thank Mr. Nathan Banks for his kind generosity in allowing me the use of the collection in the Museum of Comparative Zoology. I am also greatly indebted to Mr. C. A. Frost who loaned me his collection with permission to dissect any of the specimens which I might see fit to use for such purposes.

In a previous paper (Wilson 1926) the structure of the Coccinellid œdagus was described in detail. The general structure of the œdagus of Scymnus is similar to that of other Coccinellids. The basal lobe surrounds the median lobe and is very variable in shape. In such forms as *Scymnus americanus* Muls., the basal lobe is quite similar to that of *Brachyacantha ursina* Fab., which is one of the simplest of the forms described in that paper.

The material here presented seems to fall naturally into four groups, and if a study of the whole genus could be made it would probably be possible to separate the genus into several groups, each group showing some relation to the other groups.

The œdagus of *quadritæniatus* Lec. is particularly interesting because the proximal end of the median lobe is not flattened and expanded as in the other species. The median lobe is also less chitinized and is looped around the median strut. The lateral lobes are large as compared with the basal lobe.

In the second group which consists of *americanus* Muls., *punctatus* Mels., *cervicalis* Muls., and *terminatus* Say, the proximal end of the median lobe shows specific variations. In fact the proximal end of the median lobe, and the basal lobe, are the structures which are most variable in all the groups.

The œdagus of *nanus* Lec., *semiruber* Lec., *cinctus* Lec., and *hæmorrhous* Lec., are larger than the œdagi of the second group. All of the drawings were made at a magnification of about 115 diameters, except in the case of *americanus* and *puncticollis*, which were magnified about 85 diameters. The proximal end of the median lobe in *nanus* and *semiruber* are somewhat alike, and resemble that of *terminatus* to a certain extent. The same area in *cinctus* and *hæmorrhous* has in addition a small area, in the upper portion of which are found alternate bands of thick and thin chitin. The basal lobe is also much modified in *cinctus* and *hæmorrhous.* It extends through the basal piece, and beyond it anteriorily, for a short distance. Possibly if more material were available, there would be two groups instead of one, *nanus* and *semiruber* belonging to one, and *cinctus* and *hæmorrhous* to the other.

The basal lobe of *puncticollis* Lec., *consobrinus* Lec., and *tenebrosus* Muls., is much expanded, and very much larger than the lateral lobes. The shape of the basal lobe is also rather complicated in structure and projects beyond the basal piece anteriorily. At the distal end of the median lobe there are several stiff, bristle-like projections which point forward. There are also specific differences in the proximal end of the median lobe.

If we consider the genitalia of *consobrinus* and *tenebrosus* it would appear that these species are closely related, while in the key they fall into separate groups, and their relation would never be suspected. The genitalia of the Coccinellidæ are rarely extruded and are rather difficult to dissect out, for this reason they will never be of any value as key characters, as in the case of other groups. However, further study of the genitalia of the genus Scymnus will undoubtedly show the relationship between the various species.

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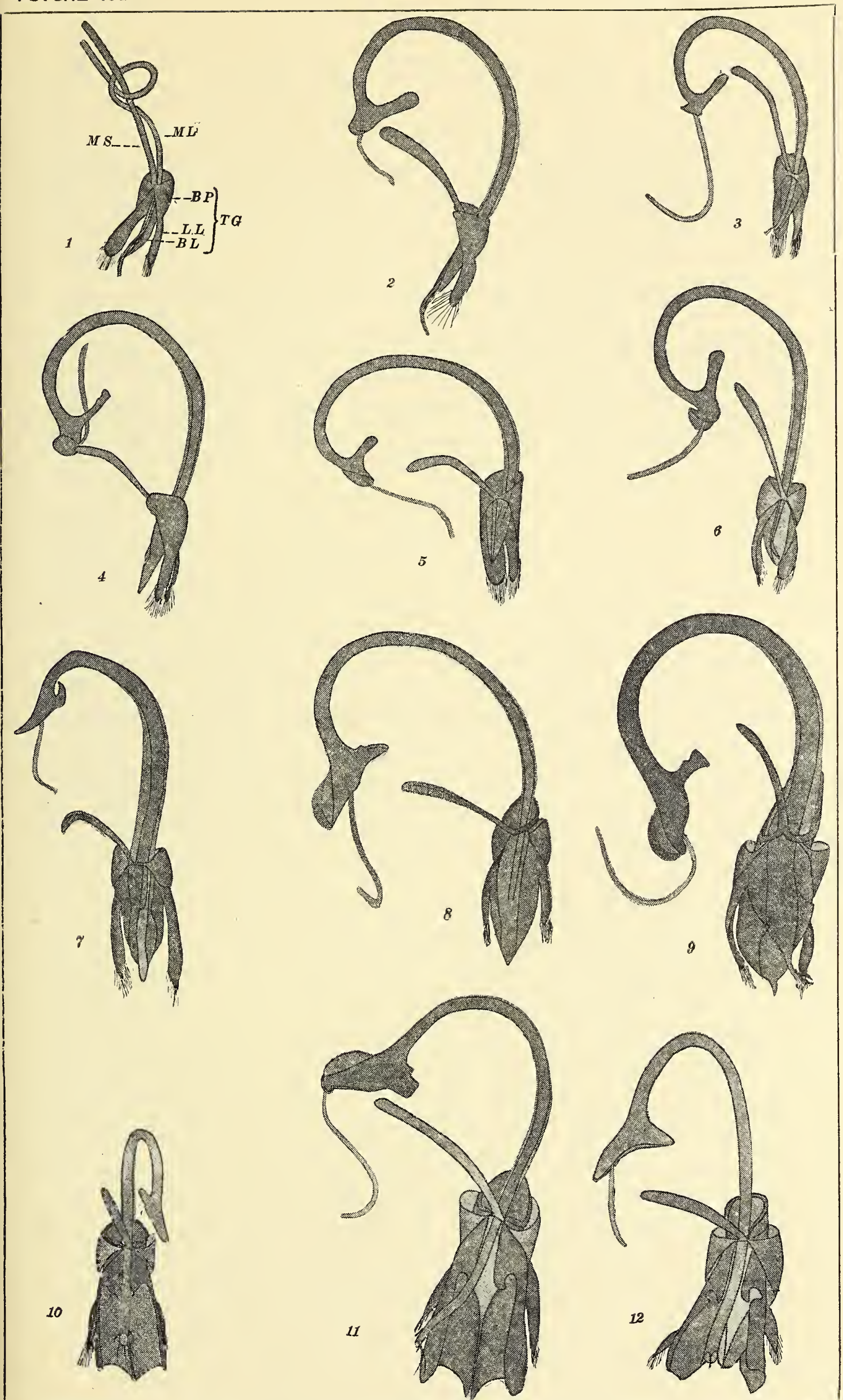
Abbreviations

BL. . . . . Basal lobe
BP. . . . . Basal piece
LL. . . . . Lateral lobe
ML. . . . . Median lobe
MS. . . . . Median strut
TG. . . . . Tegmen

Explanation of Plate VI.

Fig. 1 *Scymnus quadritæniatus* Lec.
Fig. 2 *Scymnus americanus* Muls.
Fig. 3 *Scymnus punctatus* Mels.
Fig. 4 *Scymnus cervicalis* Muls.
Fig. 5 *Scymnus terminatus* Say
Fig. 6 *Scymnus nanus* Lec.
Fig. 7 *Scymnus semiruber* Lec.
Fig. 8 *Scymnus cinctus* Lec.
Fig. 9 *Scymnus hœmorrhous* Lec.
Fig. 10 *Scymnus puncticollis* Lec.
Fig. 11 *Scymnus consobrinus* Lec.
Fig. 12 *Scymnus tenebrosus* Muls.



WILSON — MALE GENITAL TUBE OF SCYMNUS

DESCRIPTION OF A NEW EULOPHID PARASITIC ON *BUCCULATRIX CANADENSISELLA* CHAMBERS.

By A. B. Gahan

U. S. Department of Agriculture, Bureau of Entomology.

In order that the name may be available for use in connection with biological notes to be published in a bulletin of the Connecticut Agricultural Experiment Station, the new species of *Pleurotropis* bred by R. B. Friend is herewith described.

FAMILY EULOPHIDAE

Subfamily Entedoninæ

Pleurotropis bucculatricis, new species.

In Crawford's key to species of *Pleurotropis* from the United States[1] this species runs to *niger* Ashmead but is at once distinguished from that species by its bright metallic green color. Resembles *lithocolletidis* Ashmead but differs by having the frons above the transferse furrow and also the vertex entirely smooth except for a very faint reticulation within the ocellar traingle. Differs from *lithocolletidis* also by having the abdomen shorter and more blunt at apex.

Female—Length 1.6 mm. Head, viewed from in front, smooth and polished, the ocellar triangle and a small area on the vertex immediately behind the ocelli faintly reticulated; vertex broadly concave and opaquely sculptured; face below the transverse furrow finely reticulate-punctate, subopaque; inner eye-margins broadly concave; antennal scape slender, about as long as pedicel and two following flagellar joints; pedicel nearly twice as long as thick; three small ring joints; flagellum five jointed, not clavate, the first joint slightly longer and somewhat thicker than pedicel, broadest near middle; second joint ovate, shorter than first and about one and one-half times as long as broad; third joint cup-shaped, as broad as long; fourth joint similar in shape and subequal to the third; fifth joint (club) conical, about

[1]Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 177.

as long as the fourth but much narrower and terminated by a slender stylus which is approximately half as long as the segment; all flagellar joints moderately hairy; declivous anterior portion of pronotum sculptured like the occiput; dorsal posterior portion smooth and polished; mesoscutum and scutellum rather weakly reticulated, the two depressions on mesoscutum in front of scutellum shallow and smooth; propodeum smooth with the usual two diverging carinæ medially, the lateral folds distinct; pleura for the most part weakly reticulated, the metapleura mostly smooth; forewing devoid of discal cilia from base to near middle of marginal vein and with a wedge-shaped extension of this bare area along the anterior margin to about the apical one-fourth of marginal vein; marginal vein much longer than submarginal; stigmal and postmarginal about equal; hind coxæ polished; posterior tarsi with the joints subequal; abdomen about as long as thorax, petiolate, the petiole a little broader than long, closely punctate and opaque; abdomen, exclusive of petiole, elliptical in outline, the basal tergite above occupying more than two-thirds of its length and perfectly smooth, the following tergites very short and weakly shagreened; abdomen beneath distinctly shagreened; ovipositor concealed. General color bright metallic blue or green; occiput and face below transverse groove black with a slight bronzy tinge, a small area above clypeus more or less metallic green and the cheeks bluish black; antennæ metallic blue or green; declivous anterior portion of pronotum, axillæ and pleura bronzy black, the pleura more or less tinted with metallic blue or green in some lights; coxæ metallic green, all femora and tibiæ entirely metallic blue, all tarsi pale with the apical joint black; wings hyaline, venation dark brown; abdominal petiole, entire venter of abdomen and the dorsal segments except the second, bronzy black; second tergite bright metallic blue or green.

Male—Length 1.4 mm. Antennal pedicel not quite twice as long as broad; ring joints very small; flagellum not clavate; first and second flagellar joints subequal, each narrowed into a short next at apex; third joint slightly shorter than the second, ovate, about twice as long as broad; fourth like the third but more broadly truncate at apex; fifth as long as preceding and distinctly narrower, conic-ovate, terminating in a stylus approximately one-third as long as the joint; abdomen shorter than the thorax, squarely truncate at apex, the apical segments retracted, petiole slightly longer than broad. Face below the transverse groove sculptured as in the female but metallic green like the front; axillæ, mesopleura, and metapleura nearly concolorous with the mesoscutum. In other respects agreeing with the description of the female.

Type locality.—New Haven, Connecticut.

Type.—Cat. No. 40398 U. S. N. M.

Host.—*Bucculatrix canadensisella* Chambers.

Six females (one type) and one male (allotype) in U. S. National Museum, reared from the above named host, June 24 to July 9, 1926, by R. B. Friend. Four female paratypes with similar data in the collection of the Connecticut Agricultural Experiment Station, New Haven, Connecticut.

HELOPHORUS AQUATICUS L. IN AMERICA

By P. J. Darlington Jr.

Helophorus aquaticus L., of which *H. grandis* Ill. is cited as a synonym, is a common and wide-spread species in Europe, but is apparently not recorded from North America. A single specimen of the species, however, was taken in a mossy puddle beside the upper and smaller of the Eagle Lakes on the shoulder of Mt. Lafayette, N. H., at about 4100 ft. elevation. The insect was taken on Apr. 20, 1927, which was said at Boston to be the warmest April day in the history of the weather bureau. The so-called "Lakes" were almost entirely frozen over and contained no visible insect life, but the flood pools were warmed by the sun and yielded over a dozen species of aquatic beetles. The fauna of these Lakes, as determined by a collection made in Sept. 1926, is similar to that of the high, exposed pools of the Presidential Range about twenty-five miles to the north and includes such arctic species as *Ilybius discedens* Shp. and *Colymbetes longulus* Lec. The presence in large numbers of *Hydroporus badiellus* Fall, which is dominant in the Eagle Lakes but apparently absent on the Presidentials, indicates some difference, however.

In our funa *Helophorus aquaticus* is comparable in size only with *H. fortis* Lec. and very large specimens of *H. oblongus* Lec., from both of which it differs conspicuously by having the pronotal disk, except the depressions, densely and coarsely granulate, each granule having a median puncture. It is also duller, broader, with larger and shallower punctures on the elytral striæ and flatter elytral intervals. It differs from all the species of the genus in the Leconte collection, and I think from all our other North American species, by having a row of large punctures between the first and second elytral striæ near the base.

The New Hampshire specimen is 7 mm. long and has the pronotum green or coppery where it is not obscured. It has been compared with a series in the Museum of Comparative Zoology Cambridge labeled "Germany" and "Austria," and determined as *H. grandis* Ill., with which it seems to be specifically identical. It answers perfectly to the description of *H. aquaticus* L. in

Fowler's "British Coleoptera," and there seems to be nothing with which it could well be confused. Fowler gives the length of the species as 5.—7 mm., and states that the pronotum varies from green to bronze and that the species is common throughout the kingdom.

More recently I have seen four American specimens of the species in the collections of the Boston Society of Natural History and of Mr. C. A. Frost. The former contained two specimens taken by Professor H. M. Parshley at Orono, Me., Apr. 24 and 13 respectively; the latter, two from Orono, Me., May 3, and Penobsquis, N. B., July 23, the second taken by Mr. Frost. The species is well distributed and probably native, but apparently rare.

NOTES ON THE PRESENT DISTRIBUTION OF TWO INTRODUCED MOTHS.

By Charles W. Johnson,

Boston Society of Natural History.

In June 1926, Mrs. John A. Walker, of Brookline, Mass., gave me some little, white, spindle shaped cocoons that she said were abundant in her flower garden. I put them in a jar and between June 29 and July 6 a number of little brown moths emerged. Through the kindness of Mr. August Busck of the Bureau of Entomology it was determined as *Harpipteryx xylostella* Linn. "A European species introduced within recent years." In referring to the "Lepidoptera of New York and Neighboring States," by William T. M. Forbes, I found the species recorded under *Cerostoma xylostella* L. with the following distribution, "Mass. Hyde Park (Frank Haimbach); Ithaca, N. Y." Writing to Mr. Haimbach for the date of capture he says: "I collected *Harpipteryx xylostella* L. at Hyde Park, Mass., July 13, 1910. I found it along the Neponset River, flying around honeysuckle and took many specimens."

Mr. John V. Schaffner, Jr. has kindly given me the following data pertaining to this species, obtained by members of the Gypsy Moth Laboratory, Melrose Highlands, Mass. On May 31, 1918, larvæ of *H. xylostella* were collected on honeysuckle (*Lonicera*), at Melrose, Mass., by C. W. Collins and R. T. Webber. The adults issued June 25 to July 5, and were determined by Mr. Carl Heinrich of the U. S. National Museum. Larva considered by Mr. Webber to be the same species, were taken on honeysuckle at Westerly, R. I., June 3, 1919, by H. J. Miles, Quarantine Inspector, and at Newport, N. H., June 4, 1919, by A. C. Ward, Quarantine Inspector.

While at Salisbury Cove, Mt. Desert, Me., in August, 1926, Professor Ulric Dahlgren, showed me some moths he had captured at his light in July. Among these were some that proved to be the European *Eurrhypara urticata* Linn. I remember seeing a moth of this species in a box that the late F. H. Mosher had at the Museum and Mr. Schaffner has given the following note pertaining to the specimen, "A pupa of *Eurrhypara urticata* L. was collected at Falmouth, Me., June 22, 1923, by S. M. Dohanian. The adult issued June 25, 1923. Identification was made by F. H. Mosher and verified by C. Heinrich." The previous records of this species in America is that given by Wm. T. M. Forbes in the work above cited: "*E. urticata* L. has become established at MacNab's Island, and at Truro, Nova Scotia. The larva is found on nettle."

Although the two moths are not of special economic importance, it seems desirable that their gradual dispersion from time to time should be given as showing the time required and the apparent lines of dispersal of introduced species.

NOTES ON THE MEGACHILIDÆ

By Theodore B. Mitchell,

Department of Zoology and Entomology, North Carolina State College.

Published with the approval of the Director of the North Carolina Agricultural Experiment Station as paper No. 16 of the Journal Series of the North Carolina Station.

Osmia sandhouseae n. n.

Miss Sandhouse has kindly called my attention to the fact that the name *Osmia albohirta* (see Journ. Elisha Mitchell Soc., Vol. 4, p. 164) is preoccupied, having been used by Brullé in 1840 in describing a species of *Megachile* which he wrongly assigned to *Osmia*. This opportunity is taken therefore, to name the species for her.

Megachile manumuskin Vier. = **Megachile addenda** Cress.

Upon examination of the type it was found to be identical with *M. addenda* Cress.

Megachile semimucida Ckll. = **Megachile mucida** Cress.

On page 118, Vol. 52, of the Transactions of the American Entomological Society the males of *M. audax* Mitch., *M. semimucida* Ckll., and *M. mucida* Cress. are given as being the same. At that time I had assumed that the female of *mucida* was the type, since it preceeded the male in the description.[1] The male has been designated as the type, however (Memoirs Am. Ent. Soc. 1, p. 125, 1916) and *semimucida* therefore, becomes a synonym, since the female described under that name is the female of *mucida*.

Megachile mucida ♀ Cress. = **Megachile gemula** Cress.

The female described as *M. mucida*[1] is conspecific with the male of *M. gemula* Cress., which has been designated as the type of that species (Mem. Am. Ent. Soc. 1, p. 119).

Megachile gemula ♀ Cress. = **Megachile vidua** var. Sm.

The female described as *gemula*[1] is a variety of *M. vidua* Sm., differing from the typical form in lacking the abdominal fasciæ. This variety occurs in the southern Appalachians, and the fasciæ are entirely absent in both males and females.

1. See Transactions American Entomological Society, Vol. VII, p. 118.

Megachile shermani Mitch. = **Megachile floridana** Rob.

The type of *M. floridana* has been received from Professor Robertson, and a comparison of the two types shows them to be the same.

Megachile abducta Mitch. = **Megachile sidalceœ** Ckll.

A comparison of the type of *abducta* with specimens of *sidalceœ* determined by Professor Cockerell indicates that these are the same.

Megachile aspera Mitch. = **Megachile relativa** Cress.

At the time *M. aspera* was described it was suspected to be the same as *M. exclamans* Vier. It has since been compared with a homotype of *relativa* and is doubtless the same. *M. exclamans* is possibly the female of *M. infragilis* Cress., but I have not yet seen the type.

Megachile strophostylis Rob. = **Megachile integra** Cress.

A determined specimen of *strophostylis* received from Professor Robertson is the same as the female of *integra.*

Megachile tephrosiana n. sp.

♀. Head broader than long, eyes subparallel; supraclypeal[1] plate impunctate medially, but closely punctured laterally; clypeus with a median longitudinal area which is almost impunctate, the punctures becoming close and rather fine laterally, apical margin entire; mandibles black, very broad, sparsely striately punctate on upper face, 5-dentate, the three apical teeth low but distinct, the two inner ones with hardly any emargination between them and thus forming a straight edge; cheeks broader than eye, the punctures close, fine and shallow below, becoming more sparse and distinct above, shining, with thin white hair on lower half, the pubescence above thin, short and black, with some black hairs on posterior orbits all the way to the inferior angle; vertex slightly rounded, shining, the punctures deep and widely separated, the pubescence short, sparse and black; lateral ocelli slightly nearer eyes than to edge of vertex; antennæ black above, obscurely reddish below, first joint of flagel twice as long as broad, the second with length about equal to breadth, and the others gradually increasing in length to the apical one which is twice as long as broad; pubescence thin on face, long and greyish-white around antennæ and on inner orbits, extending over the extreme sides of the clypeus which is otherwise nearly bare.

Thorax shining above, white pubescent laterally, behind and beneath; on the mesonotum the pubescence is thin and white anteriorly, black on the larger part of the disc, with no white spots or bands, punctures sparse medially, closer and finer laterally, the surface between them polished; scutellum rather sparsely punctate, polished, with some black pubescence, the pubescence whitish posteriorly; pleura with fine crowded punctures above, larger and more separated below, pubescence quite dense and white; propodeum rather coarsely tessellate, with numerous fine and indistinct punctures, basal triangle granular, pubescence long, thin and whitish; tegulæ piceous, more reddish medially and on anterior margin, with scattered minute punctures; wings fuliginous, darker apically, nervures piceous to black, basal nervure slightly beyond transverse median, the second recurrent nervure nearer the apex than the first is to the base of the second submarginal cell; legs black, white pubescent, reddish-yellow on tarsi beneath, the middle and hind metatarsi narrower than their tibiæ, the front and middle tibiæ with the longitudinal carina on the posterior apex strong and sinuate, the carinate apex deeply notched at the anterior end; spurs yellowish-ferruginous; claws red basally, piceous apically, with strong but short basal teeth.

Abdomen rather ovoid, shining, finely and quite uniformly punctured, somewhat closer basally, the punctures throughout rather widely separated; pubescence black, conspicuous, longer apically, but segment 1 with entirely white pubescence which is dense at the sides; segments 2-5 with conspicuous entire white apical fasciæ, narrow medially on segment 2, broad on the apical segments, the middle segments slightly depressed apically and basally; segment 6 rather broad and short, distinctly concave at sides viewed from above, and very slightly concave in profile, but this largely obscured by the dense erect black pubescence which becomes subappressed and fuscous on the apex, the segment closely and finely punctured; scopa very pale yellow, black on segment 6, and almost entirely so on segment 5, and segments 3 and 4 with a tuft of black hairs on the extreme sides. Length 13 mm.

Type: Female; Tarboro, N. C., May 28, 1925, on flowers of *Tephrosia virginiana*. Paratype; 1 female, Raleigh, May 22, 1925, also on *Tephrosia*.

This seems to be quite close to *M. vidua* Sm., especially to the northern form which is definitely fasciate. It is at once separated, however, by the black scopa on segments 5 and 6, and the otherwise paler scopa, it being more yellowish in *vidua*. This may possibly be the female of *M. ingenua* Cress. A male of *ingenua* was caught in the same general type of country (sandy) at the same time of year and on the same flower, but in widely different localities. This seems hardly sufficient data to fix them definitely as the same species. Further collecting may possibly establish the relationship.

NOTES ON THE STREPSIPTERA AND THEIR HYMENOPTEROUS HOSTS.[1]

By George Salt.

In the course of a study of the effects of stylopization on aculeate Hymenoptera, a number of new and interesting host records and various notes on parasitism by Strepsiptera have been accumulated. Although their varied nature render it somewhat disjointed, it seems wise to bring these miscellaneous facts together in the present paper.

The following is an annoted list of the eighty-one species of Hymenoptera of which I have examined stylopized specimens. Two genera, *Zethus* and *Montezumia,* and several species apparently constitute new host records.

Sphecidæ.

Ammophila

abbreviata (Fabr.), det. Banks. Virginia: Falls Church (N. Banks).

alberti Hald., det. Banks. Arizona: Palmerlee, Tucson (F. H. Snow).

conifera Arnold, det. Arnold. Belgian Congo: Kabare (Jos. Bequaert).

pictipennis Walsh and Riley, det. Fernald. Virginia: Falls Church and Great Falls (N. Banks).

vulgaris Cress., det. Robertson. Illinois: Carlinville (Chas. Robertson); Florida: Inverness (Chas. Robertson).

Chlorion

(*Isodontia*)

auripes Fern., det. Banks. Texas: Dallas (J. Boll).

harrisi Fern., det. Fox in Coll. M. C. Z. Connecticut: Stamford (A. P. Morse).

(*Proterosphex*)

ichneumoneum (Linn.), det. Salt. Illinois: Carlinville (Chas. Robertson); Texas: Fedor.

pennsylvanicum (Linn.), det. Fernald. North Carolina: Southern Pines (H. Manee).

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 270.

Vespidæ.

Zethinæ.

Zethus

pubescens Smith, det. Bequaert. Zululand: Mfongosi (W. E. Jones).

spinipes var. *variegatus* Sauss., det. Bequaert. Texas: Dallas (J. Boll).

Eumeninæ.

Eumenes

campaniformis var. *marshalli* Bequaert, det. Bequaert, Paratype. "Dr. Melle, Arcturus. 1916, Salisbury."

fraternus Say, det. Bequaert. Massachusetts: Forest Hills (George Salt).

maxillosus var. *circinnalis* Fabr., det. Bequaert. Moluccas: Amboine (Rouyer).

maxillosus var. *reginus* Sauss., det. Bequaert. "Diego, Suarez."

Montezumia

sp. near *brunnea* Sm., det. Bequaert. Argentina: Chaco de Santiago (Del Estero, Rio Salado).

infernalis (Spin.), det. Bequaert. Paraguay: Villarrica.

Odynerus

annulatus Say, det. Bequaert. Texas: Austin, New Braunfels; Dakota: Custer Co. (S. W. Garman).

anormis Say, det. Robertson. Illinois: Carlinville (Chas. Robertson).

arvensis Sauss., det. Robertson. Illinois: Carlinville (Chas. Robertson).

bellulus Cress., det. Bequaert. Texas: Lee Co. (Birkman).

blandus Sauss., det. Bequaert. California: Stanford Univ.

bradleyi Robt., det. Robertson. No locality label.

foraminatus Sauss., det. Bequaert. Massachusetts: Woods Hole; Illinois: Carlinville (Chas. Robertson), Chicago; Pennsylvania: Philadelphia; Texas: Dallas (J. Boll), Fedor; Ohio: West Jefferson (Jos. Bequaert); Virginia: Vienna, Dyke, and Falls Church (N. Banks).

fundatus Cress., det. Bequaert. Texas: Austin; Illinois: Carlinville (Chas. Robertson).

histrio Lepel., det. Robertson. Florida: Inverness (Chas. Robertson).

histrionalis Robt., det. Robertson. No locality label.

manifestus Cress., det. Bequaert. Texas: (Fedor).

perennis Sauss., det. Bequaert. Virginia: Great Falls, Falls Church and Dyke (N. Banks).

pratensis Sauss., det. Bequaert. Texas: El Paso.

toas Cress., det. Bequaert. Texas: Valentine, El Paso; New Mexico: Steins.

Pachodynerus

cubensis (Sauss.), det. Bequaert. Cuba: Soledad (Jos. Bequaert).

erynnis (Lepel.), det. Bequaert. Florida: Lakeland (Wm. T. Davis), Miami (Jos. Bequaert), Inverness (Chas. Robertson).

guadulpensis (Sauss.), det. Bequaert. Grenada: Santeurs (Allen and Brues).

nasidens (Latr.), det. Bequaert. Rep. Honduras: Pto. Castilla (Jos. Bequaert).

Ancistrocerus

albophaleratus (Sauss.), det. Bequaert. Connecticut: Canaan (Jos. Bequaert); New Hampshire: Mount Washington (Halfway House) (C. W. Johnson); Maine; Alberta: Bilby (George Salt).

birenimaculatus (Sauss.), det. Bequaert. New York: Flushing (Jos. Bequaert); New Jersey: Newfoundland.

catskillensis (Sauss.), det. Bequaert. Massachusetts: Forest Hills (L. H. Taylor), Auburndale (C. W. Johnson); New York: Keene Valley (H. Notman); Connecticut: Colebrook (W. M. Wheeler).

fulvipes (Sauss.), det. Bequaert. Texas: Lee Co. (Birkman), New Braunfels.

parietum (Linn.), det. Bequaert. New York: Ithaca.

tigris (Sauss.), det. Bequaert. New Jersey: (Ramsey), Fort Lee (Jos. Bequaert); Virginia: Falls Church and Glencarlyn (N. Banks); Pennsylvania: Melsh; Connecticut: Colebrook ((W. M. Wheeler).

waldenii (Vier.), det. Bequaert. Massachusetts: Forest Hills (O. E. Plath).

Belonogaster

filiventris (Sauss.), det. Bequaert. Belgian Congo: La Panda (Katanga) (Dr. Mich. Bequaert).

junceus (Fabr.), det. Bequaert. Victoria Nyanza: Masinga Archipelago (Dr. J. Carl).

Ropalidia

cincta (Lepel.), det. Bequaert. Belgian Congo: Gani (Lisalto, Monveda) (Jos. Bequaert).

nobilis (Gerst.), det. Bequaert. Congo: Lisala.

Polistes

canadensis var. *annularis* (Linn.), det. Bequaert. West Virginia: Mongolia Co. (L. H. Taylor).

crinitus (Felton), det. Bequaert. Rep. Dominica: Sanchez (A. M. N. H.).

crinitus var. *americanus* (Fabr.), det. Bequaert. Porto Rico: Aibonito, Cayey, Coamo Springs, Jayuya, Manati, and Mayaguey.

gallicus (Linn.), det. Bequaert. No locality label.

pallipes Lepel., det. Bequaert. Connecticut: Colebrook, Robertsville, and Chapenville (W. M. Wheeler).

variatus Cress., det. Robertson. Illinois: Carlinville (Chas. Robertson).

Apidæ

Chloralictus

sp. Washington: Pullman (A. D.)

sp. (N. B. Several species are probably here grouped together). Connecticut: Colebrook (W. M. Wheeler); Massachusetts: Forest Hills (George Salt).

sparsus Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

versatus Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

zephyrus Sm., det. Robertson. Illinois: Carlinville (Chas. Robertson).

Andrena

andrenoides Cress., det. Robertson. Illinois: Carlinville (Chas. Robertson).

asteris Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

bradleyi Vier., det. Salt. Massachusetts: Forest Hills (George Salt).

canadensis D. T., det. Viereck. Connecticut: Colebrook (W. M. Wheeler).

carolina Vier., det. Viereck. Massachusetts: Billerica (P. J. Darlington Jr.).

cressoni Robt., det. Viereck. Connecticut: Colebrook (W. M. Wheeler).

erigeniæ Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

forbesi Robt., det. Viereck. Connecticut: Colebrook (W. M. Wheeler).

fragilis Sm., det. Viereck. New York: Oliverea (Catskills) (Jos. Bequaert).

hippotes Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

hirticincta Prov., det. Salt. Connecticut: Colebrook, Robertsville, and Doolittle Pond (Lichfield Co.) (W. M. Wheeler); Vermont: Chittenden (Rutland).

illinoiensis Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

imitatrix var. *claytoniæ* Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

mandibularis Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

miranda Sm., det. Viereck. Connecticut: Colebrook (W. M. Wheeler); Wisconsin.

nasoni Robt., det. Viereck. Massachusetts: Forest Hills (L. H. Taylor, George Salt).

nuda Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

salictaria Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

solidaginis Robt., det. Viereck. Nebraska: Malcolm (C. R. Oertel); New Jersey: Alpine and Fort Lee (Jos. Bequaert).

vicina Sm., det. Viereck. Massachusetts: Petersham (C. T. Brues).

Panurginus

innuptus Ckll., det. Stevens. North Dakota: Minot (O. A. Stevens).

Pseudopanurgus

æthiops Cress., Colorado: Wray.

rudbeckiæ Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

solidaginis Robt., det. Robertson. Illinois: Carlinville (Chas. Robertson).

Various writers have given data on the extent of parasitism by Strepsiptera, and in his monograph and its supplements, Pierce (1909, 1911, 1918) has brought together these records and added others. Most of the published notes, however, deal with *Polistes* and *Andrena,* whereas the following have to do largely with other genera.

In 1922, Dr. W. M. Wheeler collected a total of 373 specimens of *Andrena hirticincta* Prov. Forty-four of these or 11.9% were stylopized, 6 of 23 males or 26.1%, and 38 of 350 females or 10.9%. His collecting records for the same year of species of *Chloralictus*, mostly *albipennis*, show 98 stylopized of a total of 470 specimens collected, an infestation of 20.9%; 88 of 378 males or 23.3% were stylopized, and 10 of 92 females or 10.9%

No collecting records are available for the Vespidæ other than *Polistes* but some indication of the extent to which they suffer from strepsipterous attack may be obtained from the frequency of the occurrence of stylopized individuals in collections. Of 4525 specimens of miscellaneous Eumeninæ examined by the writer, 74, or 1.64%, were stylopized. Collections of particular genera contained stylopized specimens as follows:

Masarinæ	of 96	specimens,	0	stylopized,	or	0 %.
Zethus	of 53	"	2	"	"	3.8%.
Eumenes	of 214	"	3	"	"	1.4 %.

Nortonia	of 5	"	0	"	" 0 %.
Pachymenes	of 42	"	0	"	" 0 %.
Monobia	of 52	"	0	"	" 0 %.
Alastor	of 33	"	0	"	" 0 %.
Pterocheilus	of 43	"	0	"	" 0 %.
Stenogaster	of 5	"	0	"	" 0 %.
Belonogaster	of 104	"	2	"	" 1.9%.
Ropalidia	of 160	"	2	"	" 1.3%.

In addition, 217 specimens of *Synagris* were examined rather summarily but none was observed to be stylopized.

To give detail of the sex, number, and position of the parasites in the various species of hosts would require more space than is at our disposal, but the general conditions are indicated by the following analyses of the parasitism in four of the better-known genera.

Odynerus (*sens. lat.*).

51	specimens	(29♂, 22♀)	carrying	1	parasite	(15♂, 35♀, 1?)
13	"	(6♂, 7♀)	"	2	parasites	(5♂, 21♀).
3	"	(3♀)		3	"	(3♂, 6♀).
2	"	(2♂)	"	4	"	(3♂, 5♀).
1	"	(1♂)	"	6	"	(2♂, 4♀).
70	"	(38♂, 32♀)	"	100	"	(28♂, 71♀, 1?)

Average infestation:—1.43 parasites per host.
99 parasites (28♂, 71♀) situated as follows:—42 on the right, 56 on the left, 1 median;

under the	2nd.	3rd.	4th.	5th. abdominal segments.
♂ parasites	.	1	21	6
♀ parasites	6	45	19	1

In this genus of hosts the female parasites prefer a position anterior to that of the male.

Polistes.

29	specimens	(3♂, 26♀)	carrying	1	parasite	(21♂, 8♀).
11	"	(1♂, 10♀)	"	2♂	parasites	(22♂).
2	"	(1♂, 1♀)	"	2♀	"	(4♀).
6	"	(6♀)	"	1♂, 1♀	"	(6♂, 6♀).
6	"	(6♀)	"	3♂	"	(18♂).
2	"	(2♀)	"	2♂, 1♀	"	(4♂, 2♀).
2	"	(2♀)	"	1♂, 2♀	"	(2♂, 4♀).
1	"	(1♀)	"	4♂	"	(4♂).
2	"	(2♀)	"	5♂	"	(10♂).
1	"	(1♀)	"	7♂	"	(7♂).
3	"	(3♀)	"	larval	"	
65	"	(5♂, 60♀)	"	118. .larval "		(94♂, 24♀).

Average infestation of wasps carrying adult parasites:—1.9 parasites per wasp.

118 parasites (94♂, 24♀) situated as follows:—54 on the right, 63 on the left, 1 median; 105 dorsal, 3 lateral, 10 ventral;

under the	2nd.	3rd.	4th.	5th. abdominal segments.
♂ parasites	1	44	41	8
♀ parasites		1	2	21

The normal position for the male is here obviously under the 3rd. and 4th. segments. In the eight cases in which a male was found under the 5th. segment, only once was it the only parasite; twice it was one of two, twice one of three, once one of four, and twice one of five parasites, and may be considered to have been crowded from its normal position. On the other hand, the female usually occurs under the 5th. segment; where it was under the 3rd. it was one of three parasites, where it was under the fourth it was one of two or one of three parasites. This condition, in which the males normally lie anterior to the females in the body of the host, is exactly the opposite of that in *Odynerus* where the females lie anteriorly, the males behind.

Chloralictus

313	specimens	(276♂, 37♀)	carrying	1	parasite.
161	"	(142♂, 19♀)	"	2	parasites.
45	"	(44♂, 1♀)	"	3	"
1	"	(1♂)	"	4	"
520	"	(463♂, 57♀)		774	"

Average infestation:—1.5 parasites per host.

774 parasites, all females, situated as follows—386 on the right, 358 on the left, 30 median; 763 dorsal, 4 lateral, 7 ventral; 40 under the 3rd., 712 under the 4th., and 22 under the 5th. abdominal segments. In seven of the eleven cases in which the parasite was lateral or ventral, it was one of three parasites; in three cases, one of two; and in only one case was it the only parasite. The normal position of the parasite in *Chloralictus*, therefore, is dorsal, under the 4th. abdominal segment.

It will be noticed that here, as also in the case of the stylopized *Halicti* studied by Perkins (1892, 1918), all of the parasites found were females; no males or male exuvia were seen in *Halictus*. This fact at once raises the question of parthenogenesis among the females of *Halictoxenos* already suggested by Perkins. Mrs. Schrader (1924), to be sure, has shown that the females of *Acroschismus* must be fertilized to produce their young; but in that genus males are of common occurrence and, indeed, in the present study were found in much larger numbers than the females. Pierce (1918) claims to be the only one who has ever captured an *Halictus* with a male parasite. In view of the very rare occurrence of males of *Halictoxenos*, then, or their almost complete absence, parthenogenesis is strongly suggested in this group notwithstanding Mrs. Schrader's contrary observations on *Acroschismus*.

Andrena.

147	specimens	(41♂, 106♀)	carrying	1 parasite	(40♂ 107♀).
18	"	(4♂, 14♀)	"	2♀ parasites	(36♀).
3	"	(3♀)	"	2♂ "	(6♂).
3	"	(3♀)	"	1♂, 1♀ "	(3♂, 3♀).
1	"	(1♀)	"	3♀ "	(3♀).
2	"	(2♀)	"	1 larval parasite	
174	"	(45♂, 129♀)	"	200 parasites	(49♂, 149♀, 2 larval).

Average infestation:—1.1 parasites per host.

200 parasites (49♂, 149♀, 2 larval) situated as follows:—97 on the right, 93 on the left, 1 median, 3 unextruded, 6 unrecorded; 187 under the 4th., 9 under the 3rd., 1 under the 5th. abdominal segments, 3 unextruded. The normal position for the parasites of *Andrena* is obviously under the 4th. abdominal segment.

Finally, attention must be drawn to a matter of nomenclature. It appears to have been overlooked that von Heyden (1868, p. 398) used the name *Xenos smithii* for two male parasites of *Sphex ichneumoneus* L. from North America. Pierce (1909, p. 185) notes the specimens but apparently does not recognize the description. There can be no doubt of the validity of the name, however, for not only is the insect partly described, but also the name of the host, the essential part of many a more recent description of a strepsipterous parasite, is given. *Homilops bishoppi* Pierce (1909, p. 146), parasitic on *Sphex ichneumoneus* L. at Waco, Texas, is known only in the female sex, while *Xenos smithii* was described by von Heyden from two males only. It is therefore possible to consider the former the female of the latter, especially as it is a common practice to couple male and female strepsiptera simply by their infestation of a single species of host.

For loan of specimens I am very grateful to Mr. N. Banks of the Museum of Comparative Zoology, Mr. C. W. Johnson of the Boston Society of Natural History, Mr. Chas. Robertson of Carlinville, Illinois, Prof. W. M. Wheeler and Prof. C. T. Brues of the Bussey Institution, Harvard University, and Prof. Joseph Bequaert of the Harvard Medical School. My thanks are due to the various authorities to whom the host determinations are individually credited. To Dr. Joseph Bequaert I am especially grateful, not only for determination of the Vespidæ and for the gift of specimens, but also for generously allowing me to search for stylopized individuals in his large and valuable collection.

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PARASITES AND HABITS OF *DIANTHIDIUM PUDICUM* CRESSON

Charles H. Hicks,
University of Colorado.

The habits of *Dianthidium pudicum* Cresson[1] have not previously been known, as far as it can be learned from a review of the literature. The following account is based on studies of the species, at or near Boulder, Colorado.

D. pudicum builds cells of pebbles and resin, placing them in depressions or attaching them to the sides of rocks, in fields and open places. Nests of this bee were first taken in the fall of 1925. Many have since been found at all seasons and, during the summer of 1926, observations were made on the constructing and provisioning of a nest.

Cells have been taken from the stones, brought to the laboratory where they were kept at room temperature, and the insects reared. In this way a number of bees and several parasites have been obtained.

From a nest secured April 11, 1926 at East Boulder, a male and female parasitic wasp, *Eusapyga proxima* Cresson[2], emerged on May 12, 1926; a female wasp May 14; a male *D. pudicum* May 18; and a male wasp on May 21. Specimens of *E. proxima* have emerged from some other nests of *D. pudicum* and always from the cocoon of the latter insect. This fact shows that the parasite lives on the tissues of the young bee larva or pupa and does not early crowd it out, using its food, as do certain bees living in the cells of other bees (e. g. *Stelis sexmaculata* on *Alcidamea producta*)[3].

[1]Kindly determined by Professor T. D. A. Cockerell.
[2]This wasp has been determined by Mr. S. A. Rohwer.
[3]Reported by Graenicher, 1905.

Nests of *D. pudicum*, although not very rare, are rather difficult to find, because of the fact that they often closely resemble in color the rock to which they are attached. Again, they may fill in a depression, giving the rock a smooth outline and therefore easily overlooked. Many fields, in which these bees nest, are nearly covered with rocks and the task of finding the ones used is great. However, a bee sometimes selects a very light or white rock and builds upon it a nest consisting of dark pebbles.

When the weather is dry, the pebbles and resin become very hard and the nest is difficult to remove. Rain or very moist weather softens the material and may aid in making it easier for the mature insect to emerge.

The number of cells to a nest have varied from 2 to 8. A cocoon, which appeared to be of average size, measured 9 mm. in length from the tip of the mammillary projection to the base of the cocoon. The width at the center was a little over 4 mm. The base is slightly curved; the apex flat except for a short, blunt mammillary point. This point was much lighter than the dark, yellowish brown cocoon.

Observations were made on the habits of a bee of this species found nesting on a rock at Owens' Lake, late in the afternoon of August 24, 1926. When located one cell had already been constructed, with the orifice down. This opening was clear cut, or sharply and very neatly outlined. At 6 p. m. the female was resting within, where she spent the night, with the posterior part of her body towards the outside. Some data were obtained on following days, part of which are given below.

August 25. By 11 a. m. the orifice of the first cell was closed and a second had been started. The bee was now carrying resin and pebbles to the nest. Later, when she was walking over it slowly, as though inspecting it, a male came and mated with her on the finished cell. The period of copulation was of about 30 seconds duration.

August 27. The bee was observed flying about in the morning, probably gathering honey.

August 31. To-day, the fourth cell has been made. The place and order of occurrence had been noted on previous days.

Three of the four cells were finished. The second was to the right of the first; the third to the left of the first; and the fourth above and over the first, being attached to the rock above and partially covering the finished cell. At 9:46 a. m. the bee returned pollen laden, from a collecting trip. She entered the cell head first, and stayed within 20 seconds. She then came out, backed in to deposit the pollen and remained 35 seconds. Later in the day, when she was collecting resin, it was observed that she averaged 7 minutes in securing a load. She carried the lump of light colored resin in her mandibles and deposited it in the anterior part of the unfinished cell.

September 2. At 3 p. m. a fifth cell had been made. The sky being overcast, the bee was inside resting. The cell was above the second and parallel to the fourth. The opening was down, as has been found true of all others observed in the process of construction. Later in the afternoon, the bee was seen to be smoothing the inside of the cell with her mandibles.

September 4. To-day, a sixth cell was partly finished and the bee was seen for the last time and no further work was done. The nest was taken home September 26.

Notes on Construction of Cell.

Considerable time was spent in observing the bee constructing the cells. The resin, which had been placed in the anterior part of the cell after each collecting trip, was used as needed. The bee would take some of the resin and place it on the edge of the cell, often between two pebbles. Then she would fly to the ground and select a pebble, sometimes from very near and again as far as six feet away. The pebble was carried in her mandibles to the nest, where the legs and thorax were used to fit it into place. It is worthy of note that the bee endeavoured to place the pebble where she had previously put the resin. If the pebble did not hold, as was sometimes the case, she would get some more resin and place it usually on the same spot.

The pebble dropped was never immediately utilized again, but a new one selected. However, since she often gathered those near, she sometimes later used the ones previously tried.

In placing a pebble in a crevice or on a resin extension, the pebble was turned and rearranged, by means of the legs and abdomen, much as a mason fits a stone into place. The pebble remaining, the bee placed resin on its free edges and another was brought. Sometimes when a pebble did not fit into place, the bee tried it all about the edge of the cell in an attempt to get it to hold.

After a few trips to the cell under construction, the bee was seen to carry a pebble and place or fit it onto the general surface of the outside of the other cells, mainly in the depressions between them. This helped to break the outlines of the individual cells and make the surface more even, as well as make the walls thicker and the protection greater. Another nest of this bee, also found at Owens' Lake during this period, showed considerable thickness of resin and pebbles placed after the cells had been made. Old nests, from which bees have emerged, often show little or no trace of individual cells, probably due to the heat making the resin soft and allowing the material gradually to settle.

The contents of the cells, of the nest observed, were examined on September 26, with the following facts noted. A cocoon was found each in cells 1 and 3; but larvæ in 4 and 5. Number 2 contained much pollen and a small dead larva. The lower end of the first cell had been closed with a layer of pebbles and resin about one millimeter thick The upper end of the inner space of the cell was filled with a cocoon, surrounded with pellets of excrement; the lower part contained a space partly filled with excrement. The cocoon possessed a very distinct mammillary projection which extended downward. The head of the larva has always been towards this point.

The length of a typical cell has been found to be 15 mm. At the end opposite the location of the orifice the mass of pollen, filling the cell for a distance of 5 mm., is stored. The remaining 10 mm. of space is at first empty; later, when the larva has developed, part of the space is filled with the cocoon and part with excrement.

On October 3, the larva of cell number 4 had a fully formed cocoon which had been started October 1. The mammillary point first consisted of a round hole, with a white outer surface of silk. The larva of number 5 started a cocoon on October 6. It was at first very thin and white and early had a mammillery point apparently closed. The following day the cocoon was more compact and darker. A few days later it had quite its normal color.

On January 31, 1926 a nest, agreeing in all points of construction with nests of *D. pudicum,* was found attached to a rock along the railroad of East Boulder. Four female and one male *Monodontomerus montivagus* Ashmead emerged from a typical Dianthidium cocoon on February 20. A single hole was chewed through the side of the cocoon, all emerging through this opening. The male was observed to mate with two females. When he first alighted on the female, she vibrated her antennæ very rapidly, after which she remained nearly motionless. The male, well forward on the female, continued a rather periodic raising and lowering of his antennæ, moving first the one and then the other. Frequently he would raise his wings, vibrate them rapidly for a second, then lower them until the performance was repeated again in about 20 seconds. After 3 minutes the male moved back and copulation was effected, lasting but a second.

From another cocoon a wasp, *Odynerus* (*Stenodynerus*) n. sp.[4] which appears to be parasitic on *D. pudicum,* emerged on March 5. No other insects emerged and on May 5 the remaining two cocoons were opened. Each contained a wasp, nearly mature, but dead. These wasps were not easily determined but appeared to be young of *E. proxima.* The nest had been used a number of times as was evidenced by the fact that used cocoons were found, one within another, to the number of seven. While no bees were reared from the nest, the cocoons, type of nest, etc., were so typically those of *D. pudicum* that it has seemed safe to consider it as such.

A nest, also agreeing with the nests of *D. pudicum* taken here, was found in the summer of 1926 by Mrs. Hicks at Uva, some 6 miles north of Wheatland, Wyoming. One of the cocoons of this nest contained dead, but nearly mature parasites, *M. montivagus.*

[4]Kindly determined by Mr. S. A. Rohwer. More evidence should be obtained before definitely ascribing this wasp a parasite of *D. pudicum.*

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NESTING HABITS OF A SOLITARY BEE OF THE GENUS *SPINOLIELLA* OF ASHMEAD[1]

By Clarence P. Custer,
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The nests of the bees of this genus are generally hard to find. The insects are so small, usually not more than a quarter inch long, that they are difficult to follow in their flight. In fact, so far as I can tell, no information is available on their nesting habits.

It was on a fine sunny day in the latter part of August, 1927, while visiting the Country Club at Denver, Colorado, that my attention was called to some small mounds of dark soil resembling ant nests. These were located along the side of a tennis court. It was soon evident that they were the nests of some bees. They had picked three different areas in which to establish their dwellings. Each colony possessed some forty or fifty nests separated from one another by a distance of about six inches.

Each day the courts had been moistened and rolled by the caretaker. And each day the busy owners had thrown up the small mounds of soil over their entrances. When I arrived, the colonies were bustling with work. Here was a bee opening the entrance to her nest. Up the tunnel she backed, pushing a load of earth. When almost to the top, she suddenly stopped and descended for another load. The earth in the entrance-way remained without falling. Presently she was up again with some more. This was also pushed out of the entrance a portion remaining in the passage-way as before. The little mound of soil above the nest was steadily increasing in size. Over here was a female just in from the fields. Her hind legs were heavy and quite conspicuous with their loads of green pollen. Back and forth she circled, undecided which of the nests was her own. Several times she alighted on the ground. After a minute, the problem solved, she hovered over her nest and entered. In other

[1]*Spinoliella australior* Ckll. Determined by Miss Grace Sandhouse.

places, other females were coming in from the fields. Some had loads of green pollen; others had yellowish-green. Could they be visiting different species of flowers?[2] All the while, in a constant whir of motion, the males of the colony were circling above the nests. Occasionally one alighted for a moment or two but was soon on his way. The male was not to be worried with the intricate problems of nesting. His was a life of pleasure.

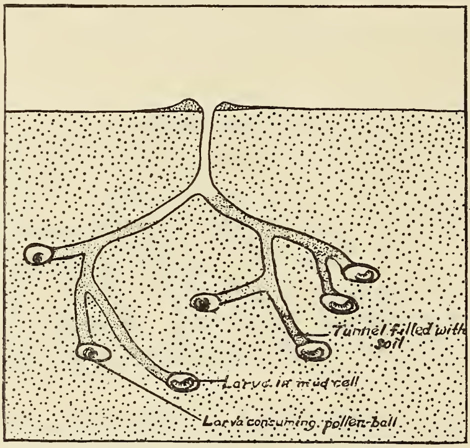

Fig. 1. Plan of nest of *Spinoliella australior*. The nests, which extend down to a depth o f three or four inches, contain about seven larvæ. This is a vertical section of the earth showing all the ramifications of the nest. Coarse stippling indicates cut surface of earth; light stippling, loose soil. (One half natural size).

Upon digging up the nests of these bees, I was surprised to find that they extended no deeper than three or four inches. Most of the tunnels led straight down for an inch and then branched. So far as the galleries were open, it was clear which way they went. But when I reached the depth where they had been filled with soil, the passage-way was usually invisible. It blended perfectly with the surrounding clay. However, in a few instances, I was able to trace the galleries down to the cells. The general plan of these nests is shown in Fig. 1. The main tunnel usually branched once, and then the two passage-ways

[2]Miss Sandhouse informs me that *Spinoliella australior* visits the flowers of the following plants: *Dithyrea wislizeni*, *Cleome serrulata* and *Solidago canadensis*. The pollen of *Cleome serrulata* is somewhat green.

resulting from this gave off three or four short galleries each of which ended at a cell. Hence there were approximately six cells to each nest. If it is to be assumed that each female is capable of laying fifteen eggs, then more than one nest must have been provisioned by each bee. She probably finished one nest and then constructed another. Surely a female was not taking care of two nests simultaneously as has been observed in the case of *Dianthidium sayi* Ckll. The reason for the latter assumption lies in the fact that in one colony of *Spinoliella*, consisting of about forty nests, I collected thirty-seven females. Then, when it was visited a few days later, there were just four nests being provisioned by as many bees. This is conclusive evidence that there was but one bee to a nest and *visa versa*.

As in the case of *Perdita opuntiæ* Ckll.[3] the pollen is constructed into a sphere and one end of the egg is inserted into this.[4] Furthermore, the cells for the larvæ have their walls similarly smoothed as though the insect had lapped them with its tongue. And, finally, it is interesting to note that the larvæ of these two bees are almost identical. Each has the typical double row of spines down its back. Some of the larvæ of *S. australior* are just as white as are those of *Perdita opuntiæ*; others however, which have probably consumed an over-abundance of pollen, are somewhat yellow.

In the key by T. D. A. Cockerell and W. W. Robbins ('10) the bees of these two genera differ principally from one another in the length of the marginal cell. In *Perdita* it is short and broadly truncate; in *Spinoliella* it is narrow and long.

It is hoped that further comparative work can be done on the nesting habits of *Perdita* and *Spinoliella* which resemble one another in so many respects.

[3]See Custer ('28).

[4]Malyshev ('25), in Russia, states that the larvæ of *Systropha planides* so start eating the pollen ball that it lies on their ventral surface, on top of them, thus preventing it from drying out from coming in contact with the cell wall. In the nest shown in Fig. 1 above, I found a larva in a similar position. This larva is pictured directly beneath the entrance.

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BEES OF THE GENUS HALICTUS FROM MIAMI, FLORIDA

By S. Graenicher,
South Miami, Fla.

The following two species belong to the group of Chloralictus with punctured tegulæ.

H. (Chloralictus) marinus Crawford.

Described from the female (1,99). The punctured tegulæ, which are pointed posteriorly, place it next to *tegulariformis* Crawford (New Mexico) in the Sandhouse key to females (3,1), but in the latter species the disk of the propodeum is granular while in marinus it has longitudinal rugæ running the length of the disk.

Male. Entire face up to the median ocellus covered with a dense short white pubescence. Head behind the eyes, sides of meso— and metathorax, scutellum, femora and sides of abdomen with long white hairs. Mesonotum and abdominal segments one to four above, shining and nearly bare. Facial quadrangle much narrower and longer than in the female. Clypeus produced half its length beyond the eyes. Antennæ dark above, light ferruginous underneath from second joint on. Tegulæ bare, shining, the punctures more plainly visible than in the female, Abdomen slender, with hardly a trace of testaceous coloration along the apical margins of the segments. Knees and tips of tibiæ narrowly testaceous, tarsi nearly white.

This species occurs at Miami Beach (across Biscayne Bay from Miami), where I have collected both males and females in January, July, August and December, at the flowers of the sunflower *Helianthus debilis.*[1] Quite recently (April 23, 1927) five males were found at Golden Beach (on the Atlantic Ocean north of Miami), visiting the flowers of *Alternanthera floridana;* also, one male and two females (April 29) on the sand dunes along the

[1]Nomenclature according to Small's "Flora of Miami" and the same author's "Flora of the Southeastern United States."

Atlantic Ocean north of Cape Florida (on Biscayne Key, across the Bay southeast of Miami). These, too, were taken on the flowers of *Alternanthera floridana.* In all three localities they were encountered on the upper beach, a short distance from the ocean, and this agrees entirely with what Viereck and Crawford observed in New Jersey and Virginia. According to the former's statement (cited by Crawford, **1**), the specimens were swept at Ocean City, N. J. (type locality) from plants "growing along the strand just within the beach, and constituting the first zone of plant life from the ocean." Crawford (**2**,580) came across this species at Virginia Beach, Va. "on grasses on the beach just above high tide limit." In view of these facts it is safe to assume that *H. marinus* is an inhabitant of the upper sandy beaches along the entire Atlantic coast from south Florida to New Jersey.

Halictus (Chloralictus) lepidii, n. sp.

Female. Length about 4.5 mm. Head and thorax dark green, abdomen dark brown. Antennæ dark with testaceous tips. Facial quadrangle longer than broad, plainly narrowed below. Clypeus produced more than half its length beyond the eyes. Punctures on front and sides of face small and close together, those on supraclypeal area larger and farther apart; on the clypeus they become much coarser towards the base, which is dark purple. Sides of face with short sparse whitish pubescence. Mesonotum with fine pucntures, close on top, more scattered along the sides. Metathorax coarsely punctured. Scutellum much more finely and closely punctured than the adjoining portion of the mesonotum. Propodeum truncate with smooth rounded angles. Disk with inconspicuous short plicæ. No rim. Abdomen ovate. First two segments smooth and shining with whitish hairs on the sides. Remaining segments covered with short, sparse pubescence. Extreme apical margin of each segment faintly testaceous. Front wing about 3 mm. long, somewhat dusky. Tegulæ black and shining, lighter on top, with inconspicuous sparse punctures. Veins dark, stigma dark testaceous. Second submarginal cell about as long as high, much narrowed above. Third submarginal over one and one-half times as long as the second on the marginal vein. Legs dark, clothed like the rest of the body with pale pubescence.:

Male. Differs from the female as follows: Mesothorax of a lighter green and more shining. Abdomen black, long, very slender, smooth and shining above along its entire length. Facial quadrangle much narrower below. Face below antennæ with a dense covering of short white pubescence. Antennæ below testaceous from third joint on. Third antennal joint a little longer than second. Tegulæ more closely punctured. Ridges on disk of propodeum shorter and less distinct. Wings clearer, stigma and veins darker, the latter more sharply defined. Second submarginal cell shorter.

Described from twelve males and fourteen females captured at South Miami, Miami, Cape Florida (across the bay southeast of Miami), Golden Beach and Hollywood (both north of Miami). They were visitors to the flowers of *Lepidium virginicum, Warea Carteri, Galactia pinetorum, Sida carpinifolia, Chrysopsis Tracyi* and *Alternanthera floridana.* Type and allotype in the author's collection.

In the Sandhouse Key to females this species runs next to *ellisiæ* Sandhouse from Massachusetts (3,11), but differs mainly in the following characters: antennæ testaceous at the tips, scutellum closely punctured all over (no smooth spots on the disk), tegulæ slightly testaceous above, disk of propodeum with ridges on basal half.

H. (Chloralictus) nymphalis F. Smith

Described from St. John's Bluff, East Florida (4,68.) There are in my collection specimens from Miami, South Miami and Hollywood (north of Miami) and also one from Jacksonville (near the type locality) captured September 25, 1925. At South Miami it flies with slight interruption throughout most of the year, but seems to be present in greater numbers during the fall months. It has been taken at the flowers of *Opuntia austrina, Croton linearis, Galactia pinetorum, Lepidium virginicum, Warea Carteri, Chrysopsis Tracyi* and *Portulaca oleracea.* It prefers sandy soil, and will probably be found in suitable locations along the entire East Coast of Florida.

H. (Chloralictus) longiceps Robertson

Described from the female (5,272). This species is easily recognized on account of its long, narrow head with the strongly produced clypeus, and the swollen upper portion of its occiput.

Male. Face narrower and longer than in the female, covered to a little above the antennæ with short loose pubescence. Face above the antennæ, and vertex with a brassy tinge. Antennæ slightly testaceous underneath from the third joint on. Third antennal joint longer than second, fourth nearly as long as second and third combined. Wing veins darker and more clearly outlined than in the female. Abdomen slender, black and nearly bare except near the tip. Tarsi white, the last joint brownish.

The time of flight of the females covers the entire year. Males and females have been taken at Miami, South Miami and Hollywood at the flowers of *Croton linearis*, *Warea Carteri*, *Lepidium virginicum*, *Pycnothymus rigidus*, *Opuntia austrina*, *Galactia pinetorum*, *Laciniaria gracilis*, *Mikania batatifolia*, *Chrysopsis Tracyi* and *Solidago angustifolia*.

Halictus (Chloralictus) halophitus n. sp.

Female. Length 5.5 mm. Head and thorax dark green and shining. Abdomen ovate, dark brown with narrow, hardly perceptible testaceous margins. Dirty-white pubescence of body sparse and short, longer on sides of thorax and femora. Face longer than broad, narrowed considerably below. Clypeus produced nearly its entire length beyond the eyes. Punctures of the face delicate and close together, those of the supra-clypeal area and clypeus coarser and less numerous. Clypeus with a purplish reflection, mandibles reddish beyond the middle. Apical region of antennæ faintly testaceous. Mesonotum finely and closely punctured on a slightly roughened surface. Mesopleuræ coarsely scluptured. Tegulæ shining, light testaceous, rounded in front, nearly straight behind. Front wing about 3.8 mm. long. Wings somewhat dusky, veins dark testaceous, stigma much lighter. First submarginal cell nearly as long as second and third together. Second considerably shorter than third, narrowed one-third towards the marginal. Disk of propodeum without a rim, narrowed towards the apex to such an extent as to appear somewhat triangular. Its surface finely granular, with a distinct median ridge, and about 8 lower and much shorter ones on each side. Legs dark, knees and tarsi testaceous. Abdomen shining throughout, especially the first segment, which is smooth. Remaining segments with indistinct scattered punctures.

Male. Inner orbits straighter than in the female, especially above. Face densely covered with a short white pubescence beneath the antennæ and on the sides above. Mandibles slender, very light testaceous, tips blackish. Labrum light testaceous. Antennæ dark on upper surface, reddish underneath from the second joint on. Third joint longer than second. Mesonotum and scutellum shining, nearly bare. Ridges on disk of propodeum more numerous but less prominent than in the female. Knees, tips of tibiæ and tarsi light yellow. Abdomen slender, very shiny with metallic reflections. Apex of first segment convex, forming a distinct depression between it and the second segment.

Described from six males and seven females taken April 20, May 20 and August 15 at Cutler, south of Miami, on the flowers of *Bramia Monniera* and *Sesuvium maritimum.* Type and allotype in the author's collection.

The low marshy grounds in this locality border on Biscayne Bay. On account of the influence of high tides and occasional storms which drive the water up over the shores, the soil supports a typical halophytic (salt-loving) plant association, and the two species mentioned above (Bramia and Sesuvium) form low carpet-like patches between the shrubs and small trees inhabiting the dryer portions of the marsh.

This species seems to be most closely related to *tropicior* Ellis, from Guatemala (8,219), but the female differs from that of tropicior as follows: clypeus produced nearly its entire length beyond the eyes, punctures uf mesonotum closer together (not scattered as in tropicior), abdominal segments with testaceous margins.

H. (Chloralictus) rhododactylus D. T.(*fulvipes* F. Smith)

A female captured July 19, 1916 at Homestead (28 miles south of Miami) evidently belongs here. Type locality: St. John's Bluff, East Florida (**4**, 67). This specimen agrees well with the original description, as also with the notes furnished by Cockerell (**9**, 351), who examined the type in the British Museum. I have never come across it since, and it seems to be a rare insect in this part of Florida.

H. ligatus Say.

For this species Robertson has proposed the genus Odontalictus (**7**, 91) on account of the cheek of the female being produced into a tooth. It is by far the most common bee of our surroundings, flying throughout the year, and visiting a great variety of flowers, especially Compositæ. Robertson (**6**,322) has given a synonomy of this widely distributed and variable species, and pointed out that the specimens from Florida belong to the form described by F. Smith as H. capitosus (**4**, 67).

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EVIDENCE IN SUPPORT OF THE OLFACTORY FUNCTION OF THE ANTENNÆ OF INSECTS.[1]

By R. W. Glaser

1. *The Present Status of the Problem.*

Investigators agree that chemotropism or the reaction of an animal to chemical stimuli plays a very important role in the biology of insects. Richardson (1) recently reviewed the extensive literature on odor as a factor in the selection of places for oviposition and in the choice of food. Odor likewise assists insects in gathering material for their nests, in detecting members of their own or "alien" species, and in bringing the sexes together.

The assignment of the sense of smell to particular organs has been beset with great difficulties. Most histologists assign the olfactory sense chiefly to the antennæ. On these organs sensillæ are found in the form of pits, cones or plate organs which are morphologically of such a nature that a chemoreceptor function has been attributed to them. Similar sensillæ may occur in other places, as on the maxillary and labial palpi, on the cerci and perhaps elsewhere, but they seem generally to be numerically greatest on the antennæ. Correlations between the number of antennal sensillæ and the habits of certain insects have disclosed a number of facts. The antennæ of Diptera that oviposit on putrid meat or feces harbor many olfactory pits whereas phytophagous forms possess few. Bloodsucking flies have many, as do those forms whose larvæ are parasitic, such as Oestrids, Bombyliids and Tachinids. The Hymenoptera possess enormous numbers of antennal sense organs. In male honey bees the number of plate organs has been computed at 30,000. In Odonata, large-eyed forms that prey on other swiftly moving insects, the number of antennal olfactory sense organs is small. Among those species where sexual dimorphism of the antennæ exists, these organs are generally more fully developed in the males than in the females. This seems to be associated with the more

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aggressive nature of the males and assists them to find the opposite sex even at great distances.

Contributions on the habits of certain moths by Forel (2) and Riley (3) and the extremely interesting deductions made from careful observations on the life of ants by Forel (2), Wheeler (4), Lubbock (5), Bethe (6), Wasmann (7), Fielde (8), and others seem to demonstrate that the antennæ serve as tactile and olfactory organs. The results of these investigators may be briefly summer up. They chiefly considered the behavior of insects when subject to various stimuli, such as the exploratory movements of the antennæ when the creatures are searching for food or for proper places to lay their eggs; the antennal movements and subsequent behavior of insects when encountering members of their own or "alien" species; the part the antennæ play when the animals are attempting to find their way to their nests and back to the forage supply; the trilling of the antennæ by males in the presence of females, etc.

Experiments to prove the above contentions are not lacking. Forel showed that certain insects which appear to find their mates by smell are unable to do so when the antennæ are amputated. Kellogg (9) showed that when one antenna is removed from silkworm moths, they always turn towards the source of odor stimulation in the direction of the remaining antenna. Barrows (10) demonstrated that Drosophila is unable to respond to odors when the last segment of the antennæ is removed. Von Frisch (11) trained bees to come to an odorous food supply. When the antennæ were amputated the bees could no longer find the food. In order to prove that this failure was not due to any general constitutional effects of the operation, he trained other bees to associate the food with a particular color. When the antennæ of such bees were removed they promptly found the food. Minnich (12) in some experiments on the cabbage butterfly found that the antennæ were olfactory organs but not the only ones. Most of the experimenters referred to agree that some insects will still respond, but much more slowly, to odors after the antennæ have been removed or coated with substances impermeable to volatile materials. This seems to show that olfactory organs are also located in other regions of the body.

McIndoo (13) entirely discards the view that the antennæ function as olfactory organs. This investigator has done much work on this subject and has experimented chiefly with beetles, bees and ants. McIndoo considers the abnormal behavior of insects towards odor when the antennæ are amputated, but thinks this is due to the fact that such insects are abnormal in their whole behavior. This is, of course, contrary to von Frisch's careful experiments and, if true, would apply equally to McIndoo's own work. Any animal that has been deprived of a sense organ will react abnormally with respect to a stimulation that affects this particular organ. McIndoo finds that olfactory pores exist in other regions of the body, especially at the bases of the wings and legs. When these pores are varnished over the insects respond much more slowly to odors than do those whose antennæ are amputated. Kennedy (14) recently carefully weighed the evidence for and against the antennal sense of smell and thinks that while olfactory receptors undoubtedly do occur on other parts of the body, the experimental evidence against the older theory of an antennal sense of smell is insufficient. Judging from the literature, it seems that much substantial evidence exists in favor of the older theory. However, since roaches are exceedingly favorable material for a study of this question and furnish another rather lucid illustration in support of the older view, the writer feels prompted to report some observations.

2. *Observations and Experiments on Periplaneta americana.*

Periplaneta americana, the large American roach, carries two extremely long antennæ on which occur the so-called olfactory cones. The maxillary and labial palpi of this species also bear sense organs which were, likewise, considered by Graber to function in the detection of odors. It was noticed by us that the antennæ of starved roaches moved continuously when some odorous food was tendered but held at a distance to prevent contact. This then led to the performance of some further experiments which would demonstrate whether the antennæ harbored chemoreceptors. Full grown male and female roaches were placed in an atmosphere containing a slight amount of ether vapor. After a minute or two the insects began to behave in a curious manner. First one antenna was pushed down with the fore legs, caught near the base and rapidly passed through the mouth parts clear to the tip when it was released and the procedure repeated with the other antenna. This apparent cleaning of the antennæ continued indefinitely, or until the animals became completely anaesthetized. The maxillary and labial palps were also frequently drawn through the mouth. The same reactions occured when carbon tetrachloride vapor or bromine was used. Two inert esters, ethyl acetate and amyl acetate (banana oil) produced identical reactions. The animals simply responded to these volatilized substances with their antennæ and palpi. No other reactions occurred until the anaesthetic effect through the spiracles became noticeable. These experiments, it seems to us, signify that chemoreceptors are located on the antennæ and on the maxillary and labial palps. This, however, does not necessarily mean that these chemoreceptors are those of smell. The reactions obtained might very easliy represent merely the effect of violent chemical irritations such as the reaction of the human eye to onion oil or the reactions of the mucous membrane of the human mucosa to pollen particles. It seems unlikely, however, that two such inert substances as amyl and ethyl acetate could produce much irritation aside from exciting perhaps an obnoxious odor sensation in the insects. Nevertheless, insect sense organs are constructed differently from those of higher animals. Their surfaces, as pointed out by Kennedy, are often external and on long processes. They are also dry and consequently the direct contact with a chemical stimulus, not first dissolved in mucous secretions, may explain the differences in behavior and the reason for the great sensitivity to such stimuli. To meet the objection of simple chemical irritation and to prove that olfactory sensations are received through the antennæ some additional experiments were performed.

Two roaches with perfect antennæ were segregated in an oblong cage having a glass top and a corked hole on each of two ends. These holes were ordinarily used for the introduction of food and water. Another pair of roaches with their antennæ amputated at the base was placed in a similar cage. Each cage was completely divided in half by a double layer of a fine mesh copper screen, producing two compartments, one for the roaches the other empty. The roaches were then held for two days to permit the operated ones to recover from the effects of the amputation. During this time they were given nothing but water in order to create an intense hunger. On the second day the insects seemed perfectly normal and a small piece of Roquefort cheese, for which these animals manifest a great fondness, was placed in the empty compartment one inch from the copper screen. In a few seconds the normal insects, which were huddled in a far dark corner, began to move their antennæ and within two or three minutes one began to move over towards that part of the screen from which the cheese odor emanated. This one waved his antennæ about near the cheese, but not being able to touch it soon returned to the corner. A little later the other roach followed the same maneuver. Both insects repeated this behavior three to four times. During the entire length of these operations, the roaches with amputated antennæ gave no response and when they moved they progressed along the side opposite the cheese which happened to be the darker side. During these tests both cages were held in the same position and at the same distance from the source of light. The cheese and the roaches were then removed and the cages washed thoroughly to remove all odors.

In a few days the roaches were again placed in their respective cages, and after the animals had been starved again for two days some Roquefort cheese was smeared on each cork plugging the hole of the compartment containing the insects. Within one to two minutes the normal roaches ran over to the soiled cork and ate off the cheese. The roaches with amputated antennæ did not respond. After more than two hours they finally came across the cheese, waved their palpi and ate. It seems that the antennæ receive smell impressions at considerable distances and that the maxillary and labial palps can only perceive an odor when the insects are in close proximity to the volatile substance. The antennæ, maxillary and labial palpi were removed from another group of roaches. After recovery from the operation, and after the customary starvation, they had even greater difficulty in finding the cheese than those roaches with simply the antennæ amputated. They did not perceive the cheese until it was placed under their mouth parts, when they carefully tasted it before eating.

Another experiment appears significant. If the end of a stick is smeared with cheese and held at a distance of about one inch from the head of roaches with amputated antennæ nothing occurs. When the same stick is held at the same distance from the head of the normal roaches the antennæ follow the movements of the stick until they touch it, much like the pursuit of a magnet by a piece of iron. If one antenna is removed and the other left intact and the contaminated stick is held alternately on the right and left side of the head, the response occurs in about half the time on the unoperated side than on the other.

Naturally cheese is not the only substance that produces the above reactions. Dog biscuit will cause an identical response in starved roaches, but more tardily due to the much slighter odor emanating from this food.

Roaches are gregarious animals and are often found huddled together in enormous numbers. These insects emit a strong species odor rather disagreeable to humans. This odor is probably responsible for their gregarious habit. During the course of our experiments, it was noticed that those insects with the antennæ removed did not huddle as readily as was the case with the unoperated ones. After huddling the roaches with antennæ were separated by disturbing them with a prod. In approximately one-half minute they were usually found together again. Those with amputated antennæ remained separated until they accidentally ran into one another.

All of the roaches operated upon are alive up to the present (six weeks after the experiments). They behave perfectly normally in so far as their appetite is concerned and the females have deposited several egg capsules. That they are abnormal with respect to the function of smell is a foregone conclusion, but it would certainly require a stretch of the imagination to assert that they were abnormal in all their behavior.

3. *Conclusions.*

Chemoreceptors are located on the antennæ, maxillary and labial palps of *Periplaneta americana*. The antennæ are the most efficient organs in detecting odor stimuli, especially from a distance. This does not imply that olfactory organs do not exist elsewhere on the body.

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THE *TRICYPHONA INCONSTANS* ON NANTUCKET ISLAND, MASS.

By Charles W. Johnson.

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While collecting insects along the margin of Upper Hummock Pond, Nantucket, June 25, 1926, I collected some specimens of this common species. I did not examine these carefully until my return home and was then surprised to find that the two or three I had pinned had an unusual number of supernumerary cross-veins in the second submarginal cell (cell 4), whereupon I went over the sweepings from that locality and found in all 15 specimens, all having the supernumerary cross-veins confined to cell 4. The numbers of the supernumerary cross-veins in the right and left wings are given in the following table.

No. speciment	Right wing.	Left wing.
1 (Fig. 1)	7	3
3	4	3
1	3	4
2	3	3
3	3	2
1	3	1
2	2	2
1	1	2
1	1	1

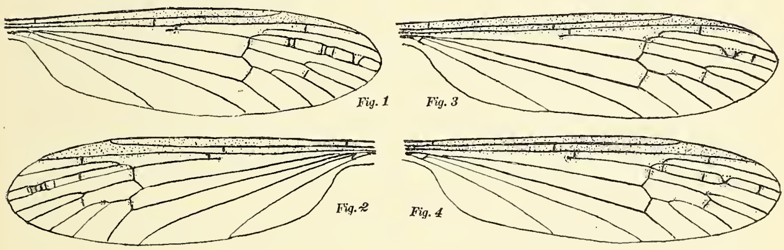
Visiting this place again on July 16 I was unable to find a single specimen. The locality was again visited June 7, 1927, and five were obtained showing the following variation.

No. Specimens	Right wing.	Left wing.
1 (Fig. 2)	7	4
1	3	3
1	1	3
2 with normal vanation.		

On June 22, 1927, at the same locality 18 specimens were taken, showing the following variation.

No. specimens.	Right wing.	Left wing.
1	4	6
1	5	2
1	4	4
2	4	3
1 (Fig. 3)	3	4
2	3	3
1 (Fig. 4)	5	2
1	4	1
1	3	2
1	2	3
1	2	2
2	1	2

1 with normal venation.
1 with discal cell open on the left wing.
1 with the first submarginal cell (cell 3) normal on the right wing, but on the left wing of the same length as cell 4.



Figs. 1-4. Wings of *Tricyphona inconstans.*

In 1901 I published a paper on the variation of this species (Entom. News, vol. 12, p. 305) but the material at hand was from various localities and as usual only a small percentage of the specimens taken showed abnormal venation. To find therefore a locality where the conditions were reversed seemed very remarkable, and that the supernumerary veins should all be confined to cell 4 was likewise interesting. In examples where the supernumeraries are numerous or where some of them are oblique there is a tendency for the longitudinal veins to be imperfect. This part of the vein is indicated by dots in the accompanying figures. If this species could be readily bred it would form an interesting subject for a study in genetics.

THE NORTH AMERICAN SPECIES OF RYBAXIS

By H. C. Fall,
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The little group Rybaxis, call it genus or subgenus as you prefer, was established by Saulcy in 1874 to contain a few species definitely separable from Bryaxis by the presence of a sharply impressed biarcuate groove connecting the lateral pronotal foveæ, and a deep submarginal stria on the vertical flanks of the elytra. At that time two species only were known in our fauna which possessed the characters of the new genus, viz.—*Bryaxis conjuncta* described by Le Conte in 1850, and *B. clavata* described by Brendel in 1865 as a supposed "northern climatical form of *conjuncta*, but declared by him the year following to be a distinct species, differing from *conjuncta* in certain sexual characters, notably in having the anterior trochanters armed with a short sharp spine, the same being unarmed in *conjuncta*. In the Crotch Check List of 1873 Dr. Horn changed the name *clavata* to *brendelii*, the former being preoccupied.

On page xli of the Horn Bibliography by Henshaw (Trans. Am. Ent. Soc. 1898) there is a synonymical note from Mr. Schwarz pointing out that while Dr. Brendel had discovered that there were two distinct species included under the name *Bryaxis conjuncta*, one with the front trochanters of the male spined, the other not, through a failure to read Le Conte's original description Brendel in describing his *clavata* with spined trochanters succeeded only in rediscribing Le Conte's *conjuncta*, thus leaving without a name the species with simple male trochanters which he had wrongly assumed to be the true *conjuncta*. Oddly enough Le Conte himself, apparently completely forgetful of his original description, follows Brendel's lead and in his table of the genus in the "Transactions" of 1880 uses the name *conjuncta* for the species with simple male trochanters.

The Schwarz note of nearly thirty years ago however seems to have been generally overlooked and the error there pointed out still awaits adjustment; moreover some recent study by the writer of available Rybaxis material shows that the problem is not quite so simple as at first supposed, for instead of having to do with two species only, I have discovered that we have at least half a dozen species that pass under the old names, of which several satisfy about equally well the descriptions of *conjuncta* and *clavata.*

Obviously, before further progress can be made, it becomes necessary to determine just what *conjuncta* and *clavata* really are. This has been done with the highest degree of probability possible by a critical study of the respective series under these names in the Le Conte and Brendel collections. As a result of this determination, *conjuncta* and *clavata,* supposed by Schwarz to be identical, prove to be quite distinct species.

All our species of Rybaxis are superficially very similar, and for the most part are only recognizable with certainty by the secondary sexual characters of the males, the females by themselves being often indeterminable. In all our species the males have the anterior tibiæ acutely dentate within above the middle, and in most of them the antennal Club is enlarged and otherwise modified, and the anterior trochanters are apically spined or toothed in this sex. In addition to these characters, all of which are given in the books, the early descriptions of *conjuncta*(1850) and *clavata* (1866) record the presence in the male of acute metasternal processes. These are usually invisible in mounted specimens, and both Le Conte and Brendel seem to have forgotten all about them, for they make no mention of them in their later writings when speaking of sexual characters nor do any subsequent authors appear to have noted their existence.

In the examination of my material I have discovered still another and most remarkable structure which seems to be present with modifications in the males of all species of this genus, and which hitherto has apparently entirely escaped observation. This consists of a very small thin ligula arising perpendicularly from the rear margin of the second ventral segment for a short distance, then abruptly bent forward and more or less expanded into a thin nearly horizontal plate, variable in form and size according to the species, and sometimes to a lesser degree individually. The form of this ventral plate, the position and form of the metasternal processes, the modifications of the antennal club, and to a less extent the distance apart of the dorsal abdominal carinæ, constitute the chief diagnostic characters used in the table following. Color is of no value whatever, all species probably varying from pale dull yellow to blackish with elytra of some shade of red or brown. Likewise the ordinary distinctions in size, form and sculpture are so slight as to be of little or no use in determining the species.

Table of Species.

1. Median pronotal fovea larger, spongiose pubescent.. .*valida.*
   Median pronotal fovea small, nude.....................2
2. Antennal club a little larger in the male, the last joint with an oblique tooth beneath near the base; dorsal abdominal carinæ unusually approximate, being separated at base by only about one fifth the discal width of the segment.......................................3
   Antennal club in the male with last joint not toothed beneath.......................................4
3. Metasternal processes posterior in position, feebly developed, consisting merely of obtusely rounded tumidities; ventral plate small, subquadrate.........*truncaticornis.*
   Metasternal processes long and acute, similarly posterior in position; ventral plate lacking, but in its place an obliquely erect parallel sided laterally compressed process, its summit blunt.........................*obliquedens*
4. Antennal club in the male stouter and more cylindrical, the lower surface flattened and more or less asperate........5
   Antennal club not appreciably modified in the male........8
5. Pronotum of male more angularly prominent at middle of hind margin; metasternal processes rather widely truncate at apex as viewed from the side.........*conjuncta*
   Pronotum much less prominent medially behind, the metasternal processes acute.............................6
6. Metasternal processes more nearly median in position; ventral plate moderately transverse, less than twice as wide as long, truncate in front, and either subangulate or

rounded posteriorly; dorsal abdominal carinæ separated at base by slightly less, and at apex by very nearly one-third the discal width of the segment. . . . .*clavata.*

Metasternal processes posterior in position.... 7

7. Ventral plate of male very strongly transverse, typically fully three times as wide as long; dorsal abdominal carinæ separated even at base by distinctly more than one-third the discal width of the segment. . . . .*transversa.*

Ventral plate of male very small, more or less rounded behind, truncate in front, a little variable but usually about as long as wide; dorsal abdominal carinæ separated at base by slightly less than one third the discal segmental width.. . . . .*mystica.*

8. Metasternal processes of male anterior in position, widely separated, strongly developed and acuminate; dorsal abdominal carinæ separated at apex by one-third the discal segmental width. . . . .*varicornis.*

Metasternal processes anterior, short, closely approximate, and blunt at. tip; dorsal abdominal carinæ separated at apex by one-fourth the discal segmental width.*geminata.*

Metasternal processes posterior, feeble, being merely obtuse tumidities; dorsal abdominal carinæ separated by only about one-fifth the discal segmental width. ... .*arkansana.*

Rybaxis valida Brendel.

This species is our only one having the median pronotal fovea pubescent and is instantly recognizable thereby. The antennæ are rather slender, all joints, including those of the club, longer than wide, the latter not modified in the male. The dorsal abdominal carinæ are plainly more widely separated than one-third the discal width of the segment. The ventral plate, in the single male at hand in which it can be seen, is quadrate and slightly wider than long. The male front trochanters appear to be unarmed. The size is slightly larger than in any of our other species.

Described from New York and Illinois; specimens before me are from the latter state.

Rybaxis truncaticornis Brendel.

This species was described by Brendel in two lines as a variety of *conjuncta*, as he understood the species. It is however entirely distinct in numerous respects from the supposed as well as the true *conjuncta*, differing from all our other species except the next by the oblique tooth on the lower surface of the last antennal joint in the male. The anterior coxæ of the male are armed with a small apical tooth.

The type locality is Iowa, and all specimens seen by me are from that state; most, if not all of them taken at Iowa City and distributed by Prof. Wickham.

Rybaxis obliquedens sp. nov.

Closely related to the preceding species by the oblique tooth of the terminal joint of the antennæ in the male, and the more than usually approximate dorsal abdominal carinæ; but the metasternal prominences which in *truncaticornis* are feebly developed, are here long and acute. In the form of the process arising from the second ventral segment, with its total lack of a surmounting horizontal plate the present species is unique among our representatives of the genus. The anterior trochanters of the male are armed with a long slender spine instead of a short tooth as in *truncaticornis*.

Seven examples of this species are before me, all sent by Mr. Liebeck. These include 1 ♂ and 4 ♀ s from "Pa." (vicinity of Philadelphia), 1 ♂ from Burlington, Iowa) and 1 ♂ without locality. The Pennsylvania male is taken as the type.

Rybaxis conjuncta Le Conte.

The peculiar greater angular prominence of the pronotal disk at the middle of the hind margin in the male, and with it a correspondingly more pronounced angle at the middle fovea between the parts of the biarcuate groove, distinguish this species from all others. This character is only feebly indicated in the female. All three joints of the antennal club in the male are sparsely asperate beneath; the dorsal abdominal carinæ are separated by ⅓ the discal segmental width or possibly slightly more (at their apex); the anterior trochanters of the male are acutely toothed at apex; and the apices of the metasternal processes are rather widely truncate. This is one of our larger species and is only equaled or perhaps slightly exceeded in size by *valida* and *transversa* n. sp.

Le Conte's original specimens were described from "provinciis orientalibus." The only specimen at present in his series which could possibly have served as his type in 1850 is a male of the present species and bears a colored locality disk which signifies Massachusetts or possibly New England. There are in my collection four examples from Three Mile Island in Lake Winnipesaukee, New Hampshire, and I have seen other specimens from Mass.; N. Ill.; Canada (Toronto and Ottawa); Idaho (Coeur d'Alene); and one in Mr. Liebeck's collection labeled "Cal."

Rybaxis clavata Brendel.

Antennal club in the male much enlarged, subcylindrical, flattened beneath, blackish except toward the tip, 9th and 10th joints nearly or quite twice as wide as long, the flattened lower surface strongly asperate almost throughout. Dorsal abdominal carinæ separated at tip by ⅓ the discal width of the segment. Anterior trochanters armed with a slender spine. Metasternal prominences finely acute and more nearly median in position than in any other species. Ventral plate about 1-2 wider than long, truncate in front, narrowed posteriorly.

In his original description of *clavata* Brendel gives no specific locality, but merely states his belief that it is a northern form of *conjuncta*. Later, in his 1890 monograph, he gives as localities "Pa. and Ill." in the table of species, and "Region of the Great Lakes" following his description.

Rybaxis transversa sp. nov.

This species is distinguishable from all others by the very strongly transverse ventral plate, which is nearly or quite three times as wide as long, the vertical lamina supporting it of nearly equal width, but very short. The antennal club of the male is of the same type as in *clavata* but not quite so stout, the 9th and 10th joints not quite equalling the 11th in width and each less than twice as wide as long, the apical joint asperate beneath, but the 9th and 10th free from asperities except a few marginal ones. The dorsal abdominal carinæ are long and strong, the intermediate surface rather strongly impressed along their inner sides, and their distance apart is appreciably greater than 1-3 the discal segmental width. The anterior trochanters of the male are armed with a rather short acute apical tooth. The metasternal processes are strong and subacute at apex, sometimes a little obliquely so.

This is one of our larger species and is of nearly the same size as *conjuncta.*

The type is a male selected from a series of specimens collected at Springfield, Mass., by Mr. Jas. H. Emerton. There are also in my collection a male specimen from Aweme, Manitoba, and a pair taken by myself at Anchorage, Alaska, these last recorded as *brendeli* var. in my recent Alaska List (Pacific Coast Ent. Jan. 1926). I have seen other examples in Mr. Liebeck's collection from "Canada," Franconia N. H., and Westville, N. J.

Rybaxis mystica Casey.

The antennal club of the male is of the same type as in *clavata* and *transversa*, and agrees very nearly with that in the last named species; the interior flattened area of the 9th and 10th joints is free from asperities except a few around the margins, the 11th joint distinctly asperate. Dorsal abdominal carinæ separated at tip by 1-3 the discal segmental width, the carinæ rather shorter, less strong, and the adjacent surface within them less impressed than in *transversa.* Anterior trochanters of male with a rather long spiniform tooth. Metasternal processes posterior, acuminate at apex. Ventral plate very small, truncate in front, more or less narrowed behind, and varying from slightly wider than long to as long as wide. Average size a little smaller than in *transversa* and *conjuncta.*

The above characters are taken from a series of specimens in my collection from Tyngsboro Mass. and Kittery Point, Maine. A male from the last named locality sent to Mr. L. L. Buchanan at the National Museum for comparison with Casey's type he finds to be closely in agreement therewith in all essentials. In his description Casey says the terminal antennal joint is as long as the four preceding, but careful measurements made by Mr. Buchanan prove it to be distinctly shorter than the four preceding joints, as is usual. Casey's unique type is from Rhode Island.

Rybaxis varicornis Brendel.

Very similar to *Mystica* and scarcely separable except by the male characters, the females being virtually indistinguishable. The antennal club in the male does not differ from that in the female. Dorsal abdominal carinæ as in *mystica*; anterior trochanters of male unarmed; metasternal processes anterior in position, behind the middle coxæ, well separated; ventral plate very small, as long as or slightly longer than wide, narrowed in front.

This is the species which Brendel erroneously assumed to be the *conjuncta* of Le Conte, and which he distinguished from *clavata* by its unmodified antennal club and simple anterior trochanters in the male. The name *varicornis* was proposed for a variety with the terminal joint of the club yellow. This paler last joint is by no means peculiar to the present species, but occurs not rarely in at least three or four others, usually in the darker colored specimens. The name *varicornis* is used for this species because available, though very little credit attaches to Brendel for his connection therewith.

This is a common species in Massachusetts, and ranges westward through southern Canada at least to Illinois. It is probably more widely dispersed, but the confusion of species in this genus renders many of the records uncertain.

Rybaxis geminata sp. nov.

Antennal club not differing in the sexes; dorsal abdominal carinæ separated at tip by ¼ the discal width of the segment;

anterior trochanters of male with a minute denticle beneath, well back from the apex; metasternal processes anterior, short, rather blunt and closely approximate; ventral plate subrectangular and rather less than twice as wide as long. The short anterior approximate metasternal processes are unique in the genus, and the tooth of the front trochanters is more minute and more remote from the apex than in any other species.

The type (♂) is one of four specimens from St. Vincent Pa., submitted by Mr. Liebeck, who kindly permits me to retain it.

Rybaxis arkansana sp. nov.

Antennal club unmodified in the male; dorsal abdominal carinæ separated at base by not more than 1/5 the discal width of the segment; anterior trochanters of male with a small apical tooth; metasternal prominences posterior in position, but ill developed and consisting merely of rounded tumidities; ventral plate small, evidently transverse in the type, but apparently as long as wide in a second specimen.

This is one of the smallest species of the genus, and sufficiently distinct by the tabular characters.

Described from two males from Arkansas (Carlisle) collected many years ago by Stromberg.

OBSERVATIONS ON THE ICHNEUMON-FLY *EPIURUS PTEROPHORI* ASHMEAD.

By Magel C. Wilder.
Cornell University, Ithaca, N. Y.

The stalks of the evening primrose (*Oenothera lamarckiana*) are very commonly found infested with larvæ of the moth, *Lophoptilus eloisella.* These larvæ are borers in the pith cavity of the stalks. They hibernate in the stalks. In autumn each larva prepares itself a hibernation chamber in the stalk by setting off a section of the empty pith cavity by building two partitions of frass and silk a little further apart than the length of its own body, and by lining the chamber so formed with a thin transparent film of silk. On splitting apart the pith cavities in autumn a number of such chambers may often be found in a single stem. But in some of these chambers, instead of the yellow moth larva there is found the whitish larva of a rather large hymenopterous parasite. The rearing of this parasite was undertaken at the suggestion of Professor James G. Needham and continued under his kindly direction. It proved to be the larva of the ichneumon fly, *Epiurus pterophori.*

The evening primrose grows wild in vacant lots, and was gathered in a number of places at Ithaca, N. Y. The stalks were first brought into the laboratory and examined on March 13th. The moth larvæ were found distributed throughout the stalks, occurring very frequently. The larvæ of *Epiurus pterophori* were found to occur, seldom more than one in a stalk in a very small percentage of the stalks examined. Primrose stalks collected from certain places contained none. It is always found within a hibernation chamber but in no particular region of the stalk, and the head capsule together with other skin fragments of Lophoptilus have been found with it. This indicates the parasitic nature of *Epiurus pterophori.*

The larva is yellowish-white, flattened dorso-ventrally, and reposes normally in its cell in a curved position. The larvæ measure from six to seven millimeters in length and are about one millimeter in breadth. Four narrow chitinized plates are found on the dorsal surface of the head. By these characteristics it is readily distinguished from the moth larva.

Before pupating the larva forms a silken web of loose texture within the cell of Lophoptilus. It is within this silken network that the pupa is formed and remains until it emerges as the imago through the stalk. The pupa is 7.5 to 8 millimeters long and 1.5 millimeters broad.

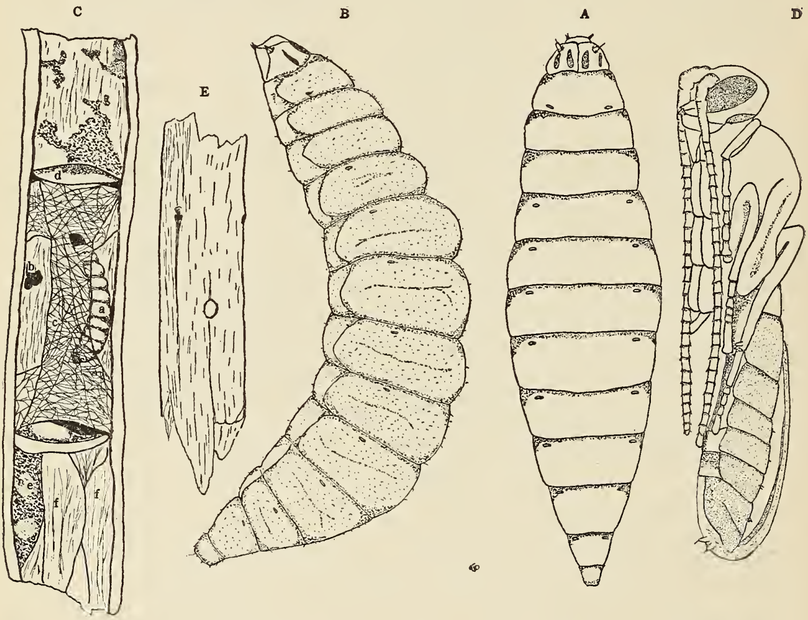

Fig 1. A, Dorsal view of larva of *Epiurus pterophori* Ashmead; B, Lateral view of larva showing normal curved position; C, Longitudinal section of stalk of *Oenothera lamarckiana* showing:– *a*, Larva in web of silk within cell; *b*. Head capsule of *Lophoptilus eloisella*; *c*, Silken web; *d*, Partition; *e*, Frass deposit in pith cavity of stalk; *f*. *f*, Pith cavity.

Larvæ were found in stalks collected and examined throughout March and April. The first pupa was found within the stalk March 22nd from material which had been inside the laboratory for a week. Pupæ were found to exhibit a great deal of activity; some were able to turn their bodies completely over within the cell.

The first adult was found March 29th in a stalk that had previously been slit open to show the larvæ. The insect was left within the cell in which it was found, the upper surface of the stalk replaced, and both fastened securely together. This section of the stalk was kept under observation in a cheese-cloth covered battery jar. The adult emerged through a small round hole it had made in the stalk a few days afterward.

The adult was identified by Dr. J. Chester Bradley as *Epiurus pterophori* Ashmead. It is known also in literature as *Pimpla pterelas*, *Pimpla pterophori* Ashmead, and *Scambus pterelas*. Notes kindly given by Dr. Bradley indicate that it is "parasitic on larvæ of stem-boring and stem-gall-making Lepidoptera and Coleoptera such as *Gelechia gallœ-solidaginis*, *G. gallœ-asterella*, *Pyronata nubilalis*, and *Stagmatophora ceanothiella*. In literature it is also recorded as a parasite of *G. gallœ-asterella*, and the beetle *Mononychus vulpeculus*."

A description of the adult may be found in Walsh.

Epiurus pterophori has been mentioned as having been found feeding on the pupa of the European corn-borer.[3] According to the description: "the hymenopterous larva of *Epiurus pterophori* was found feeding on the internal juices of a *P. nubilalis* pupa which had been broken open. The full-grown parasite larva spun a brown silken cocoon and pupated within the remains of its host. Only two of these parasites were bred."

Although a pale silken web was found to be spun by the parasite, it was not such that could be described as a "brown silken cocoon" as is described above.

By the first of June all of the adults had emerged. The adults were transferred to breeding cages containing evening primrose plants. Although an attempt at oviposition was noted on the part of one female against the glass wall of the battery jar, none was observed after they were placed with the evening primrose plants. No mating was observed; and no feeding, although several sorts of food were offered, first sugar and water solution, and later small insects, placed in the cages. The adults lived for but a few days, during which time they were moderately active.

Literature Cited.

(1) J. Hamilton: Ent. News. 1894-'95, pp. 287-288.
(2) Walsh: Trans. Acad. Sci. of St. Louis III, 1873, pp. 1, 133.
(3) Mass. Ex. Sta. Bull. 189, p. 58, 1919.

NEW NEOTROPICAL THYSANOPTERA COLLECTED BY C. B. WILLIAMS. II[1]

By J. Douglas Hood,
University of Rochester.

The earlier paper of this series was published in Psyche, Vol. XXXII, pp. 48-69, 1925, and made known five new genera and thirty–six new species. During its preparation several doubtfully distinct forms belonging to difficult genera were reserved for further study. Thesee—leven in number—and one new genus, are described below. Two are named after their collector, whose careful field work has done much to increase our knowledge of the Thysanoptera of tropical America.

The holotypes, allotypes, and a portion of the paratypes will remain in the collection of the author.

Sericothrips williamsi sp. nov.

Female (*macropterous*).—Length about 1.0 mm. Color yellow, paler by reflected light, with head, fore coxæ, metascutum, and a narrow basal band (wider laterally) on tergites 2-6 of abdomen, brown; pronotal blotch conspicuous by reflected light, invisible by transmitted light, lateral margins straight and parallel, anterior margin roundly, and posterior margin subangulately, concave; antennæ with segment 1 white; 2 and 3 gray, the latter darkened just beyond pedicel; 4-8 dark blackish brown, 4 and 5 with a light spot near base; legs yellow, with mid and hind femora brown at apex and mid tibiæ brown at base; fore wings grayish brown shading to nearly white in apical portion and pale also just beyond scale, darkest in scale and just beyond the subbasal pale band. Mouth cone long and slender, decidedly surpassing base of prosternum, heavily chitinized, labrum nearly black apically. Antennæ noticeably long and

[1]Contributions from the Entomological Laboratories of Cornell University.

conspicuously slender, segment 3 about 3.5, and 4 nearly four, times as long as wide, 8 hardly four times as long as wide.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	36	67	60	51	54	11	15
Width (μ)	27	26	19	16	15	15	6	4

Total length of antenna 0.32 mm.

Described from one female taken by Mr. C. B. Williams March 9, 1915, on the island of St. Croix, then Dutch, now American, West Indies. It was found in sweepings from grass.

Aside from the differences in coloration, which are conspicuous, this species may be known from *tricinctus*, undoubtedly its closest relative, by the very much longer and more acute mouth cone.

Sericothrips tricinctus sp. nov.

Female (*macropterous*).—Length about 1.0 mm. Color pale yellow, with ocellar area, anterior half of pterothorax, and abdominal segments 2, 3, and 7 abruptly dark blackish brown; segment 8 of abdomen pale brown; pronotum without trace of dark blotch; antennæ with segments 1-3 nearly white, 3 grayish apically; 4-8 dark gray, with pedicel of 4 pale; legs pale yellow, hind femora and usually mid femora lightly brown at apex; fore wings brown at extreme base and in scale, nearly white in remainder of basal fourth, dark gray beyond, fading to white at tip. Mouth cone moderate in length, hardly attaining base of prosternum. Antennæ very long and slender, segment 3 about 3.5 times as long as wide, and 8 more than four times as long as wide.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	36	60	58	50	59	14	17
Width (μ)	28	28	17	17	16	16	6	4

Total length of antenna 0.32 mm.

Described from several females collected by C. B. Williams in Martinique (type locality), Dominica, Guadeloupe, and Trinidad. All except one, which was found in a flower of *Hydrangea*, were taken by sweeping grass.

The long, slender antennæ and the coloration make this a very distinct species.

Sericothrips inversus sp. nov.

Female (*macropterous*).—Length about 1.1 mm. Color by transmitted light nearly uniform yellow, with a few brown spots on prothorax two on the metascutum, and one on each side of abdominal tergites 2-7, behind a narrow, transverse, subbasal brown line; antennæ gray in segments 1-3, the first palest, 2 and 3 lightly darkened at sides; 4-8 abruptly dark blackish brown, excepting distal constriction of 4, which is conspicouslу pale; legs pale grayish yellow, sometines lightly washed with brown; fore wings gray, darker in scale and shortly beyond it, paler at tip. By reflected light, the color is nearly white, with a large gray pronotal blotch (which has a concave anterior margin and is darkest at anterior angles), two gray spots on metascutum, and the bases of abdominal tergites each with a narrow transverse gray band. Mouth cone very long and acute, attaining base of prosternum. Antennæ long and slender; segment 3 about three times as long as wide, 4 decidedly narrowed in distal third, urn-shaped, 8 unusually slender, more than four times as long as wide.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	42	62	52	48	54	14	19
Width (μ)	27	26	19	19	16	16	6	4

Total length of antenna 0.32 mm.

Described from several females taken by Mr. C. B. Williams in Dominica and Trinidad, by sweeping grass.

The coloration of the antennæ—abruptly dark brown in segments 4-8, save for the pale gray *apex* of segment 4, which is decidedly narrowed—should serve for its recognition. The second segment of the antenna is longer than usual in this portion of the genus, and segment 8 is especially long and slender.

Hercothrips gen. nov.

(ἕρκος, a net; θρίψ, a wood worm.)

Body reticulate, at least in head and thorax, abdomen frequently striate. Head always broader than long, with vertex elevated between eyes but not produced to overhang insertion of antennæ. Eyes usually distinctly protruding, pilose. Ocelli approximate, borne on the elevated vertex. Antennæ eight-segmented, with segment 1 small, 2 much longer and broader, 3 and 4 stem-like at either end and with forked trichomes, 6-8 closely united, 8 long and slender. Maxillary palpi two-segmented. Prothorax strongly transverse, shorter than head, without strong bristles, notum foveate. Hind coxæ approximate, separated by a fraction only of their transverse width. Wings slender, not conspicuously broadened at base nor much narrowed beyond it, with two longitudinal veins frequently united with ambient vein; costal bristles and costal fringe distinct, subequal in length. Abdomen not sharply constricted basally; tenth segment rarely divided above.

Genotype: *Heliothrips striatus* Hood.

The following species are known to belong here: *aulmanni* (Karny), *bicinctus* (Bagnall), *brunneipennis* (Bagnall), *cinctipennis* (Hood), *fasciapennis* (Hinds), *fasciatus* (Pergande), *femoralis* (Reuter), *indicus* (Bagnall), *marginipennis* (Hood), *minutissimus* (Bagnall), *pattersoni* (Bagnall), *phaseoli* (Hood), *punctipennis* (Hood), *sculptilis* (Hood), *striatopterus* (Kobus), and *striatus* (Hood), in addition to the five new species described in this paper.

It will be noted that *Hercothrips* comprises essentially those species which we used to place in *Heliothrips*, minus the genotype *hæmorrhoidalis*. In *Heliothrips* as now restricted, is found a somewhat different type of wing, lacking as it does the costal fringe of bristles and having the anterior vein separate from the ambient vein through most of its length, as well as being decidedly broadened basally. In *Heliothrips*, too, the third and fourth antennal segments are differently formed and lack the forked trichomes of *Hercothrips*, while the metascutum is more differentiated, with an elevated triangular central area which overhangs laterally and posteriorly and serves in this way to hold the wings more firmly in position. Most important of all, however, is the closely approximate condition of the hind coxæ of *Hercothrips*—a type of structure which I have learned to associate with the jumping habit, but with what degree of accuracy I am not sure.

Selenothrips is perhaps the closest relative of *Hercothrips*; but in it is found a fore wing with conspicuous, enlarged bristles on the costal margin and on the two longitudinal veins, many of them much longer than the width of the wing; a pronotum which instead of being reticulate is transversely striate; and an abdomen in which the distal segments are shortened.

Hercothrips insularis sp. nov.

Female (*macropterous*).—Length about 1.1 mm. Color nearly blackish brown, *head and thorax not noticeably paler*; coxæ brown; fore and mid femora yellow, shaded with brown at middle, hind femora yellow at base and blackish brown beyond; tibiæ yellow at either end, brown between, hind pair darkest; tarsi lemon yellow; fore wings *brown at base* (excepting costal margin and end of scale), *with a narrow nearly white band just before the fork in the principal vein, nearly uniform brown beyond, very slightly paler toward tip of wing, ambient vein in distal eighth of wing and all veins in third eighth, dark blackish brown*; antennæ with segments 1, 2, and 6-8 blackish brown, 1 paler; 3-5 pale yellowish, indistinctly darkened apically. Head broadest across eyes, 1.25 times as wide as long, cheeks nearly straight, curving slightly to eyes and to base; dorsal surface reticulate (though not deeply) with faint indication of occipital line, roughened within the reticules; frontal costa nearly as wide as first antennal segment. *Eyes about* 0.6 *as wide as their interval*, of normal structure. Ocelli of normal form and position. Antennæ normal, segments formed almost exactly as in *phaseoli*.[2] Prothorax with reticulation much like that of head. Metascutellum distinctly reticulate except at sides. Fore wings with bristles and veins as

[2]See Psyche, Vol. XIX, Pl. 8, fig. b; 1912.

in *phaseoli.*[3] Abdomen reticulate, not striate, strongly roughened within the reticules; segment 10 divided dorsally to near base.

Measurements of holotype (♀): Length 1.13 mm.; head, length 0.118 mm., greatest width (across eyes) 0.148 mm., least width (at posterior angles of eyes) 0.136 mm.; eyes, length 0.068 mm., width 0.040 mm., interval 0.068 mm.; prothorax, median length of pronotum 0.108 mm., width 0.195 mm.; pterothorax, width 0.230 mm.; fore wings, length 0.780 mm., width at middle 0.042 mm., width near base 0.068 mm.; abdomen, greatest width 0.269 mm.; segment 8, length to fringe 0.078 mm., segment 9, length 0.114 mm., segment 10, median length 0.056 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	20	40	46	40	33	27	15	31
Width (μ)	24	28	21	21	20	17	7	5

Total length of antenna 0.25 mm.

Described from a number of females collected in St. Croix (type locality), Grenada, Tobago, Martinique, Trinidad, Porto Rico, and Cuba, by C. B. Williams, F. W. Urich, T. H. Jones, and S. C. Bruner. Most of the specimens were taken by sweeping, though the Cuban and Porto Rican ones came from corn, sugar cane, and possibly from molojillo.

This is a member of the group which includes *fasciatus.* The long head will distinguish it from that species, while the italicized characters will serve for its separation from *cinctipennis,* to which it is more closely allied.

Hercothrips nanus sp. nov.

Female (*macropterous*).—Length about 0.84 mm. Head and thorax brownish yellow, the head darkened with brown in posterior half and with a narrow, nearly black line along posterior margin, the thorax darkened with brown along sides and in anterior portion of mesothorax, *dorsum of metathorax very pale;* abdomen with segment 1 concolorous with dorsum of metathorax, 2-8 dark brown, and 9 and 10 pale brown; antennæ with segments

[3] L. c., Pl. 8, fig. a.

1 and 2 gray or very pale brown, 3-5 pale gray with apices (particularly of 3 and 4) darker, and 6-8 dark gray-brown; femora pale brown, mid and hind pairs with their apical thirds nearly colorless; tibiæ pale yellowish, with a brown band at middle; tarsi pale yellow; fore wings clear white in basal third, dark gray brown in middle third, and white in apical third save the tip, which is dark gray brown. Head about 1.5 times as wide as long; cheeks nearly straight, rounded to eyes and slightly converging posteriorly; dorsal surface distinctly but not conspicuously reticulate, roughened between the lines of reticulation; *frontal costa broad,* 1.2 *times as wide as first antennal segment, the interval between antennæ fully* 1.3 *times the width of first antennal segment*; vertex subcarinate in front of ocelli. Eyes not prominently protruding, pilose. Ocelli approximate, opposite center of eyes. *Antennæ about* 2.1 *times as long as head*, formed almost exactly as in *phaseoli,*[4] but slightly stouter. *Prothorax more than twice as wide as long, shorter than head* and with similar reticulation. Wings of fore pair 13 times as long as width at middle, venation as usual; *principal vein at base with five bristles, the first three of which are slender and white, the other two stout, approximate, nearly black, and situated at the fork*; anterior vein with two bristles near apex, the latter one nearly black; *posterior vein with four equidistant bristles at middle, the second and fourth ones nearly black and situated, respectively, near the outer margin of the dark band and at the middle of the white band.* Abdomen with tergites 2-8 closely striate laterally, the striæ transverse toward middle of segments and longitudinal at sides, almost exactly as in *phaseoli*;[5] tergite 10 without longitudinal dorsal suture, though irregularly weakened toward tip.

Measurements of holotype (♀): Length 0.84 mm.; head, length 0.102 mm., greatest width (behind eyes) 0.157 mm., least width (across eyes) 0.151 mm.; interval between antennæ 0.031 mm.; eyes, length 0.065 mm., width 0.038 mm., interval 0.075 mm.; prothorax, median length of pronotum 0.081 mm., width 0.176 mm.; pterothorax, width 0.228 mm.; fore wings, length

[4]See Psyche Vol. XIX, Pl. 8, fig. b; 1912.
[5]L. c., fig. c.

0.585 mm., width at middle 0.045 mm., near base 0.061 mm.; abdomen, width 0.236 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	17	34	43	37	30	23	10	23
Width (μ)	23	28	21	21	18	16	7	4

Total length of antenna 0.22 mm.

Described from 18 females from Trinidad and Tobago, British West Indies, taken by F. W. Urich and C. B. Williams, respectively, principally on a wild vine belonging to the genus *Couania.*

Very close to *phaseoli,* but the smaller size and the italicized characters will separate them readily.

Hercothrips masculinus sp. nov.

Female (*macropterous*).—Length about 1 mm. Color uniform gray brown, ocellar pigment dull orange yellow by transmitted light, lemon yellow by reflected light; antennæ largely brown and nearly concolorous with body, segment 1 paler, 2 dark blackish brown; 3 with stem white, globose portion and apex gray brown; 4 with brief pedicel nearly white, remainder dark blackish brown, but paler basally; 5 clear white except for a slight brownish cloud at extreme apex; 6-8 dark blackish brown; legs largely brown, knees, tarsi, and most of fore tibiæ pale yellow; *fore wings dark gray brown, with a narrow white band just beyond scale and another in eighth tenth, a few darker streaks at base* and a small slightly elevated dark spot on the costal margin just beyond the pale subbasal band, this spot darker because covered with longer and heavier pubescence than the rest of wing, all veins darker, especially the ambient vein at tip of wing, scale paler. Dorsal surface of head and thorax, lateral thirds of abdominal tergites 1-8, and a narrow median portion of tergites 1 and 2, with dark polygonal reticulation, surface roughened within the reticles. Head broad, without occipital line or neck-like constriction, cheeks nearly straight but somewhat converging posteriorly, rectangularly narrowed to eyes; ocellar area opposite center of eyes, slightly elevated but not produced no overhanging. Antennæ separated by somewhat more than the width of segment 1; segments 3 and 4 much as in *phaseoli*[6] but more globose and with the pedicel of 4 more abrupt and shorter; 5 slightly slenderer; 8 longer and slenderer; 3 and 4 with forked trichomes. Wings of fore pair with about 18 short, inconspicuous bristles on costal margin, *those in basal portion of wing half as long as distal ones and less than half the width of wing, fringe about as long as distal bristles;* anterior vein with one near fork and one near tip, very inconspicuous and pale; posterior vein with about five similar bristles. Abdomen with *segment 9 long, 2.5 times the length of 10 and about 1.2 times as wide at base as long, width at apex (across bases of lateral bristles) about 0.66 that at base,* its inner pair of dorsal bristles shorter than outer, which are slightly longer than segment 10, both pairs approximate and *disposed in a straight transverse line.*

Measurements of holotype (♀): Length 1.05 mm.; head, length 0.118 mm., greatest width (behind eyes) 0.174 mm., least width (at base) 0.160 mm.; eyes, length 0.072 mm., width 0.044 mm., interval 0.080 mm.; prothorax, median length of pronotum 0.104 mm., width 0.212 mm.; pterothorax, width 0.255 mm.; fore wings, length 0.735 mm., width at middle 0.044 mm., near base 0.057 mm.; abdomen, width 0.261 mm.; segment 8, length to fringe 0.078 mm.; segment 9, length 0.128 mm., width at base 0.156 mm., width across bases of lateral bristles at apex 0.104 mm.; segment 10, length 0.050 mm., width at base 0.082 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)			43	38	35	22	8	25
Width (μ)	23	30	22	21	18	17	9	5

Total length of antenna (approximate only) 0.23 mm.

Described from a unique female taken from bamboo at St. Annes, Trinidad, in the British West Indies, March 28, 1915, by C. B. Williams [C. B. W. No. 612].

The elongate and only slightly tapering ninth abdominal segment seems to be unique in the genus, occurring in none of

[6]See Psyche, vol. XIX, Pl. 8, fig. b; 1912.

the other fourteen species before me, and aids in giving the female a most decidedly male-like appearance when seen under a low-power objective. Other important differentiæ are those italicized above.

Hercothrips williamsi sp. nov.

Female (*macropterous*).—Length about 1.05 mm. Color dark brown (nearly black to the naked eye), darkest in abdominal segments 5 and 6, *head yellow between eyes, save for the ocellar area and a narrow brown line from it to the frontal costa*; antennæ with segment 1 brownish yellow; *distal constriction of 3, pedicel and distal constriction of 4, and all of 5 clear white, the intervening portions dark blackish brown*; legs blackish brown, the mid and hind pairs darkest; tarsi and tips of tibiæ yellow; fore wings dark brown, paler between veins and in a narrow transverse band just beyond scale, with a darker streak at base in front of longitudinal vein and a *small, round, slightly elevated dark spot on the costal margin just beyond the pale subbasal band, this spot darker because covered with longer and heavier pubescence* than the rest of the wing. Dorsal surface of head, thorax, and median portions of abdominal tergites 1 and 2 with conspicuous subequal polygonal reticulation, formed by raised *black* chitinous lines, not roughened between the lines of reticulation. Head broad, with a *prominent lateral swelling at anterior end of cheeks*, sides abruptly converging posteriorly to a transverse groove on each side which shallows dorsally and disappears before attaining the median line; ocellar area opposite center of eyes, slightly elevated but not at all produced nor overhanging, with a narrowly grooved ridge running from it downward to frontal costa. *Antennæ separated by 1.8 times width of segment 1*; segments 3 and 4 with a subglobose middle portion, pedicels slender, *distal portions slender and much prolonged*; forked trichomes on 3 and 4 exceptionally long. Wings of fore pair with about 20 dark bristles on costal margin, averaging fully as long as width of wing and subequal in length to fringe; anterior vein with one similar bristle near fork and 3 in distal fourth of wing; posterior vein with about 8 equally spaced bristles; about four bristles on vein basal to fork. Abdomen with last segment short and broad; *tergites 2-7 striate, rather than reticulate, at sides*, the lines curving outward and backward; bristles not long, yellowish and inconspicuous.

Measurements of holotype (♀): Length 1.05 mm.; head, length 0.140 mm., greatest width (behind eyes) 0.196 mm., least width (across eyes) 0.184 mm.; eyes, length 0.082 mm., interval 0.096 mm.; prothorax, median length of pronotum 0.102 mm., width 0.220 mm.; pterothorax, width 0.293 mm.; fore wings, length 0.810 mm., width at middle 0.044 mm.; abdomen, width 0.318 mm.; segment 9, length 0.116 mm.; segment 10, length 0.049 mm., width at base 0.080 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	48	73	58	40	34	16	30
Width (μ)	26	32	24	23	17	16	8	5

Total length of antenna 0.32 mm.

Described from a unique female taken at St. Annes, Trinidad, in the British West Indies, March 28, 1915 by C. B. Williams, from an unidentified plant. [C. B. W., No. 614.]

A very distinct and most interesting species, resembling *brunneipennis* in wing coloration but related more intimately to *striatus*, *phaseoli*, and their allies. The sculpture, large head, anteriorly tubercled cheeks, and peculiarly colored antennæ are distinctive.

Hercothrips funebris sp. nov.

Female (*macropterous*).—Length about 1.1 mm. Color nearly black (quite so in abdomen), head and thorax paler; antennæ brown, with segments 1 and 2 paler, and the basal half of 3, basal third of 4, and basal two-thirds of 5, grayish white; fore legs brown, with trochanters, tips of tibiæ, and tarsi pale yellow, nearly white; mid and hind legs similarly colored, but with the dark portions nearly black; fore wings nearly uniform dark brown, with a pale transverse band just beyond scale, with a dark streak at base in front of principal vein and another behind it, and with the costal half of wing just beyond the pale band and the extreme tip, nearly black. Dorsal surface of head, thorax, and abdomen strongly and prominently reticulate with heavy black lines, not roughened between the lines of reticulation, except for a few dots in basal reticules of head. Head broad, cheeks rounded and swollen, with a strong neck-like constriction which is bounded in front by a heavy chitinous line. Antennæ separated by about 1.7 times the width of segment 1, formed almost as in *phaseoli*,[7] forked trichomes on 3 and 4 exceptionally long, that on 4 attaining apex of segment 5. Metascutum without differentiated triangle; metascutellum strongly reticulate. Wings of fore pair with about 22 inconspicuous brown bristles on costal margin, averaging in length less than the width of wing, fringe fully twice as long; anterior vein usually with one similar bristle at the fork and four in distal half; posterior vein with about eight and principal vein with six. Abdomen of normal form, opaque black, reticulation coarse and heavy, not absent from middle portions of tergites but extending entirely across them and strongest just beyond the irregular, subbasal, transverse line; segment 10 with an irregular dorsal suture in apical half; all abdominal bristles pale and short.

Measurements of holotype (♀): Length 1.08 mm., head, length 0.105 mm., greatest width (behind eyes) 0.176 mm., least width (near base) 0.135 mm.; eyes, length 0.085 mm., width 0.045 mm., interval 0.087 mm.; prothorax, length 0.102 mm., width 0.201 mm.; pterothorax, width 0.267 mm.; fore wings, length 0.780 mm., width at middle 0.041 mm., near base 0.067 mm.; abdomen, width 0.300 mm., segment 8, length to fringe 0.076 mm.; segment 9, length 0.087 mm.; segment 10, length along median dorsal line 0.036 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	41	59	49	36	28	12	25
Width (μ)	24	30	22	23	20	17	8	5

Total length of antenna 0.27 mm.

Male (*macropterous*).—Length 0.87 mm. Color of body and appendages like that of female. Tergite 9 with the two pairs of bristles slender, the inner pair shorter, slenderer, and with their bases more distal, the four thus being disposed on a semicircle.

[7]See Psyche, vol. XIX, Pl. 8, fig. b; 1912.

Described from one female and one male, taken by J. B. Rorer at Hacienda Pretoria, near Barraganetal, Equador, December 29, 1917, on "cojojo" [C. B. Williams, No. 1058.]

Close to *errans* and *brunneipennis*, but differing from both in the non-specialization of the metascutum, the clouded antennæ, the incompletely divided tenth abdominal segment, and various other details.

Tryphactothrips lineatus sp. nov.

Female (*macropterous*.—Length about 1.05 mm. Dorsal surface deeply reticulate. Color yellowish brown, with head, prothorax, middle of pterothorax, and last two or three abdominal segments more yellowish; segment 10 of abdomen gray in apical sixth; antennæ yellow, with segment 2 decidedly darker than 1 and brownish at sides and base, 3-5 clear lemon yellow, 6-8 blackish brown excepting yellowish base of 6; fore legs yellow with tibiæ shaded with blackish brown on inner surface, mid and hind legs brown with tarsi, knees, and bases of femora yellow; fore wings yellowish at base and along veins, with two indistinct brown bands, one occupying the third tenth, the other the seventh tenth, and with two or three very faint maculations between the bands and one at extreme tip of wing, all of these wing markings produced by darker pubescence; wing bristles nearly black in basal half, nearly white beyond. Vertex produced, overhanging insertion of antennæ; occiput without a crescentic series of large reticulations; *antennæ eight-segmented*; segment 1 short, subcylindrical, about as broad as long; 2 broadest in entire antenna; 3 slender, vasiform, about 4.3 times as long as wide; 4 asymmetrical, swollen on outer surface; 5 clavate, broadest at apical fourth or fifth; 6 with a stout pedicel which is nearly twice as thick as that of 5, somewhat obliquely united at apex to 7, the two forming a compact mass; 8 slender, about six times as long as basal width; sense cones slender, those on 3 and 4 bifurcate beyond base (Y-shaped). Mesoscutum without median suture, but acutely notched behind. Wings of fore pair with first longitudinal vein united with ambient vein, posterior vein not so united, one bristle at their fork and three basally; anterior vein with six bristles beyond fork and posterior vein with seven or eight, positions not constant; all wing bristles long, broad, flattened, and dilated, as long as width of wing at middle. Abdomen strongly and sharply constricted at base of segment 2, which is the longest in the entire abdomen; dorsal surface with the usual deep, prominent reticulation at sides, but with the *dorsal surface of segments 3-7 with three or four perfectly parallel transverse lines* at base, between the areas of reticulation; segment 10 long, tubular, reticulate, somewhat constricted at base, divided above by a longitudinal suture; bristles at apex of segment 9 about one-half as long as 10.

Measurements of holotype (♀) Length 1.05 mm.; head, length 0.100 mm., greatest width (across eyes) 0.172 mm., least width (near base) 0.152 mm.; eyes, length (approximate) 0.092 mm., width (approximate) 0.040 mm.; prothorax, median length of pronotum 0.090 mm., width 0.180 mm.; pterothorax, width 0.248 mm.; fore wings, length 0.780 mm., width at middle 0.046 mm., just beyond scale 0.076 mm.; abdomen, width 0.285 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	20	34	65	42	36	25	12	30
Width (μ)	24	30	15	17	18	17	11	5

Total length of antenna 0.26 mm.

Trinidad; C. B. Williams; on an unidentified plant.

This is the only New World species with eight-segmented antennæ. The curious transverse lineation of the abdomen is also distinctive.

Tryphactothrips brevipilus sp. nov.

Female (*macropterous*).—Length about 1.04 mm. Dorsal surface deeply reticulate. Color yellowish brown, with middle of pterothorax and last three or four abdominal segments paler and more yellowish; segment 10 of abdomen shading to *gray in apical fourth*; antennæ yellow, with segment 2 decidedly darker than 1 and brownish at sides and base, 3-5 pale lemon yellow except apex of 5 which is washed with gray, 6 yellowish gray;

femora yellowish brown, paler at base and sometimes at apex, middle pair lightest; tibiæ yellow at base and apex, brown between; tarsi lemon yellow; fore wings brown in first tenth (except the yellowish costal margin and the paler outer half of scale) and with brown bands (due to dark pubescence) occupying most of the third tenth, all of eighth tenth, and the extreme tip of wing, between the bands with three or four faint maculations, the veins somewhat darkened with brown; bristles on veins of wings unicolorous, brown. Vertex strongly produced, about attaining second segment of antenna, overhanging. Antennæ six-segmented, segment 5 with a more or less distinct transverse suture at distal third; segment 1 short, subcylindrical, about as broad as long; 2 broadest in entire antenna; 3 slender, vasiform, about 4.6 times as long as wide; 4 asymmetrical, swollen on outer surface, with a rather long and slender pedicel; 5 subfusiform, pedicellate; 6 long and very slender; sense cones slender, those on 3 and 4 bifurcate beyond base (Y-shaped). Mesoscutum with a longitudinal, median suture extending nearly to anterior margin, *the reticles on either side with their inner margins not at all deflected posteriorly.* Wings of fore pair with first longitudinal vein united with ambient vein, posterior vein free, one bristle at their fork and three basally; anterior vein and costa together with about eleven bristles beyond fork, the two series indistinguishable; posterior vein usually with six bristles beyond fork; *all wing bristles short, stout, but not dilated, averaging about one-half as long as width of wing at middle.* Abdomen strongly and sharply constricted at base of segment 2, which is the longest in the entire abdomen; dorsal surface with the usual deep, prominent reticulation at sides, the intervening portion with transversely elongate polygons of reticulation arranged in regular transverse rows; segment 10 nearly tubular, about three-fourths as long as prothorax, *not constricted at base,* reticulate, divided above by a longitudinal suture; *bristles at apex of segment 9 about one-third as long as 10.*

Measurements of holotype (♀): Length 1.04 mm.; head, length 0.116 mm., greatest width 0.190 mm.; eyes, length 0.056 mm., width 0.042 mm., interval 0.101 mm.; prothorax, length 0.106 mm., width 0.183 mm.; pterothorax, width 0.266 mm.;

fore wings, length 0.720 mm., width at middle 0.041 mm., near base 0.076 mm.; average length of bristles near middle of wing 0.020 mm.; abdomen, greatest width 0.293 mm.

Antennal segments:	1	2	3	4	5	6
Length (μ)	24	40	73	43	59	28
Width (μ)	26	31	16	19	20	5

Total length of antenna 0.27 mm.

Trinidad: C. B. Williams; on creepers, bushes, and a leaf of Arum Lily.

The characters italicized in the description separate it from *constrictus,* the only New World species with which it agrees in the possession of six-segmented antennæ and a divided mesoscutum.

Eurythrips cinctus sp. nov.

Female, forma macroptera.—Length about 1.16 mm. Color yellowish brown, *with transparent red subhypodermal pigmentation,* sides of head and all of thorax and apical abdominal segments darker, the *base of abdomen* (*especially segments 2 and 3*) *decidedly paler* and almost free of red pigmentation, giving the insect a distinct yellowish band at middle; *antennæ nearly uniform blackish brown,* somewhat paler in basal portion of segment 1, apical portion of 2, and pedicel of 3; femora brown, shading to lemon yellow beyond middle of tibiæ; fore wings pale brown, decidedly darker at base. Head nearly 1.2 times as long as greatest width; *ocelli rather widely separated, nearly touching margins of eyes, the interval between posterioro celli about 0.54 that between eyes*; postocular bristles about 0.4 as long as head, pointed or very nearly so; postocellar bristles very minute, about attaining posterior margins of posterior ocelli; mouth cone broadly rounded, somewhat surpassing middle of prosternum; prothorax with anterior marginal bristles minute, all others long, pale, and very nearly pointed; fore tarsus with a small, claw-like, somewhat forwardly-directed tooth arising from the inner distal angle of the first tarsal segment; fore wings without accessory hairs at tip and with the three subbasal bristles short, slightly dilated apically.

Measurements of holotype (♀): Length 1.16 mm.; head, length 0.165 mm., greatest width 0.139 mm., least width (across eyes) 0.131 mm.; eyes, length 0.046 mm., width 0.035 mm., interval 0.061 mm.; postocular bristles, length 0.068 mm.; prothorax, length of pronotum 0.120 mm., width across coxæ 0.240 mm.; pterothorax, width 0.248 mm.; abdomen, greatest width 0.300 mm.; tube, length 0.124 mm., width at base 0.071 mm., at apex 0.035 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	40	48	51	48	50	46	44	34
Width (μ)	38	32	32	31	30	26	25	16

Total length of antenna 0.36 mm.

Female, forma brachyptera.—Apparently identical with the macropterous form except for the following: Legs much paler, the tibiæ, tarsi, and distal portions of femora lemon yellow; ocelli wanting; wings reduced, the fore pair represented by a pair of small oval brown pads, each with two rather long, nearly pointed bristles.

Described from three females taken by Mr. C. B. Williams at Caura Valley, Trinidad, British West Indies, April 20, 1916, by sweeping grass.

Very close indeed to *E. harti*, but readily known by the italacized characters.

Book Notices.

Needham, J. G. & Needham, P. R.

A guide to the Study of Fresh-water Biology. 88 pp. American Viewpoint Soc. New York & Albany, N. Y.

This is a very practical compendium of the fauna and lower plant organisms of fresh-water ponds and streams. As might be expected, the major portion of the text relates to insects, but the several other groups are covered equally well. There are an enormous number of good line drawings, and these, together with dichotomic keys for the determination of the organisms, occupy the bulk of the book.

Aside from its value to young students of biology, it should be very useful to the more mature biologist who disdains the intricacies of taxonomy.

C. T. B.

Garman, Philip

The Odonata or Dragonflies of Connecticut. Bulletin 39, State Geological & Natural History Survey of Connecticut. 1927.

The present volume of 331 pages, illustrated by 67 figures and 22 plates, is the latest addition to the "Insects of Connecticut." Many of the figures contain ten or more well executed line drawings and leave little to be desired in the way of illustration. In addition to keys and descriptive matter in the text, pertaining to the imaginal dragonflies, the nymphs are dealt with in great detail. All in all, this compendium will be a great boon to entomologists in New England.

C. T. B.

Buxton, P. A. & Hopkins, G. H. E.

Researches in Polynesia & Melanesia. Mem. Series No. 1, London School of Tropical Medicine, 260 pp. London 1927.

This is a very beautifully prepared account of the bionomics of *Aedes variegatus* and *A. argenteus* and contains much other material of interest to medical entomologists.

Of particular interest to general biologists is a chapter on the "Climate of Samoa," which discusses temperature and humidity in relation to the biological environment, together with some very sane observations on the use of physical instruments for recording such data.

C. T B.

PSYCHE

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NEW COLEOPTERA FROM WESTERN HOT SPRINGS[1]

By P. J. Darlington, Jr.

The three descriptions brought together in this paper are of widely different species which have in common only aquatic habits and an apparent preference for thermal water. They were collected with a number of described species by Professor C. T. Brues in Nevada, Oregon, and California during the summer of 1927, and are described now so that the names will be available for use by Professor Brues in his paper on the hot spring fauna, which will probably appear in the Proceedings of the American Academy of Arts and Sciences.

I am indebted to Mr. Nathan Banks and Director Thomas Barbour of the Museum of Comparitive Zoölogy at Cambridge for permitting me to study the types of *Ochthebius* and *Helmis* in the LeConte collection, and to Mr. H. C. Fall for the opportunity of examining some of the types of his species of *Cœlambus*.

By arrangement with Professor Brues, the holotype, allotype if any, and some of the paratypes of each species will be deposited in the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

Coelambus thermarum n. sp.

Moderately elongate, oval. Front not margined. Head and pronotum piceous, the former with a small spot on the vertex, the latter with the side margins, vaguely paler; elytra pale testaceous and semi-transparent except for the fuscous

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 288.

suture, a fine fuscous line along the sutural series of impressed punctures, and a large faint irregular infuscate cloud on the disk extending from just before the middle nearly to apex. Body beneath black; legs rufo-piceous; antennæ rufous with the outer joints infuscate. Integuments shining above and below. Disk of pronotum and elytra moderately densely punctured with rather fine punctures which may become sparse on the pronotum at middle, and which scarcely vary in size on the elytra except for the distinctly impressed sutural and discal series; metasternum, coxal plates, and sides of ventral segments coarsely punctured; epipleuræ more finely but rather closely punctured. Hind femora finely strigose in both sexes.

♂ characters: pro- and mesotarsi a little broader than in the ♀, claws small and unmodified; front femur broader than in the ♀, shining and bent downward apically, deeply transversely impressed on the anterior face a little before apex, posterior face with a longitudinal line of long silky pubescence near the upper margin and a shorter one apically near the lower margin; front tibia a little broader than in the ♀, with a longitudinal line of silky pubescence along the middle of the posterior face; middle femur sinuate and produced downward (inward) in a small shining lobe at apex, broadly lobed below at base, the lobe flattened and punctate on the anterior face; middle tibia nearly parallel sided except for a small lobe internally near base; hind femur broader than in the ♀; hind tibia with sexual pubescence along the lower edge.

♀ characters: no unusual modifications except that the middle tibia is slightly broadened at base where it is lobed in the ♂.

Length: 4.1-3.2 mm. Width: 2.0-1.6 mm. Holotype: 4.0 x 2.0 mm.

Holotype ♂ and allotype ♀ no. 15948 in the Museum of Comparative Zoölogy, collected by Professor C. T. Brues in "Hot Spring no. 23-a; Temperature 30°; 37 mi. So. of Battle Mtn., Nevada." Paratypes: 2 ♀'s with the same data as the holotype; 6 ♂'s, 2 ♀'s from "Hot Spring no. 20; Temperature 38 ; 29 mi. So. of Winnemucca, Nevada," also collected by Professor Brues. Paratypes to be deposited in the Museum of

Comparative Zoölogy, the United States National Museum, the California Academy of Sciences, the collection of Mr. H. C. Fall, and the collection of the writer.

The semi-transparent elytra and striking secondary sexual characters of the ♂ make this a very distinct and easily recognized species. In Mr. Fall's table in the "North American Species of *Cœlambus*," published by John D. Sherman Jr., Mt. Vernon, N. Y., 1919, it would run to near *C. pedalis* Fall, from which it may be distinguished by several definite characters. Direct comparison shows that *C. thermarum* is also a narrower species with a proportionately smaller prothorax and narrower head. For the opportunity of examining the type and type series of *C. pedalis* at Tyngsboro I am indebted to Mr. Fall, whose excellent revision of *Cœlambus* has made the placing of the present species ridiculously easy.

Ochthebius bruesi n. sp.

Elongate, slightly depressed. Black; head and pronotum with distinct æneous or metallic rose reflections; elytra entirely piceous to testaceous with piceous humeri and base; legs dull rufous, tarsi and basal part of femora darker; antennæ and maxillary palpi rufous, the latter with the ultimate and the tip of the penultimate joints fuscous. Ultimate joint of maxillary palpus twice as long as wide, narrowed and rounded at apex, but subject to modification; penultimate joint typically convex on all sides, but at times flattened and concave on one side, as described below. Head bifoviate between the eyes; labrum entire, feebly rounded in front. Prothorax about two-fifths wider than long, widest about two-sevenths from the distinct but not prominent apical angles, rather strongly narrowed and with very broadly and evenly recurved sides in posterior five-sevenths; lateral transparent membrane beginning a little behind anterior angles, widest near base, where about one-seventh as wide as prothoracic base; median groove well impressed, nearly complete; discal impressions deep, well separated, the posterior longer, placed nearly as in *O. interruptus*; lateral grooves narrow, well impressed; pronotal disk rather strongly shining, not or but very slightly alutaceous, sparsely punctured. Elytra about one and two-thirds times as long as wide; sides explanate to about one-third from apex; disk slightly shining; striæ closely punctate to apex, where they are a little confused.

Length: 2.1-2.3 mm; Width: 0.9-1.0 mm.

Holotype number 15950 in the Museum of Comparative Zoölogy, collected by Professor C. T. Brues in "Hot Spring no. 24; Temperature 38.8°; Beowawe, Nevada." Paratypes: 24 with the same data as the holotype; 1 collected by Professor Brues in "Hot spring no. 9; Amedee, California." Paratypes to be deposited in the Museum of Comparative Zoölogy, the United States National Museum, the Canadian National Collection, the California Academy of Sciences, the collection of Mr. H. C. Fall, and that of the writer.

In Horn's table (Trans. American Ent. Soc., 1890, pp. 18-19) *O. bruesi* would fall in *Ochthebius s. str.* near *interruptus* and *attritus*, from both of which it differs in being larger and more elongate and in having both the discal and lateral impressions strongly marked. The legs are longer and stronger, and the entire insect has a distinctive loose-jointed appearance which is difficult to describe. I have seen all the older types of the genus in the LeConte collection at Cambridge, and have studied all the more recent American descriptions, none of which can fit the species here described.

The penultimate joint of the maxillary palpus is rather curiously and consistently deformed in certain of the specimens at hand. Normally it is rounded on all sides and rather thick, but sometimes it is flattened in the vertical plane and concave on one side. In this case the ultimate and apparently the pseudobasal joints are also strongly flattened. Of the twenty four specimens in which the palpi can be clearly seen, thirteen are normal on both sides, two have the right palpus only deformed, two have the left palpus only deformed, and six have both palpi deformed. One specimen has the left palpus normal and the right with the penultimate joint represented by a small globular body and the ultimate joint absent. How this wholesale malformation has been produced I do not know.

I take great pleasure in naming this insect after its collector, in recognition of his success in collecting hot spring Coleoptera.

Helmis thermarum n. sp.

Elongate, parallel, rather convex. Black or piceous; tarsi, palpi, and antennæ dull rufous. Last joint maxillary palpus about one and one-half times as long as wide. Antennæ eleven-jointed with the second joint distinctly and evenly inflated. Prosternal intercoxal process not quite half as wide as the mesosternum between the coxæ; meso- and metasterna sulcate along the middle; last ventral segment finely notched at sides. Femora sides of ventral surface, and inner side of front tibiæ at apex clothed with a dense mat of silvery hair, which may, however, be partly rubbed away. Prothorax rectangular, distinctly longer than wide, a little narrowed at base and apex, the sides broadly and shallowly emarginate two-fifths from apex where there is a complete transverse impression on the pronotal disk; lateral margins finely crenate, nearly paralleled on the disk, about a fifth of the prothoracic width from the sides, by a pair of fine lateral costæ which extend from base to apex except that they may be partly or almost entirely obsolete on the interior two-fifths; pronotum in anterior two-fifths faintly shining, evenly convex, sparsely punctate; pronotum in anterior three-fifths opaque, with a low rounded "Y"-shaped elevation running from the middle of the base to the transverse impression, where the arms of the "Y" terminate on each side of a central foveate depression; on each side there is also an oblique elevation extending from near the base of the "Y" to near the pronotal margin two-fifths from base. Elytra about twice as long as wide, the sides parallel from just back of humeri to apical third; disk dull, finely pubescent; third interval not or but slightly prominent at base, seventh interval with a fine inconspicuous costa; discal striæ marked by rows of very coarse punctures which are larger and sub-confluent toward elytral base and which extend to apex, giving the whole elytron the appearance of being irregularly cribrate.

Length: 1.4-1.7 mm. Width: 0.5± mm.

Holotype number 15949 in the Museum of Comparative Zoölogy, collected by Professor C. T. Brues in "Hot Spring no. 15; Opal Mine 25 mi. So. Denio, Ore." Paratypes: 61 with the same data as the holotype. Paratypes to be deposited in the Museum of Comparative Zoölogy, the United States National Museum, the Canadian National Collection, the California Academy of Sciences, the collection of Mr. H. C. Fall, and that of the writer.

This species is allied by the pronotal sculpture and the character of the ventral pubescence to *Helmis pusilla, foveata,* and *similis,* but it may be easily distinguished by its much narrower form and the coarsely punctate, inconspicuously costate elytra. Occasionally the punctures of the elytra are filled up or concealed by a superficial layer of dirt, but the remaining characters are sufficient to make the species readily recognizable. Professor Brues found two specimens of *H. similis* in the same locality.

A NEW SPECIES OF PROBOLOMYRMEX FROM JAVA.

By William Morton Wheeler,
Bussey Institution, Harvard University.

In a collection of Javanese ants kindly sent me by Dr. K. Dammerman I find four workers of an interesting undescribed species of the little known Ponerine genus Probolomyrmex, which Mayr in 1901 (Ann. k. naturhist. Hofmus. Wien 16, p. 2) based on the worker of a species, *filiformis*, taken by Dr. Hans Brauns at Port Elizabeth, Cape Colony. More recently, Mann (Psyche 30, 1923 p. 16, fig. 2) has described and figured the deälated female of another species, *boliviensis*, from Rurrenabaque, Bolivia. Owing to the difference in caste, he was doubtful of the generic allocation of his specimen, but Emery's figures of the type, in the "Genera Insectorum" (Ponerinæ 1910, Pl. 2, figs. 10, 10a) show that the Bolivian species is a true Probolomyrmex. The finding of a third species in Indonesia now shows that the generic distribution in Africa and South America cannot be used as evidence of former geological connection between these continents, but that Probolomyrmex, like Discothyrea, Centromyrmex, etc., must be regarded as a genus of archaic, tropicopolitan, relict species, and perhaps as the remains of a formerly cosmopolitan group. The rather pale color and complete absence of eyes in the worker and the very small eyes and ocelli in the female, show that the Javan form, as well as the other two species, are hypogæic in habit like all the other Proceratiini (Proceratium, Sysphincta, Discothyrea, Prodiscothyrea and Escherichia).

Probolomyrmex dammermani sp. nov.

Worker. Length 2-2.5 mm.

Head subelliptical, one and one-half times as long as broad, slightly narrower in front than behind, with evenly rounded, feebly convex sides and slightly concave posterior border; in profile rather convex dorsally, with straight gular surface, without any traces of eyes or ocelli. Mandibles very small, narrow and convex, with four minute, indistinct, oblique teeth. Clypeus as in *P. filiformis*, projecting forward and concealing the mandibles and with a median ridge formed by the coalescence of the frontal carinæ which terminate posteriorly in a short bifurcation. Frontal groove absent. Antennæ stouter than in *filiformis*, the scapes reaching to about the posterior fifth of the head; first funicular joint not longer than broad; joints 2-10 decidedly

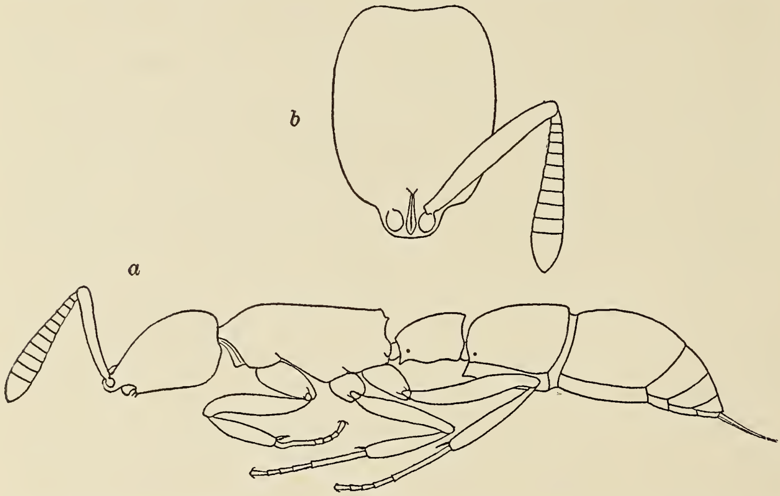

Fig. 1. *Probolomyrmex dammermani* sp. nov. worker. *a*, profile view; *b*, dorsal view of head more enlarged.

broader than long, gradually increasing in width apically, the penultimate joint more than twice as broad as long, the terminal joint glandiform, not more than one-third longer than broad and scarcely as long as the three preceding joints together. Thorax shaped much as in *filiformis*, long and narrow, without sutures, the dorsal outline even and straight, except anteriorly where it is feebly convex. Prosternal angles sharp; epinotal declivity perpendicular and concave, on the sides sharply marginate and distinctly dentate. Petiole elongate, laterally compressed, from above nearly twice as long as broad, about one-fourth broader behind than in front, and with feebly rounded sides; in profile nearly one and one-half times as long as high, highest behind where it is concavely truncated; the dorsal surface convex, rising evenly to the posterior truncation, the ventral surface convex in the middle, at the anterior end with an acute tooth which is directed forward. Postpetiole strongly constricted off from the first gastric segment, one and one-fourth times as long as broad, narrowed anteriorly, evenly convex dorsally and laterally, its anteroventral protuberance rather sharply angular in profile. First gastric segment as long as the postpetiole, longer than broad. Sting very long and slender. Legs long.

Nearly opaque throughout, legs scarcely more shining; very densely, finely and evenly punctate, the head and thorax somewhat more distinctly.

Hairless; pubescence white, extremely fine, forming a delicate bloom, most distinct on the thorax and abdomen.

Clear ferruginous red, the head in some specimens a little paler than the thorax; anterior portion of head, clypeus, mandibles, antennæ, legs and gaster beyond the first segment reddish yellow.

Described from four specimens taken Dec. 18, 1922 by Dr. Karl Dammerman at Buitenzorg, Java.

This species is smaller than *P. filiformis*, which measures 3 mm.; its antennal funiculi are decidedly thicker, with broader joints, the epinotum is distinctly dentate and the ventral portion of the petiole has no lamella and its anterior tooth is directed forward instead of backward. The female *P. boliviensis* Mann resembles the Javan species in its smaller size (the female measures only 2.8 mm.), in the shape of the antennal funiculi and the ventral portion of the petiole, but the dorsal portion of the latter is higher and has a very different outline in profile, the postpetiole is shorter than the first gastric segment and the color is more brownish red. This last character, however, may be peculiar to the female.

ANTS OF NANTUCKET ISLAND, MASS.

By William Morton Wheeler,
Bussey Institution, Harvard University.

After making an intensive study of the insect fauna of Nantucket Island, Mr. C. W. Johnson has turned over to me for identification all the ants which he was able to collect. There are seventeen different forms, all of which, with the exception of *Monomorium minimum*, are common on the New England mainland. The absence of certain conspicuous species, especially of the genera Aphænogaster and Prenolepis, is worthy of note.

1. *Ponera coarctata* Latr. subsp. *pennsylvanica* Emery. A single male.

2. *Myrmica brevinodis* Emery var. *canadensis* Wheeler. Workers, females and males.

3. *Myrmica scabrinodis* Nly. var. *sabuleti* Emery—Workers, females and males.

4. *Monomorium minimum* Buckley.—A single winged female. This is a southern species which has entered New England along the coast. It has been taken near New Haven, Conn., at Providence, R. I. and at Woods Hole, Mass. The only inland record is Wellesley, Mass. (A. P. Morse).

5. *Crematogaster* (*Acrocœlia*) *lineolata* Say.—Workers, females and males.

6. *Tapinoma sessile* Say.—Workers and a deälated female.

7. *Dolichoderus* (*Hypoclinea*) *plagiatus* Mayr var. *inornatus* Wheeler.—A worker and a winged female.

8. *Lasius niger* L. subsp. *alienus* Först. var. *americanus* Emery.—Workers and females.

9. *Lasius* (*Chthonolasius*) *brevicornis* Emery—Workers, females and males.

10. *Formica truncicola* Nyl. subsp. *obscuriventris* Mayr. var. *gymnomma* Wheeler.—Single worker, female and male specimens.

11. *Formica difficilis* Emery var. *consocians* Wheeler.—Workers. This ant is a temporary social parasite of *F. schaufussi* var. *incerta*.

12. *Formica exsectoides* Forel.—Workers. This is a temporary social parasite of *F. fusca* var. *subsericea.*

13. *Formica fusca* L. var. *subsericea* Say.—Workers and females.

14. *Formica* (*Neoformica*) *pallidefulva* Latr. subsp. *schaufussi* Latr.—Workers.

15. *Formica* (*Neoformica*) *pallidefulva* subsp. *schaufussi* var. *incerta* Emery.—Workers.

16. *Formica* (*Neoformica*) *pallidefulva* subsp. *nitidiventris* Emery var. *fuscata* Emery.—Workers.

17. *Camponotus herculeanus* L. subsp. *ligniperda* Latr. var. *noveboracensis* Fitch.—Workers.

NOTES ON THE GENUS *PROCTACANTHUS* WITH THE DESCRIPTIONS OF TWO NEW SPECIES (DIPTERA: ASILIDAE)

By Stanley W. Bromley.

Proctacanthus is a genus of large robber flies, the majority of species of which are found in the New World. Practically all the species with which I am familiar inhabit dry fields or pastures, several being restricted to dry sandy plains.

In 1923, I published a short article (Psyche, Vol. XXX, No. 2, April, 1923, pp. 41-45.) dealing with the food habits of two species (*Proctacanthus rufus* Willist. and *P. brevipennis* Wied.) occurring in the latter situations. I did not mention in the article that the species concerned were identified by myself by comparison with specimens determined by Mr. C. W. Johnson.

Since the publication of this paper, I discovered that the specimens, determined as *P. rufus* Willist. would not fit the description of this species as given by Hine (Annals Ent. Soc. Am. Vol. IV, pp. 153-172. 1911) but rather would run to the next species given as *rufiventris* Macq. The principal differences between the two are cited by Hine as being the enlarged hypopygium and uniform red thorax in *rufus*, against the darker thorax with nearly black stripes and spots and the narrow hypopygium (narrower than the last segment) of *rufiventris*.

Unfortunately, no mention is made of the latter character in Williston's original description which fits, as far as it goes, the specimens which I had noted as *rufus*.

In August 1925, I collected a species of *Proctacanthus* in the sandy areas along the Rio Grande near Albuquerque, N. Mexico. These specimens agreed with Hine's description of *rufus*, and differed as noted from the New England specimens. Since then I have examined a number of collections from states on the Atlantic Coast from South Carolina north to Maine and have found plenty of specimens of what Hine describes as *rufiventris*, but none from this region of what he describes as *rufus*. Now Williston's specimens were from Masaschusetts and North

Carolina, and—as the specimens taken in these regions fit his description—it is very probable that it was this species with which he was dealing. The name *rufus* should, therefore, be applied to the eastern species with the dark thorax and narrow hypopygium. The western species (which, however, comes as far east as Ohio and Kentucky) with the uniform light red thorax and enlarged hypopygium is a new species. I should note that this designation of "Eastern" and "Western" species is more or less arbitrary. I have seen specimens of Williston's *rufus* from Oklahoma.

I am, therefore, proposing a new name for Hine's *P. rufus*. I take pleasure in naming this species *Proctacanthus hinei* in honor of this worker who has contributed so much to the knowledge of this interesting family of flies in this country.

Proctacanthus hinei new species.

♂ Total length 33 mm. Dull reddish species with genitalia from above wider than last abdominal segment. Antennæ reddish with black bristles. Facial gibbosity prominent, dull red. Proboscis upturned at tip; black above, red beneath. All hairs of head (mystax, beard, palpal hairs) white, some with faint yellowish tinge, particularly in mystax. A few black bristles on vertex and occiput. Thorax and legs dull reddish. Legs with black bristles and spines. Mass of white hairs on anterior part of pro-coxa. Bristles of scutellum and posterior dorsum of thorax black. Fine hairs on anterior dorsum of thorax also black. Pleuræ with fine whitish bloom. A few black bristles on meso— and meta—coxæ. Tuft of hairs in front of halteres pale yellowish. Wings nearly clear with light, reddish veins. Abdomen yellowish-red, except first tergite and anterior half of second which are very dark red—practically black. Anterior four or five incisures darker than rest of abdomen. Sides and venter of anterior portion of abdomen with thin, white pile. A few black hairs on sides of first tergite. Genitalia yellowish-red with fine hairs, some black, some pale yellowish. Genitalia wider than last abdominal segment, the appendages from dorsal view wide at base, narrowing toward apex.

Holotype ♂ Albuquerque, N. Mexico. Aug. 3, 1925. In Coll. S. W. Bromley.

I have never seen a specimen of the true *P. rufiventris* Macq. from the United States. The species was originally described from San Domingo, but the description is very meagre and might very well apply to Williston's *rufus*. I have seen, however, specimens of what I take to be *rufiventris* from Haiti, the Dominican Republic, Cuba, and the Bahamas, and it is quite different from any species I have seen from the United States, being more closely related to *P. fulviventris* Macq. from Florida than to *P. rufus*. The principal points of difference distinguishing it from the latter are the yellow hairs on the scutellum (in *rufus* they are black), the thick yellow pile along the sides of the abdomen near its base, the general golden color of the thoracic vestiture, and the smaller average size. The black markings on the thorax are also very decided, contrasting with the general reddish color of the thorax. *Fulviventris* Macq. has the femora black. In the present species they are red.

Macquart's name *rufiventris*, however, can not stand, as the same species was, beyond the slightest doubt, described from San Domingo by Olivier in 1789 (Encyclop. Methodique IV, 263.4) as *Asilus vittatus*. Macquart's description of *rufiventris* in Dipteres Exotiques (I, 2, 123), appeared in 1838. E. Lynch—Arribalzaga described a species of *Proctacanthus* from Misiones, giving it the name of *vittatus* in 1880, (Annal. Soc. Cient. Argent., IX. 261. 29), but I have not seen the description of this species.

In recapitulation, therefore, we have the following established species and synonymy.

1. **Proctacanthus vittatus** Olivier.
   Syn: *Proctacanthus rufiventris* Macquart.
2. **Proctacanthus rufus** Williston.
   Syn: *Proctacanthus rufiventris* Hine.
3. **Proctacanthus hinei** new species.
   Syn: *Proctacanthus rufus* Hine.

In studying a number of Asilidæ from the Cornell University collection, kindly loaned me through the good offices of Drs. Johannsen and Bradley, I came across an interesting new species of *Proctacanthus* from Southern Georgia, related to *P. brevipennis*

Wied. but lighter in color and averaging larger. The abdomen is comparatively longer and the femora are uniformly reddish. The proboscis is longer and more slender than in *brevipennis* and the palpal hairs are all white.

Proctacanthus gracilis new species.

Total length, 26-30 mm. ♂ Proboscis slender, black. Palpi black. Hairs of palpi mystax, beard and post-genæ nearly white with very pale yellowish tinge. Antennæ dark reddish, second segment lightest. Occipital bristles and a few on vertex black. Frons light yellowish pruinose. Thorax reddish in ground color, with dark red median line and lateral vittæ and covered, except the median line and vittæ, with pale yellowish bloom. Coxal hairs and tuft in front of halteres pale yellow. Pronotal bristles, bristles on posterior part of mesonotum and scutellum black. Legs reddish with black bristles and fine pale hairs, the tarsi darker in color. Wings nearly hyaline with faint reddish tinge. Veins reddish. Ground color of abdomen reddish, but covered with pale yellowish bloom and fine pubescence. Side bristles on first abdominal segment black. There is an obscure brownish area in the center of each segment forming a broken median line along the dorsum of the abdomen.

♀ Same as male, but with blackish ovipositor with circlet of black spines.

Holotype ♂. Spring Creek, Decatur County, Ga. July 16-19, 1912. Cornell U. lot 482 sub. 132. Coll. J. C. Bradley. Allotopotype ♀, same date, lot and sub. 12 paratypes. All topotypes but two. Of the latter, one bears the label "Georgia," and the other "Billy's Island, Okefenokee Swamp, Ga., June 1912."

THE MUTILLIDAE OF CUBA (HYM.).[1]

By Clarence E. Mickel,
The University of Minnesota.

Mutillidæ from Cuba are apparently very rare in collections. The largest collection, on which notes have been published, comprises the material belonging to this family in the Gundlach collection of Hymenoptera. The total number of specimens of Mutillidæ in that collection was nine, representing five species and three genera. The specimens were recorded and described by Cresson (1865), and at that time included all the species known from Cuba. Two additional species from Cuba have been described since by Blake (1871) and Mickel (1926).

Dr. George Salt succeeded in collecting a number of Mutillidæ in 1925 in the vicinity of the Harvard Biological Station at Soledad, Cuba. His collection includes the greatest number of specimens from the island of Cuba which has so far been made available for study. Dr. Salt very courteously offered me the opportunity of examining and studying this material for which I take this occasion to express my sincere appreciation.

There are thirty-five specimens in the Mutillid material collected by Dr. Salt, representing six species and four genera. The genus *Pseudomethoca* which was heretofore unknown from Cuba is represented in the material by a new species. The identity of *senex* Guérin and *palliceps* Cresson as two sexes of the same species which had been suggested by André (1898) is verified by Dr. Salt's collecting. Two new species of the genus *Ephuta* were also found in the material. In addition to the records and descriptions of the species in the Salt collection, I have included complete synonymical notes on all the species known from Cuba. I have appended also a list of the Mutillidæ known to occur in the West Indies exclusive of Cuba, in order to make readily accessible in one paper a complete catalogue of the Mutillid fauna of the West Indian Islands. None of the species known from Cuba have been recorded from the other islands.

[1]Published with the approval of the Director as Paper No. 694, of the Journal Series of the Minnesota Agricultural Experiment Station.

Genus **Pseudomethoca** Ashmead.

1. **Pseudomethoca salti** n. sp.

Female. Head broader than the thorax, pale ferruginous, densely clothed with appressed, brilliant ochraceous pubescence; thorax blackish; abdomen ferruginous; pygidium granulate. Length, 8 mm.

Head pale ferruginous, densely clothed throughout with appressed, brilliant ochraceous pubescence; mandibles ferruginous, black at the tips, edentate; anterior margin of the clypeus with a prominent tooth each side at a point about one-fourth the width of the clypeus from the base of the mandibles; medio-anterior area of clypeus glabrous, impunctate; antennal tubercles separated by about half the length of the scape; scape ferruginous, glabrous, indistinctly punctate, with scattering, long, erect, pale hairs; first segment of flagellum longer than the second, but not as long as two and three united; antennal scrobes distinctly carinate above; puncturation of front and vertex obscured by the pubescence; genæ closely, distinctly punctate, the pubescence sparse; posterior margin of the genæ prominently carinate, the carina extending to the postero-lateral angles; relative widths of head and thorax, 6—5.2.

Thorax hexagonal, strongly constricted behind the middle, very dark mahogany red, almost black, clothed above with sparse, inconspicuous, dark pubescence; dorsum of thorax densely and deeply punctate; scutellar scale absent; propleura closely punctate, a carina extending ventrally from the humeral angles; mesopleura, metapleura and sides of propodeum glabrous, impunctate; anterior half of mesopleura with sparse, fine, pale pubescence; upper part of posterior face of propodeum coarsely punctato-reticulate, the ventral half with large, close punctures.

Abdomen ferruginous; first segment completely sessile with the second; disk of first tergite with intermixed large and fine punctures, the posterior third with large, deep, dense punctures; posterior margin of first tergite with a fringe of dark ferruginous pubescence; second tergite ferruginous, the areas at the basal lateral angles very dark ferruginous, almost black; basal two-thirds of second tergite densely and deeply rugoso-reticulate, apical third with dense, moderate punctures; sides and disk of second tergite clothed with sparse, pale pubescence; apical third of second tergite, except at the sides, clothed with sparse, long, black pubescence; tergites 3-5 densely, finely punctured, clothed with dense, appressed, brilliant ochraceous pubescence; a very small, inconspicuous spot of black pubescence medially on the apical margins of tergites 3 and 4; ultimate tergite with brilliant ochraceous pubescence basally; pygidial area distinct and granulated; first sternite with a median, longitudinal carina; second sternite with large, distinct punctures throughout; apical margins of sternites 3-6 densely punctured; all the sternites clothed with very sparse, pale pubescence.

Legs ferruginous, sparsely clothed with pale pubescence; calcaria pale.

Holotype: ♀, Soledad, Cuba, February 9, 1925 (George Salt), in collection of Museum of Comparative Zoölogy, Cambridge, Mass.

This species appears to be somewhat similar to *flaviceps* André described from Haiti but differs in the thorax being dark throughout, the absence of pubescent spots on the pleura, the ferruginous abdomen, first abdominal tergite without a median spot of silvery pubescence on the posterior margin, second abdominal tergite without three dark red spots, and in other minor characters. I am pleased to name this species for Dr. George Salt, through whose kindness I have been able to study this collection of Cuban Mutillids.

Genus **Dasymutilla** Ashmead.

2. **Dasymutilla nigriceps** (Cresson).

1865. *Mutilla nigriceps* Cresson, Proc. Ent. Soc. Phila., **4**: 110, ♀.

1871. *Mutilla* (*Sphærophthalma*) *nigriceps* Blake, Trans. Amer. Ent. Soc., **3**: 245, ♀.

1886. *Sphærophthalma nigriceps* Blake, Trans. Amer. Ent. Soc., **13**: 238, ♀.

1897. *Mutilla fiorentinii* Dalle Torre, Cat. Hymen., **8**:40, ♀.

1898. *Mutilla* (*Ephuta*) *nigriceps* André, Ann. soc. ent. France, **67**: 53, ♀.

1900. *Mutilla nigriceps* Fox, Ent. News, **11**: 401, ♀.

1903. *Ephuta* (*Ephuta*) *nigriceps* André, Gen. Ins., **1** (fasc. 1): 62, ♀.

Type: ♀, Cuba, in collection of American Entomological Society of Philadelphia.

Specimens examined:

♀, Soledad, Cuba, February 22, 1925 (J. G. M.); ♀, Soledad, Cuba, March 18, 1925 (George Salt); ♀, Soledad, Cuba, April 1, 1925 (George Salt); ♀, Soledad, Cuba, May 28, 1925 (George Salt); ♀, Soledad, Cuba, June 9, 1925 (George Salt); ♀, Soledad, Cuba, December 3, 1927 (J. W. Wilson); ♀, Soledad, Cuba, December 6, 1927 (W. S. Creighton).

3. **Dasymutilla wilsoni** (Cresson).

1865. *Mutilla Wilsoni* Cresson, Proc. Ent. Soc. Phila., **4**: 112, ♂.

1871. *Mutilla* (*Sphærophthalma*) *Wilsoni* Blake, Trans. Amer. Ent. Soc., **3**: 240, ♂.

1886. *Sphærophthalma Wilsoni* Blake, Trans. Amer. Ent. Soc., **13**: 232, ♂.

1897. *Mutilla wilsonii* Dalle Torre, Cat. Hymen., 8: 98, ♂.

1900. *Mutilla Wilsoni* Fox, Ent. News, **11**: 401, ♂.

1903. *Ephuta* (*Ephuta*) *Wilsoni* André, Gen. Ins., **1** (Fasc. 11): 65, ♂.

Type: ♂, Cuba, in collection of American Entomological Society of Philadelphia.

Specimens examined:

♂, Soledad, Cuba, February 16, 1925 (J. G. Myers); ♂, Soledad, Cienfuegos, Cuba, Jan.-Feb., 1927 (C.T. and B. B. Brues).

This may possibly be the male of *nigriceps* Cresson.

4. **Dasymutilla insulana** Mickel

1926. *Dasymutilla insulana* Mickel, Ent. Mitt., **15**: 197, ♀.
Type: ♀, Guantanamo, Cuba, in Deutches Entomologisches Institut, Berlin-Dahlem, Germany.

Specimens examined:

Two females from Guantanamo, Cuba, in addition to the type.

Superficially this species resembles *nigriceps* Cresson, but is very different as pointed out in the original description. It is probably more nearly related to *bouvieri* André described from San Domingo.

Genus **Timulla** Ashmead.

5. **Timulla senex** (Guérin).

1844. *Mutilla senex* Guérin, Iconogr. regn. anim., **7**: 429, Pl. 69, fig. 4, ♂.
1857. *Mutilla senex* Lucas, Ramon: Hist. fis. Cuba, **7**: 758.
1865. *Mutilla senex* Cresson, Proc. Ent. Soc. Phila., **4**:110, ♂.
1865. *Mutilla palliceps* Cresson, Proc. Ent. Soc. Phila., **4**: 112, ♀.
1871. *Mutilla senex* Blake, Trans. Amer. Ent. Soc., **3**: 230, ♂.
1871. *Mutilla palliceps* Blake, Trans. Amer. Ent. Soc., **3**: 230, ♀.
1879. *Mutilla senex* Girard, Traité elem. d'entom., **2**: 994, Pl. 75, fig. 4, ♂.
1886. *Mutilla senex* Blake, Trans. Amer. Ent. Soc., **13**: 199 ♂.
1886. *Mutilla palliceps* Blake, Trans. Amer. Ent. Soc., **13**: 200, ♀.
1897. *Mutilla pallidiceps* Dalle Torre, Cat. Hymen., **8**: 70, ♀.

1897. *Mutilla senex* Dalle Torre, Cat. Hymen., **8**: 85, ♂.

1898. *Mutilla senex* André, Ann. soc. ent. France, **67**: 38, ♂, ♀.

1900. *Mutilla palliceps* Fox, Ent. News, **11**: 401, ♀.

1903. *Mutilla senex* André, Gen. Ins., **1** (fasc. 11): 42, ♂.

Type: ♂, Cuba, in the Museum of Paris.

Type of *palliceps* in collection of American Entomological Society of Philadelphia.

Specimens examined:

2♂, 2♀, Soledad, Cuba, February 7, 1925 (George Salt); 14♂, Soledad, Cuba, February 16, 1925 (George Salt); 2♂, Soledad, Cuba, February 21, 1925 (George Salt); ♂, Soledad, Cuba, March 2, 1925 (George Salt); 2♂, Soledad, Cuba, March 4, 1925 (George Salt); ♀, Soledad, Cuba, June 1, 1925 (George Salt); ♀, Soledad, Cienfuegos, Cuba, October 24, 1926 (Darlington); 2♀, Soleland, Cienfuegos, Cuba. November 7, 1926 (Darlington).

Blake (1871) first suggested that *palliceps* was probably the female sex of *senex* Guérin. Later André (1898) united the two as sexes of the same species, although the evidence was not absolutely conclusive. In the material collected by Dr. Salt there is a male specimen and a female specimen pinned on the same pin, which apparently indicates that they were taken *in copula*. Since these are the only two members of the genus *Timulla* described from Cuba the evidence seems to justify the uniting of *palliceps* Cresson with *senex* Guérin as the two sexes of *senex*.

Genus **Ephuta** Say.

6. **Ephuta rubriceps** (Cresson).

1865. *Mutilla rubriceps* Cresson, Proc. Ent. Soc. Phila., **4**: 111, ♀.

1871. *Mutilla rubriceps* Blake, Trans. Amer. Ent. Soc., **3**: 257, ♀.

1886. *Sphærophthalma rubriceps* Blake, Trans. Amer. Ent. Soc., **13**: 216, ♀.

1897. *Mutilla rubriceps* Dalle Torre, Cat. Hymen., **8**: 79, ♀.

1900. *Mutilla rubriceps* Fox, Ent. News, **11**: 401, ♀.

1903. *Ephuta* (*Ephuta*) *rubriceps* André, Gen. Ins., **1** (fasc. 11): 63, ♀.

Type: ♀, Cuba, in Gundlach collection, Instituto de Segunda Ensenanza de la Habana, Obispo street, Havana, Cuba.

Known only from the type specimen. This species has always been placed with the group of species which now form the genus *Dasymutilla* Ashmead. It seems perfectly evident from Cresson's description of the first abdominal segment that it really belongs to the genus *Ephuta*. From the original description it appears to be very closely related to *cubensis* Blake.

7. **Ephuta cubensis** (Blake).

1871. *Mutilla cubensis* Blake, Trans. Amer. Ent. Soc., **3**: 231, ♀.

1886. *Mutilla cubensis* Blake, Trans. Amer. Ent. Soc., **13**: 202, ♀.

1897. *Mutilla cubensis* Dalle Torre, Cat. Hymen., **8**: 29, ♀.

1900. *Mutilla cubensis* Fox, Ent. News, **11**: 401, ♀.

1903. *Rhoptromutilla cubensis* André, Gen. Ins., **1** (fasc. 11): 44, ♀.

Type: ♀, Cuba, in collection of American Entomological Society of Philadelphia.

Known only from the type specimen.

8. **Ephuta festata** n. sp.

Female. Very dark ferruginous, deeply, foveately punctate;

head slightly wider than the thorax, clothed with dense, appressed, ochraceous pubescence; thorax subrectangular, bituberculate on each side; abdomen maculated with areas of appressed, black and ochraceous pubescence. Length, 9.5 mm.

Head ferruginous, densely clothed with appressed, ochraceous pubescence and sparse, erect, ochraceous hairs; mandibles ferruginous, black at the tips, edentate; clypeus very broadly and prominently elevated into a process medially, the ventral surface of the process strongly concave, densely punctured and clothed with erect, ochraceous pubescence; the dorsal surface of the process coarsely punctured, with sparse, erect, ochraceous pubescence, and medially elevated into a blunt tooth; scape, pedicel and first segment of flagellum ferruginous, the remainder of the flagellum darker; scape glabrous, with scattered punctures above; flagellar segments 3-9 planate beneath; antennal scrobes not carinate above; front and vertex with sparse, deep,distinct punctures, the intervals between the latter with fine, dense, shallow punctures; genæ with large, rather close very deep punctures, the intervals between the latter sculptured like the front, posterior margin of the genæ defined by a prominent crenulate carina which terminates at the postero-lateral angles; relative widths of head and thorax, 3.75-3.25.

Thorax subrectangular, ferruginous, the dorsum and pleura densely, foveately punctate, the punctures of the pleura larger and more separated than those of the dorsum; dorsum of thorax and posterior face of propodeum clothed with sparse, erect, black pubescence; mesopleura and metapleura and ventral margins of propodeum clothed with appressed, ochraceous pubescence; thorax tuberculate at the postero-lateral angles of the pronotum, and at the propodeal spiracles, the latter opening on the posterior surface of the tubercle.

Abdomen ferruginous; first segment quadrate, the anterolateral angles dentate; first tergite with close, deep punctures, clothed with dense, appressed, ochraceous pubescence and sparse, erect, ochraceous hairs, the posterior margin with a small spot of black pubescence medially; second tergite, except broad apical margin, with deep foveate punctures, dense and confluent on the disk, larger and somewhat separated at the base and sides, the intervals between the punctures feebly granulate; the broad apical margin depressed, with only scattered, large punctures; second tergite with a large, median, basal spot, and median, apical spot of dense, appressed black pubescence, the basal spot margined basally and laterally with dense, appressed, ochraceous pubescence, the apical spot broadly interrupting a broad apical band of dense, appressed ochraceous pubescence, the latter narrowed laterally and extended anteriorly along the lateral margins of the tergite to the anterior angles; basal half of third tergite densely foveately punctate, the apical half finely, shallowly punctate with scattered, large punctures; broad, lateral margins of third tergite with dense, appressed, ochraceous pubescence, the apical half of the tergite (except lateral margins) clothed with dense, appressed, black pubescence, narrowly interrupted medially with a line of dense, appressed, ochraceous pubescence; fourth tergite like the third, except the black band is broadly interrupted by a spot of dense, appressed, ochraceous pubescence; fifth tergite clothed entirely with dense, appressed, ochraceous pubescence, except for a pair of obscure, small, lateral spots of black, appressed pubescence; ultimate tergite densely punctured, clothed with rather dense, erect, ochraceous pubescence, pygidial area punctate and pubescent; first sternite with a prominent, median, longitudinal carina; second sternite with large, elongate, contiguous punctures; apical margins of sternites 3-5 densely punctate; apical margins of sternites 2-3 with a band of dense, appressed, ochraceous pubescence, the remainder of the venter clothed with sparse, erect, pale pubescence.

Legs ferruginous; femora beneath finely and closely punctured on the apical half and clothed with fine, appressed, pale pubescence; remainder of legs clothed with sparse, erect, pale pubescence; calcaria pale.

Holotype: ♀, Soledad, Cuba, May 6, 1925 (George Salt), in collection of Museum of Comparative Zoölogy, Cambridge, Mass.

Paratypes: ♀, Soledad, Cuba, April 26, 1925 (George Salt), in collection of University of Minnesota; ♀, Soledad, Cienfuegos, Cuba, November 9, 1926 (Darlington).

Related to *rubriceps* Cresson and *cubensis* Blake. *Festata* differs from *rubriceps* in having the thorax and legs ferruginous, and in the pubescent ornamentation of the thorax and abdomen; it differs from *cubensis* in the pubescent ornamentation of the abdomen.

9. **Ephuta furcillata** n. sp.

Male. Entirely black, coarsely punctured; head, prothorax, mesopleura, dorsum of propodeum, first abdominal tergite, apical margin of second tergite and apical margin of second sternite clothed with dense, appressed, silky white pubescence; scutellum prominently bifurcate; propodeum with a pair of tubercles at the antero-lateral angles and a pair of prominent teeth a short distance posterior to the tubercles; abdominal tergites 3-7 with a median, longitudinal carina; wings hyaline, the apical border very broadly fumose. Length, 8 mm.

Head black, clothed with dense, appressed, silky white pubescence; mandibles ferruginous, black at the tips, acute at the apex and with a single tooth within; clypeus with a pair of carinæ originating just anterior of the antennal tubercles, parallel on the basal half, strongly diverging on the apical half, thus enclosing a space within the arms of a Y, the enclosed space glabrous, finely, sparsely punctate; remainder of clypeus densely clothed with appressed, silky white pubescence; scape slightly concave and bicarinate beneath, above finely and closely punctured; first segment of flagellum almost equal in length to the second; antennal scrobes carinate above; front and vertex with moderate, scattered punctures, the intervals between the punctures finely granulate; genæ coarsely, deeply punctured, the posterior margin defined by a prominent, slightly crenulate carina; relative widths of head and thorax, 3-3.6.

Thorax black; pronotum and propleura densely, closely, foveately punctate, the propleura less so than the pronotum, the whole clothed with appressed and erect, silky white pubescence, not as dense as on the head; mesonotum glabrous, with sparse, large punctures, the anterior margin and the postero-lateral angles clothed with dense, appressed, silky white pubescence, remainder of mesonotum almost bare; scutellum bifurcate, the teeth projecting posteriorly, coarsely punctate, the small antero-lateral areas clothed with dense, appressed, silky white pubescence; metanotum clothed with conspicuous, silky white pubescence; mesopleura coarsely, deeply punctate, clothed with dense, appressed, silky white pubescence; metapleura glabrous, sparsely clothed with pale pubescence; sides of propodeum glabrous with very large, distinct punctures, almost bare; dorsum of propodeum densely clothed with appressed, silky white pubescence, the postero-lateral angles produced into a prominent tooth, the antero-lateral angles with a small tubercle, on the posterior surface of which is the propodeal spiracle; posterior face of propodeum deeply reticulate, almost bare; tegulæ very large, conchatiform, punctured throughout with sparse, fine punctures, and clothed with very sparse, pale pubescence.

Abdomen black; first segment quadrate; first tergite with the antero-lateral angles strongly dentate, densely clothed with appressed, silky white pubescence; second tergite with large, elongate, more or less contiguous punctures, clothed with very sparse, erect, pale pubescence, except the apical margin with a broad band of dense, appressed, silky white pubescence; tergites 3-7 with a median, longitudinal carina, with sparse, moderate punctures, and clothed with sparse, erect, pale pubescence, except tergites 3 and 4 with a spot of dense, appressed, silky white pubescence at the lateral margins; first sternite with a median, longitudinal carina, the latter produced anteriorly into a prominent tooth; second sternite with large, close punctures, clothed with sparse, erect, pale pubescence, except the apical margin with a band of dense, appressed, silky white pubescence; sternites 3-7 with small, sparse punctures, and clothed with sparse, erect, pale pubescence.

Wings hyaline, except cell $C+Sc_1$ and the apex of the wing beyond cells 2nd R_1+R_2 and R_4, fumose; cell R_4 present; vein M_{3+4} received by cell R_5 about three-fifths the distance from the base to the apex; vein M_2 received by cell R_4 almost at the apex; veins r—m and R_5 widely separated on vein r.

Legs black, clothed with sparse, silky white pubescence; calcaria white.

Holotype: ♂, Soledad, Cuba, April 9, 1925 (J. G. Myers), in collection of Museum of Comparative Zoölogy, Cambridge, Mass.

Paratype: ♂, Soledad, Cuba, February 21, 1925 (George Salt), in collection of University of Minnesota.

This is the only male of this genus thus far described from the West Indies. It will probably prove to be the male of *festata*.

Mutillidæ described from the West Indies, exclusive of Cuba.

1. *Pseudomethoca flaviceps* André. Haiti.
   Zeit. f. Hymen. u. Dipt., **6**: 72-74, ♀. 1906.
2. *Pseudomethoca unicincta* Ashmead. St. Vincent Islands.
   Trans. Ent. Soc. London, **1900**: 239, ♀. ♂. 1900.
3. *Dasymutilla bouvieri* André. San Domingo.
   Ann. soc. ent. France, **67**: 51, ♀. 1898.
4. *Dasymutilla militaris* Smith. Jamaica.
   Cat. Hymen. Brit. Mus., **3**: 61, ♀. 1855.
5. *Dasymutilla melancholica* Smith. San Domingo.
   Descr. New Species of Hymen., 223, ♀. 1879.
6. *Dasymutilla cargilli* Cockerell. Jamaica.
   Psyche, **7** (suppl.): 16, ♀. 1895.

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AN INTRODUCED MOTH (*HELIOTHIS DIPSACEA L.*)

By Fred H. Walker,
Salem, Mass.

While looking over the Clark collection of Lepidoptera recently acquired by the Boston Society of Natural History, my attention was attracted to a single moth bearing the label "*Heliothis dipsacea* L. Europe." A close examination of the moth showed it to be similar to specimens in the author's collection of Essex County, Massachusetts, insects. Fortunately, two specimens from Essex County which had been given to the Boston Society's New England collection were conveniently available for comparison; this proved that all were undoubtedly of the same species. Through the courtesy of Mr. Nathan Banks, European specimens in the collection of the Museum of Comparative Zoölogy were examined and the identification confirmed.

With the assistance of Mr. C. W. Johnson of the Boston Society and Mr. A. P. Morse of the Peabody Museum at Salem, European literature was consulted, some disagreement as to larval characters being noted. Most of the food plants recorded are either adventive or naturalized in this country and the introduction of the moth was probably coincident with the introduction of some of the food plants; these include toadflax, teasel, hawkweed, hawk's beard and species of dock and plantain. Some of the food plants are now widely distributed throughout the northeastern United States and it would be interesting to know more about the distribution of the moth in this country with an accurate description of the larva and its habits. In Europe the species is recorded as being widely distributed but not common and it is apparently of little economic importance. Localities are given as central and southern Europe and Asia, northern Africa, Canary Islands and one author (Meyrick) includes "N. America.?"

The moth appears to be rare in the vicinity of Salem, only eight specimens having been taken by the author during six years of collecting; it has been seen but not taken several times, its unusual appearance making it easily recognized. It (the male moth) flies both by day and night, captures having been made with net in daytime and with trap-light at night.

References:

Phalæna Noctua dipsacea Linné, Systema Naturæ, ed. 12, tome, 1 pars 5, p. 2553.

Heliothis dipsacea Westwood, British Moths, vol. 1, 1843, p. 236, pl. 53, fig. 4.

Heliothis dipsacea Meyrick, Hand Book of British Lepidoptera, 1895, p. 109.

Chloridea dipsacea Seitz, Macrolepidoptera of the World, vol. 1, 1907, p. 245, pl. 50 i.

Heliothis dipsacea Scorer, Entomologist's Log Book, 1913, p. 98.

Description:—Fore wings light brown, darker at inner marginal area; dark brown bar extends across middle of wing blending broadly with dark area at inner margin; narrow dark band at outer submarginal area; dark spot on costal margin near apex; numerous fine black dots are scattered over the wing converging thickly at discal cell forming a small dark area, with a single row at outer margin and an irregular row across the limbal area. Hind wings light buff with a broad black marginal band in the middle of which there are two closely contiguous pale spots divided by vein M2, these two spots in some instances are merged into one bilobed spot; large black discal spot extending nearly to costal margin; marginal fringe whitish. Under side of wings whitish buff with black discal spots, two on fore wing and one on hind wing; irregular narrow black band extends across both wings in limbal area.

Wing expanse, 30 to 35 mm.

Described from six males taken by the author in Essex County, Massachusetts, May 31-June 16, 1916, 1919, 1921.

UNUSUAL OCCURRENCE OF GYRINUS.

By C. A. Frost,
Framingham, Mass.

My first specimens of Coleoptera collected in 1928 were taken about 1 P. M. on January 15, and, incidentally, their appearance indicates the unusual weather condition of the winter to date.

While walking around Farm Pond in Framingham I noticed a few Gyrinus resting or slowly swimming about near the shore. The pond had been covered with ice about six inches thick but the mild weather had melted large holes in it and along the shore the open water varied from two to twenty feet in width; the upper end of the pond was open over several acres. The only snow storm of account came on December 5th and deposited about two inches which soon vanished.

Where the Gyrinus were observed several large limbs had fallen into the water and in a crotch of the branches was a partly submerged mass of leaves and pond weeds. On disturbing this, two hundred or more beetles appeared. They swam about over the pebbles of the bottom where the water was from two to eight inches deep, and under the submerged limbs or clung to bits of the submerged pond weeds. Many of them came to the surface and played about a short time while a few scurried out into the pond several yards and remained up to the time I left half an hour later.

I took 36 specimens in my hand and these were very kindly determined by my friend Mr. K. F. Chamberlain, Assistant to the State Entomologist of New York, as *G. confinis* Lec., 17 males and 19 females.

The sky was generally cloudy with the sun occasionally peeping out while a cool north wind was blowing. The temperature of the air was 38° F. and the water in a neighboring reservoir was 35° F. at 7 A. M. the next morning.

As a further illustration of the abnormal season, I found on the under side of a bit of board near the shore two species of

Collembola, one spider, four yellowish cut-worm like larvæ, one Stenus and several specimens of an *Aleocharinid* beetle. The appearance of insects on the under side of sticks and stones does not normally occur much before April.

THE PROTOCOLEOPTERA.

By Wm. T. M. Forbes,
Cornell University, Ithaca, New York.

Tillyard (Proc. Linn. Soc. N. S. W. vol. 49 p. 429, 1924) proposed an order with this name, based on a fore wing from the Permian of Australia. The present note intends to show that the form there described has no distinctive characters of the Coleoptera, but is more probably to be credited to the Orthoptera, with the possibility that it may be nearer to the ancestor of the Hemiptera.

The fossil (fig. 1) is a fore wing of characteristic Coleopterous form, except in one extremely important point, the presence of a deep notch at the articulation, and a basally extended anal lobe. This is a common feature of the Orthoptera, being more or less obvious in all the families, even in the cockroaches; and is correlated with a depression or fold at the base of the wing, which tends to bury the roots of veins M and Cu (Crampton '27). In the Coleoptera there is no such fold, but the articulation of the elytron is direct, and the veins (except Sc) all start out more or less on a level.

Secondly, the venation is rich in branches of main veins, with a few obliquely directed cross-veins. This is a common Orthopterous condition, though as a rule the supply of cross-veins is also rich. Fig. 2 shows the fore wing of a Gryllacridid, with the basal notch (in this form open and filled by a triangular group of sclerites), several precostal veins, Sc and R branched, the latter richly, M and Cu branched, their branches anastomosing, but entirely free from the veins above and below; an ambilent vein, which passes over the end of the anal fold (Pl) without change of character, and several axillary (anal) veins, starting separately from the basal notch. This form does not show the oblique cross-veins, but they are obvious in many crickets, at least on the dorsal part of the wing. In the form figured (*Eneoptera surinamensis*) the venation is richer than in Protocoleus, but the

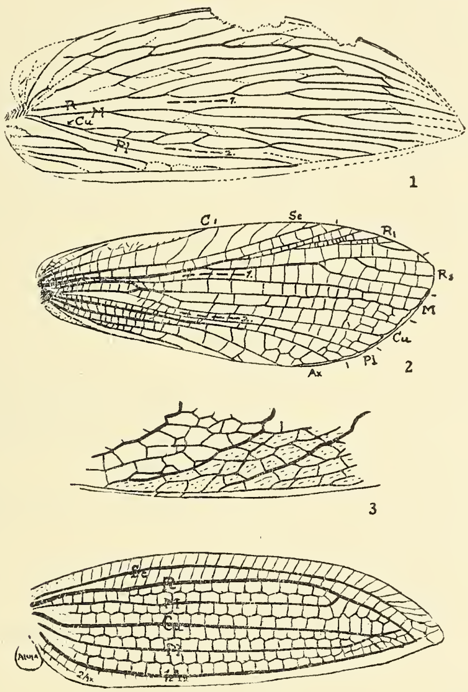

Fig. 1. 1, *Protocoleus*,, mainly after Tillard's photograph, (Pl. 46), supplemented by his restoration (fig. 3, p. 432); 2, *Gryllacris* (Orthoptera, Gryllacrididæ); fore wing; 3, *Eneoptera surinamensis* (Orthoptera, Gryllidæ); portion of inner margin of fore wing; 4, Venation of Coleopterous elytron, synthesized mainly from venation of Cupes and tracheation of Tenebrio.

general character is plainly the same. In other forms (Gryllinæ etc.) the veins are even more regular than in Protocoleus. The other characters are common to the Gryllacrididæ and Protocoleus, though the whole is distorted to form a functional elytron and the breadth of the veinless margin is exaggerated. Even in the wing as preserved there is a well-veined precostal region, and the photograph seems to leave a possibility that some has been lost, as indicated by dotted lines in the figure; M and Cu are well bound by cross-veins, though not actually anastomosing, and the veinless paths separating them from R and the anal system are striking,—the most distinctive feature of the wing.

On the other hand the Coleoptera, as shown by the forms that have veins on the elytron (fig. 4) have unbranched veins, with regularly arranged cross-veins forming double rows of cells between them; and M and Cu noticeably avoid each other, each tending to fuse with its other neighbor in the outer part of the wing,—a very distinctive wing.

In summary,—A: *Resemblances of Protocoleus to Orthoptera* and partly to Hemiptera:

1, Precostals present

2, Main veins richly branched

3, Cross-veins few, and oblique

4, Anal lobe extended basally

5, M associated with Cu, R and anals independent

6, Plical vein (the one lying in the fold) running to inner margin, as in cockroaches and Hemiptera

B: *Characters typical of the Coleoptera* (but shared by Diploptera in the Orthoptera s. l.)

1, Inner margin straight, the elytra no doubt meeting in the middle of the back

2, Apex pointed (Tillyard in lit.) and located at M rather than R.

C: *Characters of the Coleoptera not shared by Protocoleus*:

1, Costa marginal (also some Orthoptera, but not universal)

2, All veins simple (the prototype no doubt with *terminal* branching)

3, Cross-veins numerous, two-ranked and transverse

4, Base of wing simple, the anal veins when traceable run directly into the articulation

5, M running into R, Cu into the plical vein.

6, Plical vein running to apex.

I then formally refer Protocoleus to the *Orthoptera*, where it will form a well characterized family related to the Gryllacrididæ, distinguished mainly by the elytriform fore wing with apex at Media.

Note: In view of the uncertainty prevailing as to the homology of the anal veins in the various orders of insects, I hereby propose the term *Plical* (Pl) to designate, without any implication of homology, a vein or veins closely associated with the anal fold, and more or less set off from the cubitus and from the other anals. For the latter (excluding the plical or plicals) the term *Axillary*, already in use in this sense in the Lepidoptera and Orthoptera, may be used, restricting that term, then, to anals associated with the anal fan rather than the fold. The maximum number of plical veins will be *three* (hind wing of Blattoidea and Mastotermes), one of them being in that case free, one supplied by a trachea coming off the anal fan, and the third sometimes with a free trachea, but more often supplied from the base of the cubital trachea. In higher forms there will be in general one Plical, but it is not clear to which of the three in the Blattoidea (if any) it corresponds.

TABLE OF THE NORTH AMERICAN SPECIES OF MEDETERUS, WITH DESCRIPTIONS OF THREE NEW FORMS.

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

Medeterus longinervis, new species.

Male; 2-2.2 mm. Face black; front brown. Antennæ black, third joint small; artista apical; lower orbital cilia whitish.

Thorax and abdomen black with green reflections; dorsum of thorax more brown with gray pollinose vittæ; the posterior depression reaches the middle of the mesonotum, where the acrostichal bristles end, they are in two rows with a slight coppery vitta between them; one small black bristle above each fore coxa; scutellum with two pair of bristles, the outer pair half as long as the middle ones; hairs of abdomen and hypopygium white; hypopygial appendages brownish yellow.

Coxæ black, anterior pair with pale hairs on front surface and one small black bristle at tip. Femora blackish; tibiæ and tarsi yellowish brown, all their hairs white; middle tibiæ with a small black bristle at basal fourth and posterior pair with one near apical fourth. Joints of hind tarsi as 17-27-14-7-6.

Wings grayish, veins brown; last section of fifth vein 28, of cross-vein 9 fiftieths of a millimeter long.

Type, male, No. 1887, Calif. Acad. Sci., Taken by Edward P. Van Duzee, June 15, 1925, at Olney, Oregon. Two paratypes were taken at the same time and place and are also in the Academy collection.

Medeterus albosetosa, new species.

Male: Length 2 mm. Face and front gray with pollen, which covers the ground color. Antennæ black, the two basal joints more brown, third small, scarcely as long as wide, a little pointed in the middle; arista apical, orbital cilia whitish.

Thorax brown with gray pollen, which leaves narrow brown lines along the rows of bristles; prothorax with two large whitish bristles above each fore coxa; scutellum with two pair of large bristles. Abdomen and hypopygium black with white hair; hypopygial appendages yellowish brown.

Coxæ black, anterior pair nearly bare with black bristles at tips. Femora black with apical third yellow; tibiæ and tarsi yellow, the latter scarcely darker at tip; tibiæ without bristles; joints of fore tarsi as 19-17-10-5-5; of middle pair as 29-21-13-5-6; those of posterior pair as 11-31-12-8-5. Calypters, their cilia and the halteres yellow.

Wings grayish, veins yellow when seen against a dark background; last section of fifth vein 14, cross-vein 10 fiftieths of a millimeter long; venation normal.

Described from one male, taken at Galveston, Texas, in May, by F. J. Snow.

Type in the Kansas University collection.

Medeterus ciliata, new species.

Male; length 3 mm. Face and front black, rather dull, with scarcely a trace of green color. Antennæ wholly black, small; lower orbital cilia brownish yellow.

Thorax and abdomen dark green, a little shining; pollen of thorax dark gray, almost brown; scutellum with two pair of bristles; prothorax with two or three small black bristles above each fore coxa; hairs of the abdomen and legs black; hypopygium and its appendages black.

Coxæ, femora, tibiæ and tarsi black, knees narrowly yellow; fore coxæ with short black hair; fore and middle femora below and posterior pair on anterior surface with long brown hair, some of these hairs being as long as width of femora. Joints of fore tarsi as 15-21-14-5-7; of middle tarsi as 33-17-10-8-5; those of posterior pair as 20-30-14-9-8. Calypters yellow with a black edge and brown cilia; knobs of halteres yellow, their stems brown.

Wings grayish, rather dark; last section of fifth vein 32, cross-vein 16 fiftieths of a millimeter long.

Described from one male taken at Niagara Falls, Ontario, July 17, 1921, by the author.

Type in the author's collection.

Table of North American species of Medeterus.

1 Scutellum with one pair of bristles, there may be a small pair of hairs outside of these 2
Scutellum with two pair of bristles, the outer pair may be small. 12
2 Antennæ, proboscis and legs, including the fore coxæ, yellow, (Virginia). . . . . *novus* Van Duzee.
Antennæ, proboscis and more or less of the femora black. . . . 3
3 Thorax with distinct vittæ. 4
Thorax without distinct vittæ. 10
4 Thorax with a median blue vitta, (New York). . . . . *obesus* Van Duzee.
Thorax with a median brown stripe running its entire length. 5
5 Wings with a brown cloud at base of third vein. 6
Wings without a distinct cloud at base of third vein. 7
6 Tibiæ and tarsi yellow, (California). *cuneiformis* Van Duzee.
Tibiæ brownish; tarsi black with the base of the basitarsus yellowish, (California). Female of *nitidiventris* Van Duzee.
7 Abdomen bluish with gray pollen; front in male produced into a four sided pyramid, (Washington). . . . . *petulcus* Wheeler.
Abdomen shining black, or with green reflections. 8
8 Tibiæ and tarsi mostly yellow, (California). . . . . *similis* Van Duzee.
Tibiæ and tarsi black, green or brown. 9
9 Last section of fifth vein only a little longer than the cross-vein, (California). . . . . *æqualis* Van Duzee.
Last section of fifth vein one and a half times as long as the cross-vein, (California). . . . . *nitidiventris* Van Duzee.
10 Last section of fifth vein only a little more than half as long as the cross-vein, (Alaska). . . . . *minima* Van Duzee.
Last section of fifth vein longer than the cross-vein. 11

11 Femora mostly yellow; mesonotum and abdomen light green. (California)...................*longinquus* Van Duzee.
Femora mostly black; mesonotum coppery; abdomen dark green, (California)................*aeneus* Van Duzee.
Femora mostly black; mesonotum nearly opaque with gray pollen, so as to appear gray, (California)............... *falcatus* Van Duzee.
12 Bright metallic species...............................13
Darker species, usually blackish, sometimes very dark green.......................................18
13 Anterior tarsi plain..................................14
Fore tarsi modified, ornamented.......................16
14 First joint of hind tarsi only a little shorter than the second; length over 3 mm., (Guatemala)...*planipes* Van Duzee.
Posterior tarsi with the second joint twice as long as first...15
15 Legs altogether black; second joint of hind tarsi more than twice as long as first, (North America)....*nigripes* Loew.
Legs wholly yellow; first and second joints of hind tarsi as 19 to 37, (Eastern)..................*aberrans* Wheeler.
16 Length 2 mm.; male with a lobe on the side of third joint of fore tarsi, (New Jersey; Ontario)......*lobatus* Van Duzee
Length 3 mm.; fore tarsi otherwise formed.............17
17 Fore tarsi a little widened from base to tip of second joint; third joint only a little narrowed at base, but suddenly narrowed to a slender projection, to which the fourth joint is attached; fourth and fifth joints slender, (Guatemala)...........................*abruptus* Van Duzee.
Fore tarsi with the second and third joints very much compressed and expanded on upper edge; fourth and fifth joints minute, (Guatemala)..........*flavipes* Van Duzee
18 Bristles above fore coxæ black........................19
Bristles above fore coxæ pale, white or yellowish........41
19 Second joint of hind tarsi more than twice as long as first.20
Second joint of fore tarsi twice or less than twice as long as first...21
20 Legs altogether black, (North America)...*nigripes* Loew.
Tibiæ largely yellow, (Eastern).......*vittatus* Van Duzee.

21 Antennæ wholly black. 22
Antennæ partly yellow.. 30
22 Knobs of halteres blackish. 23
Knobs of halteres yellowish. 24
23 Last section of fifth vein to cross-vein as 9 to 28, (Oregon) *longinervis* Van Duzee, new species.
Last section of fifth vein and cross-vein of about equal length, (Ontario). . . . . *halteralis* Van Duzee. . . .
24 Second joint of hind tarsi slightly more than twice as long as first. 25
Second joint of hind tarsi considerably less than twice as long as first. 26
25 Metallic blue in color, (Illinois). . . . . . . *cœrulescens* Malloch.
Black in color, (Eastern). . . . . *vitatus* Van Duzee.
26 Hairs of the abdomen black. 27
Hairs on the abdomen pale. 29
27 Second joint of hind tarsi one and a fourth times as long as the first; last section of fifth vein over twice as long as the cross-vein, (Ontario; New York). . . . *frontalis* Van Duzee.
Second joint of hind tarsi one and a half times as long as first. 28
28 Last section of fifth vein only a little longer than the cross-vein, (California). . . . . *obscuripennis* Van Duzee.
Last section of fifth vein twice as long as the cross-vein, (Ontario). . . . . *ciliata* Van Duzee, new species.
29 Second joint of hind tarsi nearly one and three-fourths times as long as first, (Alaska). . . . . *bicolor* Van Duzee.
Second joint of hind tarsi about one and a third times as long as first, (Alaska). . . . . *parvus* Van Duzee.
30 Thorax with distinct gray vittæ. 31
Thorax without distinct vittæ. 33
31 Dorsum of thorax with four gray vittæ (Idaho) *aldrichi* Wheeler.
Dorsum of thorax with a distinct gray stripe each side of the acrostichal bristles. 32
32 Last section of fifth vein one and a half times as long as the cross-vein, (Washington; Alaska). . . . . *viduus* Wheeler. . .

Last section of fifth vein scarcely longer than the cross-vein, (Washington; Alaska). female of. . . . . . .*viduus* Wheeler..

33 Mesonotum with thick brown pollen. 34

Mesonotum with thin grayish pollen.. 36

34 Fore coxæ almost bare, except a few black bristles at tip; large species, (Ontario; New York).. . . . . *emarginatus* Van Duzee.

Fore coxæ with a row of hairs or bristles on outer anterior edge. 35

35 Hypopygial lamellæ black, (Alaska) *viridifacies* Van Duzee.

Hypopygial lamellæ yellow, (Alberta) *trisetosus* Van Duzee.

36 Last section of fifth vein one and a half times long as the cross vein. 37

Last section of fifth vein not but little longer then the cross vein. 40

37 Cilia of the calypters black, (Illinois). . .*cœrulescens* Malloch.

Cilia of the calypters pale. 38

38 Fore coxæ with black hair, (New Hampshire). . . . . *maurus* Wheeler.

Fore coxæ with pale hairs. 39

39 Middle femora with yellowish bristles below; second joint of hind tarsi one and three fourths times as long as the first, (Alaska). . . . .*bicolor* Van Duzee.

Middle femora without yellowish bristles below; second joint of hind tarsi one and a third times as long as first, (Alaska). *parvus* Van Duzee.

40 Hypopygial lamellæ black; second joint of hind tarsi one and three-fourths times as long as first; last section of fifth vein in male three fourths, in female a little more than the length of the cross-vein, (Oregon).. . . . . *oregonensis* Van Duzee.

Hypopygial lamellæ yellowish; second joint of hind tarsi one and a half times as long as first; last section of fifth vein and the cross-vein of nearly equal length, (Alberta). male of. . . . .*trisetosus* Van Duzee.

41 Abdomen blue.. 42

Abdomen bronze, green or black. 43

42 Dorsum of thorax with a yellowish vitta; antennæ wholly black, (Idaho). . . . . *aurivittatus* Wheeler.
Dorsum of thorax opaque with gray pollen; first two joints of antennæ yellow, (Washington). . . . *cyanogaster* Wheeler.

43 Males and females. 44
Males only. 53

44 Thorax with distinct vittæ. 45
Thorax without distinct vittæ. 50

45 Last section of fifth vein only half as long as the cross-vein, (New Jersey). . . . . *princeps* Wheeler.
Last section of fifth vein as long or longer than the cross-vein. 46

46 Last section of fifth vein about the same length as the cross-vein. 47
Last section of fifth vein distinctly, although only a little longer than the cross-vein. 49

47 Legs and feet black; knobs of halteres infuscated, (New Jersey). . . . . *modestus* Van Duzee.
Tips of femora, tibiæ, base of tarsi and knobs of halteres yellow. 48

48 Tips of third and fourth veins close together, as is typical of the genus; rather large species, (California). . . . . *californiensis* Wheeler.
Tips of third and fourth veins a little wider apart than usual, (North America). *veles* Loew.

49 Abdomen and pleuræ black; face opaque with brown pollen; thoracic vittæ very distinct; tips of third and fourth veins rather far apart, (North America). . . . . *veles* Loew.
Abdomen, pleuræ and face distinctly green; thoracic vittæ less distinct; tips of third and fourth veins close together as usual in the genus, (New York; New Jersey; Alaska). *distinctus* Van Duzee.

50 Legs yellow; cross-vein with a stump vein at its center, (Wyoming). . . . . *appendiculatus* Wheeler.
Legs black, at least the femora largely black; cross-vein normal, without a stump vein. 51

51 Knobs of halteres infuscated, at least on one side, (New Jersey). . . . . *modestus* Van Duzee.
Knobs of halteres yellow. 52
52 Last section of fifth vein only half as long as the cross-vein, (California). . . . . *xerophilus* Wheeler. .
Last section of fifth vein a little longer than the cross-vein, (specimens in which the thoracic vittæ are obsolete), (North America). . . . . *veles* Loew.
Last section of fifth vein twice as long as the cross-vein, (New York; New Jersey: Alaska). . . *distinctus* Van Duzee
53 Posterior cross-vein with a stump vein near its center, (California). . . . . *xerophilus* Wheeler. .
Cross-vein normal, without a stump vein. 54
54 Posterior basitarsus narrowed at base below and with a small tooth on this narrowed portion. 55
Posterior basitarsus without a tooth below, not narrowed at base. 56
55 Small species, 2 mm.; third and fourth veins rather far apart at their tips for the genus, (North America).... . . . . *veles* Loew.
Larger species; 3 mm. or over; third and fourth veins with their tips close together as usual in the genus, (California). *californiensis* Wheeler.
56 Last section of fifth vein only half as long as the cross-vein, (California). . . . . *xerophilus* Wheeler. .
Last section of fifth vein longer than the cross-vein, or equal to it in length. 57
57 Last section of fifth vein and the cross-vein of nearly equal length; knobs of halteres more or less infuscated, New Jersey). . . . . *modestus* Van Duzee...
Last section of fifth vein much longer than the cross-vein. 58
58 Length of last section of fifth vein to cross-vein as 14 to 10, (Texas). . . . . *albisetosa* Van Duzee, new species....
Last section of fifth vein twice as long as the cross-vein, (New York; New Jersey; Alaska). . . *distinctus* Van Duze

THE DESTRUCTIVE MEXICAN BOOK BEETLE COMES TO BOSTON[1]

By Raymond L. Taylor.

Since so many of the most destructive insect pests of the United States are of foreign origin, and also, since so many of these undesirable immigrants have made inconspicuous entrances into the country on nursery stock, food stuffs, and other merchandise, any record of an exotic, which is destructive, and which has entered the country, should be of wide interest. Undetected, the Mexican book beetle definitely invaded the Port of Boston recently.

On Dec. 12, 1927, attention was called to the condition of a large shipment of books which had been received by N. J. Bartlett and Co., a Boston firm of book sellers. Help in the matter was asked and the damaged stock was inspected. The shipment comprised 29 sizable packing cases and represented the entire library, of fully 8000 volumes, of the late William T. Brigham, Director of the Bernice Pauahi Bishop Museum, Honolulu, Hawaii. Dr. Brigham was a noted bibliophile and his collection, which embraced much on ethnology and natural history and contained many rare editions, was conservatively valued at over $25,000. At the death of Dr. Brigham, the books, presumably in perfect condition at that time, were packed in substantial wooden cases and stored in a warehouse in Honolulu for several years. Recently, they were purchased by the book concern mentioned and delivered in Boston in early December, 1927. When the books were unpacked, although the newspaper wrappings showed no evidences of injury, there was scarcely one of the collection not riddled by larval galleries and exit holes. Some of the books had only one or two borings, while others were so completely riddled that some pages were virtually consumed in their entirety and the remainder illegible. The majority, however, suffered severe injury to the bindings but were legible in spite

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 290.

of cleanly cut, circular holes, 1.5 to 2.3 mm. and oblique, larger holes, all of which extended from part way to all the way through the book. The work was confined to the covers in many other cases and cleanly cut, circular holes of about 2.3 mm. were very common in the backs. It was significant that old volumes with hand-made paper had their pages well perforated, while in recent books with clay-filled, chemical-laden paper, the injury was restricted to the binding. Also of significance, was the fact that some of the books, which were damp and marked by a brown mold, were comparatively immune to severe damage. The galleries in the covers were irregular, often appeared to radiate from a common center, and, in general, resembled to some extent, Scolytid work in wood. There was remarkably little frass and the insects which caused the destruction were not readily visible. Indeed, this latter point was a mystifying feature of the problem. Dr. Brigham had had the reputation of taking excellent care of his library and the condition of his books was well rated in collectors' lists. Since, by this presumption, the extensive damage had occurred in the two to three years the boxes had been in storage and in transit, there should have been ample insect remains. To the contrary, there was an almost complete absence of these and a great scarcity of living larvæ and adults. The probable solution of this, however, was found and will be mentioned later. It should be evident from the foregoing that these book injuries were much more considerable than might be expected of any common book insect, of which there are, relatively, but a few known.

A preliminary search for the cause of this destruction, after an examination of at least fifty books, at length yielded three living larvæ and the intact bodies of two adult beetles, either dormant or dead. Mr. C. A. Frost kindly identified the coleopteron as a species of *Catorama*, family Anobiidæ. A review of the literature inspired the conclusion that this insect was, very probably, either *Catorama mexicana* or *C. herbarium*, and, at the same time, raised the interesting question, whether or not these two species might not be synonymous.

Catorama (or *Cathorama*) *herbarium*, in the literature, is usually ascribed to Gorham, but in Gorham's own book[1], where it is described, he ascribes it to "Chevrolat, the Sallé Collection, Habitat Mexico, Cordova (Sallé)." This species seems wide-spread throughout tropical America, and is reported as injurious to books, leather goods, upholstery, furniture, woods, etc. in Brazil, Grenada, Barbados, St. Vincent, and other West Indian Islands. It is considered much more destructive than any other book pest.

Catorama mexicana, which is listed in the Fauna Hawaiiensis and there ascribed to Chevrolat, has been reported a number of times as highly injurious to books and leather goods, has also been found in tamarind bark and has been bred out of velvet bean seeds. It seems distributed throughout the Hawaiian Islands.

Since this species, *C. mexicana,* is not listed in Junk's Coleopterorum Catalogus (1912) nor to be found elsewhere, there remains the decided possibility that an error has been made and that these two names are synonymous. An error in transcription, once made, might easily be perpetuated indefinitely, or until the genus was revised. The common name, Mexican book beetle, has been given to *C. mexicana* by a committee of the Hawaiian Entomological Society and this common name would be equally applicable in every way to *C. herbarium.*

A brief description of the insect found may not be amiss. The larva, about 3.5 mm. in length, is a light grayish-cream colored little grub, somewhat thickly covered throughout, including the head, with fine, rather long, yellow hairs. The head is unicolorous with the body and not heavily chitinized except for the mouthparts and surrounding parts. These latter parts are light brown to darker, and the mandibles are tipped with black. The adult is a typical *Catorama,* a reddish-brown, ovoid-rectangular beetle about 3 mm. in length. The anterior portion of the elytra and dorsum of the head are smooth and polished; the cheeks and the remainder of the elytra, as well as the ventral parts, are covered with a fine, light yellow pilosity.

In regard to the life history of *Catorama herbarium,* de Faria says that the eggs are laid on the bindings or leaf-edges of books.

[1]Biologia Centrali-Americana, Vol. 3, Part 2, p. 207.

The eggs hatch in 5-6 days (in Brazil) and the young larvæ seek the paste of the bindings at first, but when they grow stronger, they attack the bindings themselves and feed until ready to pupate. The larvæ then tend to return to the external surface, which, in the case of books on library shelves, is the back bindings of the volumes. They increase the size of their mines and cover them with roofs of excreta and paper. The adults emerge through cleanly cut holes, thus the characteristic perforations in the backs of books are the exit holes. These perforations may be re-entered for the purpose of oviposition, although the act itself was never observed. De Faria adds that these beetles are nocturnal in habit in that, in hot weather, they may issue from the books at night and go to the windows of the room containing the library. In Sao Paulo, Brazil, the breeding season seems to be from October to December but during these months all stages of *Catorama* may be observed. The observations made in Boston on the habits of this destructive "book worm" follow.

Since the beetle is indigenous to the tropics, any life cycle in Massachusetts would, without doubt, be different from its cycle under tropical conditions, if, indeed, the species could persist here. It seems very probable that the fluctuations in humidity and especially the temperature changes of the seasons, so different from the climate of Hawaii, for example, would render impossible continued breeding of the insect in New England. A life cycle of insects raised in a greenhouse might be indicative if a humid climate of the correct sort could be approximated. It is exceedingly interesting, however, that, in spite of the time of year, an appreciable number of *Catorama* larvæ survived the conditions of transportation from Honolulu to Boston and that, since their arrival in early December, 1927, at room temperatures of from 40 to 65 deg. F., both in the book store and in the laboratory, they have shown no abatement of activity.

From this fact, there arises at once the serious possibility of the destruction of books in libraries which are heated in winter, should this insect be introduced. It seems improbable that books kept in well lit situations and in active circulation would be infested, nor does modern paper appear to be the ideal diet of the beetle larva, yet, with little used books, which are kept undisturbed in darkness, or with rare books of leather and hand-made paper, there remains the possibility of an approximation here of the extensive injury caused in tropic libraries.

Three living larvæ and two adults, either dormant or dead, with hand-made paper for food, were placed in a glass vial which was subsequently corked. The vial was then placed in a desk drawer. Observations were made from time to time and they yielded several interesting results. A few days after these insects were confined as described above, it was noted that there were but *two* larvæ. A careful examination revealed a few particles of the other larva, which had evidently been eaten by the surviving two. Unfortunately, it can not be stated whether or not the larva was killed by its companions or died from some other cause before its body was used for food. It was noted, at the same time, that these two larvæ had begun to consume the adult beetles as well. During a period of a week, the interiors of the two bodies were exhausted and thereafter the external, chitinized portions were broken into small fragments. It was impossible to ascertain whether or not these bits of the chitinized parts were actually eaten, but they were finally reduced, on the whole, to rather small particles. When the larvæ were finished with the remains of the adults, they both ate into the cork stopper. One larva, which mined on the surface, produced a furrow 11 mm. long and about as wide as its body, or 1 mm., while the other commenced a mine obliquely leading into the heart of the cork. After an absence of observation for ten days, it was found that but *one* larva was present. The inference is that this suvivor had eaten the other. This remaining larva continued to mine into the cork for a depth of 9 mm. and then turned about and widened the mouth of the boring. This total activity took three weeks time after which, the grub crawled out upon the hand-made paper and seemed as vigorous as ever although it had been bottled over five weeks. It is worthy of mention that the hand-made paper was not eaten, and that protein and cork were preferred, apparently.

The cannibalistic habit of the larvæ, if at all general, would adequately account for the surprisingly few insects found in the books examined, in proportion to the extensive mines, and with a consideration of the probable elapsed time of two to three years. No other explanation was conceived that seemed to fit all the facts as well.

In view of the persisting activity of this Catorama beetle at room temperatures, since further examination of other volumes at the book store continued to show living larvæ, and with an estimation of the chance of this pest spreading to uninfested volumes under the same roof and, perhaps, even gaining a foothold in the many heated libraries in Metropolitan Boston, it was agreed that a thorough program of fumigation with carbon bisulphide should be carried out. In spite of the remote contingency of a spread of this exotic pest to other libraries, adequate control measures were obviously justified. It would seem a safe rule, that, in general, any immigrant insect with destructive proclivities should be regarded as dangerous, and treated as such, at least, until all of its habits are known and its potentialities duly measured.

Abstract.

A tropical Anobiid, *Catorama* sp., either *C. mexicana*, the Mexican book beetle of the Hawaiians, or *C. herbarium* of the West Indies (if they are not synonymous, as they may be), inflicted severe damage to a large shipment of books from Honolulu to Boston. Larvæ have been active and have fed for at least seven weeks in Massachusetts at room temperatures, and the possibility of infestation of heated libraries throughout the city is advanced as adequate justification for a thorough carbon bisulphide treatment of the infested stock. In general, any imported noxious insect should be treated as a menace, at least until all of its habits are known and its potentialities measured.

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NOTES ON THREE ABNORMAL ANTS[1].

By W. S. Creighton

Abnormalities in ants appear to fall into three fairly well defined categories, viz.: (1) sex mosaics and intersexes, (2) aberrant forms produced through altered food supply, (3) freaks. To the first group belong the various kinds of lateral mosaics as well as the rarer anterio-posterior type. The latter often show characteristics which mark them as intersexes rather than true mosaics. The second group is composed of a large number of peculiar forms which arise from pronounced nutritional irregularities. Lack of food may produce dwarf individuals in all three castes, while loss of food due to the presence of parasites gives rise to pseudogynes or the shriveled victims of *Orasema*. In the event of an overabundance of food unusually large males and females, egg-laying workers and, more rarely, repletes may result. It is impossible to draw any hard and fast line between the members of this group and those forms considered normal since in many cases conditions which originally must have been quite aberrant have, in time, become an integral part of the life of the species (e. g. the repletes of *Myrmecocystus* or the microgynes of certain *Formicas*). In the third group may be included those individuals which show duplication, loss or malformation of parts. Most of these conditions seem to be due to injuries in the larval or pupal stages. More rarely the changes are of an atavistic nature. Many of the members of this group are veritable entomological nightmares, monstrosities with double scapes or legs; fantastic creatures with shortened and twisted antennæ and limbs or misshapen thoraces; freaks without eyes, or lacking tarsal, antennal, rarely even petiolar joints.

In this paper are described three abnormal ants, two freaks and an ergatandromorph. Both freaks are in the collection of Dr. Wheeler through whose kindness I am enabled to describe them. It is therefore my pleasure to thank the donors for their

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 291.

contributions. The first of these, a queen of *Monomorium minimum* Em. which lacks the left eye, was taken at Urbana, Ill. by Mr. M. R. Smith. Plate. 1, Fig. 4 shows the head of the insect. The asymetry caused by the absence of the left eye is further increased by a narrowing of the same side of the head. The left half is very little more than half the width of the right except just behind the mandible where it suddenly flares out to full width. The left ocellus is misshapen and displaced. Dr. P. W. Whiting informs me that similarly deficient individuals occasionally arise in his *Habrobracon* stocks, and when, as more rarely happens, both eyes are absent, extreme microcephaly results. No dissection was made of the insect here described but it seems likely that the greater portion of the left optic tract is absent. The cross sectional area of the mandibular muscles must also be greatly reduced. In all other regards the specimen appears to be perfectly normal.

The second abnormality is a dealated queen of *Myrmica scabrinodis* var. (probably *sabuleti* Mein.) which lacks both petiole and post petiole. This astonishing insect was found by Miss H. Andrews at Boulder, Colo. in 1916. Figs. 5 and 6 show the thorax and abdomen in profile and from above. The thorax is joined directly to the gaster, the two petiolar joints having fused with the anterior face of the first gastric segment. The joints are broadened and flattened past recognition, forming a fan-shaped area on the gaster. Nevertheless their nature is strikingly apparent because of their characteristic rugose sculpture and lighter color. On the right side of the gaster close to the fused nodes is a small tubercle. It has no apparent connection with them nor any obvious significance. At least two similar abnormalities have been previously described. Donisthorpe, in 1922, published a short paper containing an account of a dealated queen of *Leptothorax acervorum* F. which lacks the petiolar joints. The altered condition of this insect he considers an atavism. In 1927 Karajew described an aberrant worker of *Megaponera fœtens* F. in which the petiole is absent. Unfortunately the insect was not figured but the author notes that in other respects it was normal.

The last specimen to be dealt with in this paper is an ergatandromorph which I took in the summer of 1927 at Boulder, Colorado. On August 10th while collecting along the foot of the ridge between Gregory and Bluebell Canyons, I found a nest of *Formica nitidiventris*, Em. containing an ant with wings on the left side only. The insect was in the upper galleries of the nest in the company of twenty or thirty workers. The latter fled as soon as the covering stone was raised, leaving the ergatandromorph whose slower movements hindered its escape. When allowed to walk on a relatively smooth surface it circled to the right.

Fig. 1 shows the more important features. The left half of the insect is male, the right worker, although in the head and thorax the junction does not occur at the mid-line of the body. The structures of the opposite sides of the head appear to be quite typical as regards their respective castes. The right (worker) antenna has the requisite twelve joints of the customary shape and size. The right eye and mandible differ in no way from those of the normal worker. On the left (male) side the eye is much larger, the mandible greatly reduced and the antenna of thirteen joints, all usual male features. The clypeus is twisted to the left, a result of the obvious discrepancy in the length of the genæ (Fig. 2.) Aside from the major structural differences in the males and workers of this subspecies there are certain pecularities of color and pilosity characteristic of each. Thus the head and thorax of the normal worker are a rufous brown and those of the male a deep brownish black. In Figs. 1 and 2 this darker male coloration has been indicated by stippling. Referring to 2 it may be seen that the entire clypeus and most of the vertex and occiput are of worker origin. There is also a curious projection of worker tissue which runs downward from the vertex to the upper border of the eye. All three ocelli occur in worker tissue and all are of the small size characteristic of the worker.

Taking into consideration the radical differences in the thoracic structured of the male and worker the thorax of the mosaic is less mixed than would appear at first sight. The prothorax of the worker has fused fairly evenly with the pronotum of the male. The mesothorax is united with the scutum, the parapsis and the scutellum. The small metanotum of the male is apparently free throughout the greater part of its length. It lies in a deep suture which extends entirely across the thorax. The last portion of the thorax appears to be intermediate in structure between the metathorax of the worker and the epinotum of the male. Its color would indicate worker tissue but its structure is not that of the typical worker metathorax. Both wings are present on the left side of the insect and both are fully developed. The petiole is cleanly divided along the mid-line of the body. The right half is higher and broader than the left and has an acute upper edge. The upper edge of the left half is obtuse and the coloration is a blackish brown.

The differences in the shape of the opposite halves of the abdominal segments cause a pronounced asymetry of the gaster. Since the gastric segments of the normal male are of nearly uniform length throughout, while those of the worker successively decrease in length after the second segment, their combination has resulted in a strong bending of the tip of the gaster towards the right. This bending has affected the male genital armature. All the elements in the left half of the male genetalia are present and individually quite normal[2]. Their relative positions, however, have been somewhat altered. In the normal male the stipites are outermost in position. Just within and closely appressed to each of these is a bifurcate organ composed of an outer, hooked volcella and an inner, foliate lacinia. Innermost of all and somewhat above the rest are the paired inner paramera. In addition there are present two small lobed structures, the cerci. Ordinarily these lie just above the median lobes and are partially covered by the sixth gastric segment. They are apparently not a part of the genetalia and are mentioned here only because a single aberrant cercus occurs in the gynandromorph. Fig. 3. shows the position of the male genital armature in the mosaic. The stipes (s) has been turned inward toward the center so that it occupies a position above the volcella (v) and

[2]Emery's nomenclature is here used. For a discussion of the names applied to the structures of the Formicid genetalia see Emery, Die Gattung Dorylus. Mol. Jahrb Band 8 1895.

lacinia (l) and the inner paramer (p). The ends of these may be seen projecting to the right of the stipes.

Above the stipes is the sixth gastric segment of the male. Near the base of the stipes is the small, club-shaped cercus (c). It is entirely exposed and borne on a small extruded portion of unchitinized tissue. The very characteristic circular, hair-fringed anal aperture of the worker, if present, is distorted past recognition.

The legs of the two halves of the mosaic are normal for male and worker respectively. Those of the male side are darker and somewhat more curved than their opposites. Measurements show them to be slightly shorter. The figure cannot be used in this connection since no attempt was made to draw opposite appendages in similar positions. The difference in length is such that one would expect the insect to circle gradually to the left when walking. Actually, as has been noted, it circled sharply to the right, a result probably due to the distortion of muscles in the thorax.

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ANTHEMOESSA ABRUPTA.

By Charles Robertson,

Carlinville, Illinois.

On the habits, parasites and inquilines see Frison (**1**). Some local observations are added here.

Phenology.—Flies 84 days, My 7 — Jl 29, ♂ 51 days, My 7— Jn 26, ♀ 81 days, My 10 — Jl 29. The male beigns 3 days, and ends 33 days, before the female; 7.4 less and 15.2 more than the average of the "5 other long-tongued bees," and 5.9 less and 12.9 more than the general average in **14**.

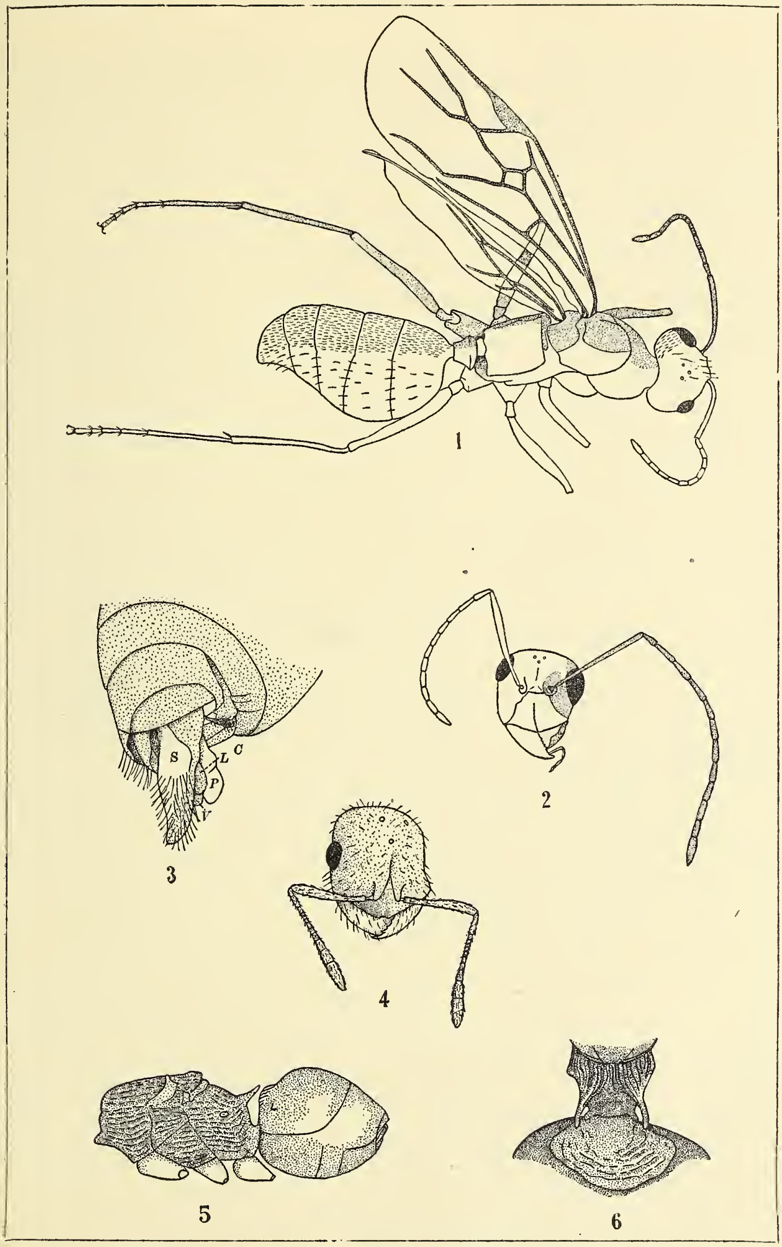
Anthophora ursina begins 29 days earlier, *Clisodon terminalis* begins 18 days later and *Amegilla walshii* 60 days later. Phenologically at their most active time these are rather non-competative.

At St Louis Rau (**4**) noted this bee from My 28 to Jl 21, 55 days, 29 less than the local flight. In about 33 years of local field work, Jl 1884–My 1916, I found the male visiting 26 species of flowers. The fact that the flight of the male never ranged over 51 days seems to show that the weather has little to do with it.

Comparison with Melitoma.—Rau says that when the life cycle of this bee had run its course, *Entechnia taurea* made its appearance. At Carlinville *Melitoma taurea* appears 48 days later and ends 70 days later, but it overlaps with *A. abrupta* for 33.9% of its flight. It flies 106 days, ♂95, Jn 24 – S 26, ♀ 103, Jn 27 – O 7. At St Louis Rau gives 94 days, ♂44, Jl 31 – S 12, ♀ 94, Jl 16 – O 17, the female beginning 19 days later and ending 10 days later than at Carlinville.

Rau says: "The males of this species do not seem to emerge before the females; or at least they do not die earlier." At Carlinville the male begins 3 days, and ends 11 days, earlier than the female, 7.4 and 14.8 less than the average of the "5 other long-tongued bees" and 5.9 and 17.1 less than the general average in **14**.

Generic selection.—The 5 local Anthophoridæ form a good example. *Anthophora ursina* is probably related to *A. pilipes*



CREIGHTON—ABNORMAL ANTS.

of Europe, *Anthemoessa abrupta* to *A. bomboides*, *Clisodon terminalis* to *Anthophora furcata* of Europe, if not the same, *Amegilla walshii* to the south-western *A. smithii*, and *Emphoropsis floridana* to southern and western species. These are the most heterogeneous. Geographically they avoid competition with 95.58% of the species mentioned in **3**.

Heterotropy.—Some writers have attributed what they call "oligotrophy," meaning few or exclusive visits, to limited tongue length and synchronism. The male, with a shorter tongue and a flight shorter by 30 days, they would expect to be more limited than the female. There are fewer flowers in the 51 days of the male than in the 81 days of the female. But the male occurs on 26 flowers and the female on 17. The female is alone 33 days, Jn 27 - Jl 29. . Of 250 native July flowers, 99, 39.6%, begin to bloom, so that the female might be expected on a good many flowers on which the male does not occur. But only 5 flowers are visited by the female alone, while 14 are visited by the male alone. The experimental augurs, who assume the simplicity of reactions, may undertake to account for this.

Flower visits (31).—♀ collecting pollen (6)—**Ebenaceae** *Diospyros virginiana*; **Libiatae:** *Scutellaria versicolor*; **Liliaceae** *Polygonatum commutatum*; **Rosaceae;** *Rosa humilis, setigera*; **Scrophulariaceae:** *Penstemon lævigatus.*

♀ s. (11).—*Asclepias purpurascens*; *Convolvulus sepium*; *Dianthera americana*; *Frasera carolinensis*; *Glechoma hederacea. Monarda bradburiana, Teucrium canadense*; *Hydrophyllum virginicum*; *Mertensia virginica*; *Rubus villosus*; *Trifolium pratense.*

♂ s. (26:14).—*With female*: A. pur.; D. amer.; D. vir.; F car.; G. hed., M. brad., S. ver.; H. vir.; M. vir.; P. læv.; P com.; T. prat. *Alone*: *Aesculus hippocastanum*; *Asclepias syriaca*; *Blephilia ciliata, Leonurus cardiaca, Stachys palustris*; *Cornus amomum*; *Delphinium tricorne*; *Gillenia stipulacea*; *Iris haxagona*; *Melilotus alba, Trifolium repens*; *Pastinaca sativa*; *Pentstemon pubescens*; *Triosteum perfoliatum.*

Oligotrophy.—This bee is an oligotrope of Hb and Ma. It shows 80.6% under Hb, 64.5 under Ma and 54.8 under red. Of the female pollen visits all are under Ma and 50% under red. Of the female nectar visits, 54.5 are under Ma and 63.6 under red. The total female visits show 70.5 under Ma and 58.8 under red. The male visits show 65.3 under Ma and 53.8 under red. The total visits show 22.5% under Labiatæ. The bee visits flowers of 17 families.

Literature.—My lists show the sexes and whether the females were collecting the pollen or not. Knuth (2) notes the pollen collecting but ignores the other data. It is not clear why those using these data think the distinction is unimportant. They evidently do not approve of making them. I found the female on 17 flowers and the male on 26. The female was observed collecting pollen on 6 flowers and sucking on 11. The male was taken on 12 flowers also visited by the female and on 14 flowers on which the female was not observed. The bunglers reduce all of these to collectors notes. Even as such the distinction is important. The 12 flowers on which both sexes were taken are the best places for the collectors to look for both. Both sexes are flying only in 57.1 per cent of the time of the species. The surest place to find the female, however, is on *Rosa humilis* and *setigera*, where the male does not occur. Of the 31 visits, 5 were made by the female alone, 12 by both sexes and 14 by the male alone.

Knuth mentions 16 of the above. Lutz and Cockerell (3) mention 9, of which 2 were not in Knuth's list, so that their list ought to give 18. The cryptic bibliography of these authors is well adapted to cover up the literature. They say "Doubtless some of the papers dealing with flowers and bees have been overlooked." The first of my Botanical Gazette papers cited by them is "Robertson 1895, Botanical Gazette XX." That is Flowers and insects XIV, concealing the fact that I-XIII were overlooked. Of the first 19 papers, they cite only 4. On *Anthemoëssa abrupta* they overlook one-half the cases[1].

[1]In the case of *Emphor bombiformis*, under "Knab, 1911, p. 71, 'Drinking' habits," they say: "See Robertson 1918", as if it were second-hand. Frison evidently thought so and ignored it. What "Robertson, 1918" shows is that Knab's paper was second-hand by 21 years and erroneous in every particular. It shows also that, as regards drinking habits and relations to *Hibiscus*, Grossbeck's and Nichols' observations were second-hand by 21 and 23 years.

Under *Bombus americanorum* and *B. fervidus* Lutz and Cockerell cite Coville 1890 on the "elatus" question and say "see also Robertson 1890" as if the latter were second-hand, in spite of the fact that it is cited by Coville himself and anticipates his paper in almost every particular.

Frison says: "Robertson (1891, 1894, and 1896), in Illinois, records males and females of etc." Here "Illinois" means "Carlinville." Only 3 of the flowers mentioned showed both sexes. Frison follows Lutz and Cockerell in overlooking most of the Botanical Gazette papers and "Labiatæ" as well as Knuth's work.

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[2]Bull, A. M. = Bulletin American Museum Natural History; Fls. = Flowers and insects; St. L. A. = Trans. St. Louis Academy of Science.

LOCALITIES OF INSECTS COLLECTED BY CHARLES ROBERTSON

By Charles Robertson,
Carlinville, Illinois.

References to my collections, observations and descriptions of insects relate to Carlinville, Illinois, and to Inverness and Orlando, Florida. Exceptions are some Oxybelidæ and 5 bees, *Parandrena wellesleyana*, *Macropis morsei*, *Panurgus novæ-angliæ*, *Sphecodes davisii* and *Halictus hartii*. The last, Hart's number 17211, is the only Illinois bee in my descriptions which was not taken by me at Carlinville. "Southern", "South," "So.", "S.", "Macoupin County," and "Illinois" mean Carlinville. Some specimens marked "S. Illinois" were credited to "Illinois," the authors regarding that as sufficient.

Likewise, "Southern," "So.," and "S." Florida mean Inverness or Orlando. The "S. Florida" on my labels meant South Florida, which is not the same as Southern Florida.

Specimens numbered on white slips were taken on flowers by me at Carlinville. Of those numbered on red slips, 3346-3503 and 7021-7043 were taken at Orlando, Feb. and Mar., 1887, 1888, all the rest at Inverness. Some specimens sent for determination did not have my regular numbers, but 1-11 etc.

A NEW BEE OF THE GENUS ANDRENA VISITING SENECIO

By T. D. A. Cockerell,
University of Colorado, Boulder, Colo.

In a large genus like *Andrena*, the discovery of a new species excites little interest, but the one now recorded has rather special claims. At Winfrith, Dorset, in England, on April 20, 1921, my wife and I had the pleasure of collecting both sexes of the beautiful *Andrena* (*Trachandrena*) *albicans* Müller. When I put the specimens away in the *Trachandrena* box, I remarked that whereas the North American fauna was rich in this group, there was nothing quite so beautiful as the English cousin, with bright red hair on the thorax above, white hair on the pleura, and bandless abdomen. However, on May 17, 1927, Mr. Chas. Wagner, one of my students, captured an *Andrena* on *Senecio* flowers at White Rocks, near Boulder, Colorado. When he brought it in, I said, "Where have you been? You must have been to England!" Superficially, it was just like A. *albicans*, though closer inspection showed various differences, thus the pleura is black haired, and the hair at end of abdomen is black, not red. It may be described thus:

Andrena seneciophila n. sp.

Female. Length nearly 11 mm.; a typical member of the subgenus *Trachandrena*; black, including antennæ and legs, tegulæ brown; head ordinary, face broad; process of labrum broadly truncate; malar space linear; clypeus coarsely and quite closely punctured, the punctures tending to run in longitudinal lines, apical third with a median smooth line; facial foveæ seen from above seal brown, running close to eyes separated by a shining band, extending downward to level of top of clypeus; third antennal joint not quite as long as next two together; hair of head thin, mostly black, but red on occiput, and slightly reddish in region about antennæ; mesothorax and scutellum dull and densely punctured, the surface covered with short stiff very bright fox-red hair, which also covers postscutellum, and extends down sides of thorax to cover tubercles and immediately adjacent parts; sides of metathorax with pale hair, which carries a great quantity of the orange *Senecio* pollen; mesopleura with black hair; wings dusky, darker apically; stigma well developed, rufo-piceous; nervures dark brown; second cubital cell broad, receiving recurrent nervure a little beyond middle; legs with black hair, spurs brown; abdomen shining, finely and rather closely punctured, without bands, hair at apex black; second segment depressed more than half, but hardly two-thirds. The area of metathorax is broadly triangular, with about sixteen strong longitudinal rugæ. The tongue is remarkably short, broad and pointed.

The problem of the independent production of superficially similar species of insects is an interesting one. I do not know whether the two species just discussed are really very closely related, but they are at any rate both *Trachandrena.* In California, there is another species with the same appearance, *A. macrocephala* Ckll., the female of which was taken by Mr. Timberlake at Riverside, at flowers of *Phacelia distans*, March 8. This even agrees wit *A. seneciophile* in the black-haired pleura and black hair at end of abdomen. Yet it is not even a *Trachandrena*, and the structure of metathorax and second abdominal segment are entirely different. In the Mediterranean region, there is a *Senecio*-visiting species, *A. senecionis* Pérez. I have it from Spezia, Italy (Morice). It has rufescent dorsal hair, but is not a *Trachandrena.*

A NEW CŒLAMBUS FROM A THERMAL SPRING IN NEVADA.

By H. C. Fall,
Tyngsboro, Mass.

Coelambus bruesi n. sp.

Narrowly ovate, perceptibly attenuate posteriorly. Head and elytra fuscotestaceous, the clypeus in front diffusely paler, the lateral margins of the elytra somewhat so. Prothorax typically yellow, vaguely infuscate postero-medially.

Head minutely alutaceous and finely sparsely punctate. Antennæ pale basally, outer half infuscate.

Prothorax finely margined at sides, these nearly straight and continuous with the sides of the elytra; surface polished, punctuation fine and rather sparse on the disk, becoming close and somewhat coarser along the front and rear margins.

Elytra polished, sculpture consisting of finer and coarser punctures intermixed, the disparity more conspicuous in basal half.

Body beneath black, polished; metasternum and coxal plates coarsely and closely punctate except at middle; venter coarsely punctate laterally at base, elsewhere finely and sparsely so. Legs either entirely pale or with the femora darker medially. Front and middle tarsi of male distinctly dilated, the 2nd joint widest; anterior protarsal claw of male a little thicker and more strongly curved.

Length 3.5 mm.; width 1.8 mm.

Described from a single pair (♂ ♀) taken by Prof. C. T. Brues at Ruby Valley, 65 miles south of Wells, Nevada, in a hot spring; temperature 39.2°-40.°C.

This species is clearly to be associated with *compar* and *nigrescens* by its dual system of elytral punctuation and the conspicuously wide second joint of the male protarsus. The form is narrower and color typically darker than in *compar*, in which also the punctuation of the upper surface is somewhat finer and that of the metasternum and coxal plates distinctly sparser and less coarse than in the present species. As compared with *nigrescens* the present species is more ovate (more attenuate posteriorly), less dark in color, somewhat more coarsely punctate, with the disparity in size of elytral punctures less marked in the posterior half, and the second joint of the male protarsus a little smaller and less triangular.

The species is appropriately and with pleasure dedicated to Prof. Brues, who kindly permits me to retain the male type. The female allotype will, at his suggestion, be deposited in the collection of the Museum of Comparative Zoology at Cambridge.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB.

During the year 1927 eight meetings were held, with the following programs: February 8: Mr. W. L. W. Field, "The Background of the Early Work of Thaddeus W. Harris." March 8: Professor C. T. Brues and Mr. P. J. Darlington, Jr., "Insect Collecting at the Harvard Tropical Laboratory, Cuba." April 12: F. W. Dodge, "Over the Range (White Mountains, N. H.)," and Mr. J. H. Emerton, "Spider Notes." May 10: Mr. Arthur Loveridge, F. E. S., C. M. Z. S., "Observations on Some East African Insects." June 14: Mr. F. M. Carpenter, "Some Recent and Fossil Insects from Kansas, Colorado, and Texas." October 11: Summer collecting notes, by several members. November 8: Mr. P. J. Darlington, Jr., "Collecting Coleoptera in the Mountains of Washington and Oregon." December 13: Mr. F. M. Carpenter, "Collecting Fossil Insects in Western United States."

The Club lost one member by death, Mr. F. C. Bowditch, of Brookline, Massachusetts. Eight new members were elected, bringing the membership number to eighty.

F. M. Carpenter, Secretary.

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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THE BEE THAT WORKS IN STONE; *PERDITA OPUNTIÆ* COCKERELL[1]

By Clarence P. Custer,

University of Colorado, Boulder.

Some seven miles east of Boulder, nestled at the foot of the Colorado Rockies, there rise some sandstone cliffs of peculiar interest to the biologist and the geologist. These are termed the White Rocks in reference to their appearance when seen at a distance. Around them there stretch for miles and miles the fertile farming lands of Boulder County. Thus the White Rocks are isolated from other similar rock formations; and here there lives a bee that has been officially reported from nowhere else in the world. It is *Perdita opuntiœ* Ckll.[2]

One may find this remarkable bee in the early summer, in the months of May and June, as it hovers and darts from flower to flower in its tireless search for pollen. And in this one notices a peculiar adaptation. Apparently it visits but one plant species, the bright yellow flowers of the cactus, *Opuntia mesacantha* Raf.,[3] from which it derives its name. How specially adapted this insect is! Not content with limitation to White Rocks, it must also depend on the flowers of but one kind of plant for its existence.

[1]The writer is indebted to Mr. S. A. Rohwer and Miss Grace Sandhouse. for the determination of specimens; to Dr. Edna Johnson for the identification of some plants; to Miss Helen Mowry and Miss Celia Light for assistance in the photography and for helpful suggestions; to Professor R. D. George for some geological material as well as interesting information concerning tunnelways in the rock formations of different localities; and to Mrs. B. O. Custer, Miss Arline Elftman and Mr. Russel Mann for assistance in the field work.

[2]Determined by Miss Grace Sandhouse.

[3]Determined by Dr. Edna Johnson. Synonyms are *O. humifusus* Raf. and *O. rafinesquii* Engelm.

Undoubtedly the question now arises as to the reason for its limitation to White Rocks. Surely this is not due to its dependence upon the cactus flowers for the same species of plant has been found quite generally distributed thruout the West. There is but one solution left. It must be dependent upon the rocks themselves. And, to be sure, I was able to show that the nest of this bee actually was in the sandstone of this locality. This seems to indicate that the bee can not make its nest in earth but only in sandstone; and being so well isolated from all other available rock formation, it of necessity is limited to White Rocks. Two facts further strengthen this explanation: First, the bee is small and a weak flier—I have not found it beyond a radius of fifty yards from the nest. Second, due to the continual tillage of the soil, the cactus plants have practically been eliminated from the adjacent territory although they are very abundant at White Rocks. Thus the bee is apparently limited to this environment.

This remarkable locality has a peculiar history. According to Professor R. D. George, head of the geology department of the University of Colorado, the White Rocks constitute the so-called "Laramie formation." This was laid down in fresh water lake basins in which, at times, vegetation grew so abundantly that extensive deposits were formed. Later, these were changed by biochemical and dynamochemical processes to coal. The sandstone over the coal was formed by the carrying of sand into the lake basin and its later solidification by pressure and an added binding material. Following this, the lake disappeared. The rock, exposed to the atmosphere, dried, shrank and the stresses were relieved by cracks radiating from centers of stress. The connections between these joints formed polygonal blocks, or "turtle backs." The joints were deepened by water freezing and thawing thereby loosening the sand grains which were later carried away by the winds. This process was repeated and in time little basins, several feet in width, were formed until now, in some cases, the joints are less emphasized. The cliffs, which rise to a height of 87 feet, were the banks of the stream which had cut out the rock along its broad valley.

Furthermore, he made the interesting statement in August, after I had informed him that the bees were making their nests in the stone at White Rocks, that in 1903 he had seen some hymenopterous insects in some cactus flowers near Trinidad,[4] Colorado. At the time, while working on rock formations nearby, he found some small white bodies in the stone. These he thought were the pupal cases of ants. Then it was eight years later, in 1911, that he saw the bee, *Perdita opuntiœ*, in the cactus flowers at White Rocks. At that time he saw evidence of tunnels in the stone but did not associate them with the bee. And finally, in 1924, while studying the case-hardening of the stone at Rocky Flats Lake,[5] he saw similar tunnels in the rock. And so he now suggested that the bee might also be found at Trinidad and Rocky Flats Lake.

With this evidence in mind, I visited these two localities in search of the tunnels mentioned to see if by chance they could be those of *Perdita opuntiœ*.

Near Trinidad, 225 miles south of Boulder, the Laramie formation, of about the same hardness as that at White Rocks, was found. Cactus plants, not blooming at the time, (August) were present in some numbers but there was no evidence at all of tunnels in the stone. Only an area of ten square miles was covered. Possibly the nests might have been present nearby. But the only sure way of proving the absence of the bee from this locality would be to diligently search the cactus flowers in the month of June over an extensive area. And so, up to 1928, no bees of this species have been officially reported from the Laramie formation near Trinidad, Colorado.

In the second place, at Rocky Flats Lake, somewhat similar results were obtained. Only a very few cactus plants grew in the vicinity. However, here and there were some openings into the rock through which an iron wire could be pushed for a few inches. After chipping through the hard, granite-like surface of the stone to a depth of one or two inches, I came upon a sandstone approximately as soft as that at White Rocks. Through this I was surprised to find that in a few instances there

[4]Two hundred and twenty-five miles south of Boulder.
[5]Twenty miles south of Boulder.

were some tunnels about .6 cm. (¼ inch) wide, to a depth of about 10 cm. (4 inches). In them I did not find the larvæ of *Perdita opuntiæ* but a few brown cocoons of a wasp instead.

The bee which is apparently isolated at White Rocks is a small insect with black head and thorax and a clear amber-colored abdomen. It is scarcely 7 mm. (¼ inch) long. The face of the female is black; that of the male, partly yellow. One is struck by the fact that the pollen grains on the hind legs are distinctly larger than are the ocelli or simple eyes of this insect. See Fig. 3.

Correspondingly narrow are the galleries of this bee in the sandstone. The entrances to the nests are generally found on

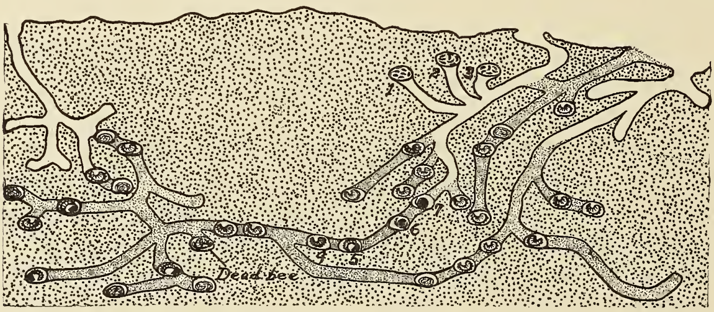


Fig 1.—The nest is composed of numerous tunnelways leading down from the surface of the stone. The larvae with their typical double-rowed sawtooth backs are shown in some of the cells. Heavy stippling indicates sandstone; light stippling, fine, loose sand. (Verticle section approximately one-third natural size.)

the upper surfaces of certain dome-shaped sandstone formations, some three to five yards wide[6]. Each nest has several entrances. These are more or less widened by the continual erosion of the stone. Hence, in a typical nest, one would expect to find three or four openings from 1-2 to 1 cm. in width, and separated from each other by a distance of about 10 cm. (4 inches). Most of these entrances are open. But, in a few cases, especially those leading almost straight down, the opening is closed with fine sand. However, the bees do not have difficulty in securing their entrance to these. They can not rake the sand out to open a passageway, for the fine particles would fall back on either

[6]See Plate II, middle figure.

side of their fore legs, much as would happen should we draw a needle through a cup of salt. So they merely insert their heads into the entrance, and made their way down thru the sand, which closes behind them. I have seen as many as four bees enter a nest thus in close succession, the one behind following quite close upon the disappearing abdomen of its leader. Once through the sandy entranceway, the bee attains the open tunnel, and thence proceeds without trouble. The pollen adheres to the bee's hind legs so tenaciously that but little is lost in the sand.

Since the nest has so many entrances, one would be right in assuming that there is more than one owner. Into one nest with three entrances, six bees were seen to enter. In another case I attempted to find the number of inhabitants. Armed with a stem of grass, I disturbed every bee that attempted to get out, thus causing its withdrawal into the tunnel. And, contrariwise, I permitted all bees, coming in from the fields, to enter without molestation. When I had waited thus for some fifteen minutes, and no more bees arrived, I stood back and counted the ones coming out. By this method I found thirteen bees, 11 females and 2 males.

When I was sure that all the bees had come out of the nest, I dropped some fine sand into the entrances. This filled them up, completely concealing them. Here, I took the following time notes, describing the return of the thirteen owners:

June 26. White Rocks.

10:47′. Seven bees arrive together from the fields. Unable to find the entrances, they francitally claw the sandstone, here and there, at about a centimeter from the closed openings.

10:50′. One bee finds entrance. It immediately makes way straight down thru sand. Two others see it enter, and rush to the spot, arriving a second after its abdomen has disappeared. These enter the sand in like manner.

10:50′: 45″. The last two bees come out head first, having failed to find the entrance. Pollen still on legs. They fly around a short distance from nest, alighting, at intervals, to dig wildly around entrance.

11:01′. More bees arrive from fields. Very much excited.

11:03′:30″. Another finds an entrance. Four others rush to the spot. These enter in succession, the one behind quite close upon the abdomen of its predecessor. Sand closes over the last bee.

11:06′. Still seven left out unable to find an entrance.

11:08′:15″. Another bee finds an entrance. Two more follow it closely. Sand closes over last.

11:10′. Remaining bees enter nest in like manner. Entrances to nests are as well concealed as ever.

11:14′:50″. A bee comes out, head first. Flies away.

11:15′:30″. Returns and enters nest as before. Backs up tunnel pushing mound of sand up over the entrance with its abdomen.

11:18′:15″. Pushes sand up again. Repeats several times.

11:21′:30″. Entrance now free of sand. Bee continues backing up tunnel. Several bees leave the nest by another entrance.

The bee does not come directly to the nest from the fields. It will first alight on a rock, a few meters away. Here it will remain quiet for a minute or two, and presently fly on to alight a meter or so nearer the nest. Perhaps it will pass over the nest two or three times in this manner. Finally, after having alighted several times, it will fly directly to the entrance, hover over it for a moment, and enter. This probably serves to deceive any parasites which may attempt to follow it to the nest.

This species undoubtedly builds its own nest. This is composed of numerous tunnelways leading down from the surface of the stone for a distance of about 7 to 10 cm. (3 to 4 inches). From these several more or less horizontal galleries branch off leading to the cells for the reception of the future generations. The tunnels from several entrances often join one another at varying distances beneath the surface. Hence a nest may have several entrances. In Fig. 1, four entrances are shown. Three of these were close together and the fourth was about 20 cm. (8 inches) away. The vertical depth was about 7.5 cm. (3 inches). Most of the passageways were in about the same plane suggesting that the bees took advantage of a fault in the stone to excavate their nest. Such a crack, if present, was hardly noticeable from the surface.

In some cases, one does not find such distinct galleries branching off from the tunnels in the stone. Thus upon chiseling out the nest used by thirteen bees I came across a most peculiar structure. The tunnelways from the entrances led down in a typical manner to a depth of 2 or 3 cm. (one inch). Here they began to branch and merged abruptly into an area of dark, moist sand about the size of one's two fists. Lower Figure Plate II is a photograph of this nest. It was taken after the moist sand with its contents had been removed. The accompanying drawing, Fig. 4, shows the larvæ as they would have appeared had the fine sand been transparent.

The explanation of such a nest is probably as follows: Apparently the bees had been working on the nest for years and years. Each season a new brood continued the work of excavation. And each year the branching galleries became more and more complicated, until, finally, nothing was left of the sandstone walls between the tunnels. Just a mass of the dark, moist sand remained.

Embedded in this chamber of sand, 215 larvæ, each within its mud-like cell, were present. Here and there was a dead adult, a silent reminder of the past season's activity. If it is true that there were but eleven females in this nest of 215 larvæ, then each female laid at least 19 eggs.[7] This is in harmony with the findings of Fabre ('15). He states further that after the bee has laid her limit of eggs, she continues her work of provisioning cells which are finished and closed up just as if the egg had been laid:—

"I seem to see. . . . . . a rough image of the industrious persistency of the insect, still toiling away at its business, even when there is nothing useful left to do. This worker knows no rest but death."

Perhaps the same explanation could be offered for the presence of over a dozen such cells in this nest. In each of these

[7]"The total number of eggs laid not only by the Osmiæ but by a host of other bees fluctuates round about fifteen."—Fabre.

there was found a typical ball of pollen, as had been present in all of the rest, but no signs of an egg or larva.

Some of the chambers for the young bees, i. e. numbers 1, 2 and 3 in Fig. 1, were but a centimeter from the surface. At the time of my chiseling these out, I saw on their walls patches of pollen of the same size as the loads on the hind legs of the females. Here, the bees were apparently forming a supply of pollen before shaping it into a ball for the young embryo. The walls of these chambers were smoothly lined with a mud-like material.

Between the cells containing the larvæ the tunnel was filled up with loose sand. This was somewhat damp and more darkly colored than the surrounding stone This probably prevents certain enemies from reaching the young bees, during the hot summer months of July, August and September when the builders of the nests are dead.

In cells labeled 4, 5, 6 and 7, Fig. 1, one sees the stages in the development of the young embryo. Thus, in cell 4 there was a large, well-grown larva, without any visible pollen.

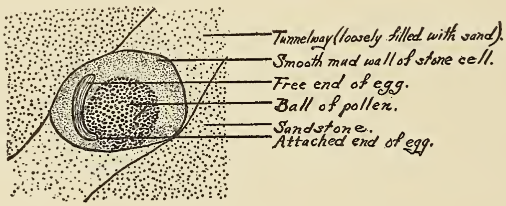


Fig 2.—The egg of the species is crescent-shaped. (Taken from Fig. 1, cell 7).

But in cell 5, the larva was not so well developed, having eaten but half of its provision of pollen and honey. The egg for this one had been laid later. Further along, in cell 6, a large ball of pollen, 2.5 mm. in diameter was present. On its side there was a slightly developed larva, just out of the egg. And finally, in cell 7, there was a similar ball of pollen with an egg along the side. One end was inserted into the pollen. Apparently it had just been laid. This latter chamber is shown in Fig. 2. The egg of this species is somewhat crescent-shaped, quite smooth, glistening and opalescent. It is approximately 1.5 mm. in length, being about one-fifth as wide as long.

In looking through the literature, I find no report of any bee, or wasp, for that matter, digging its nest out of stone. In the study of the thousands of species of wild bees one finds many different methods of nesting. The most common of all bees, those of the genus *Megachile*, excavate tunnels, to a depth of several inches, in the earth or in other suitable places such as the dried stems of pithy plants. In these they construct several cells, each about a centimeter long, out of pieces of leaves which they cut from nearby plants. These cells are partially filled with pollen and honey and an egg is laid therein. This hatches and usually takes a year to mature. The process is then repeated. Each nest is usually built by but one bee; she lives but a month or two. The males never help in the nesting. Bees of another genus, *Xylocopa*, excavate similar tunnels in wood and use sawdust to make the cells. Others, of the genus *Anthidium*, find tunnels already constructed, usually in the earth. In these, they place cells made of a cottony material consisting of hairs scraped from plant stems. Then they fill up the tunnel above the cells with the cottony material, soil or pebbles, etc., according to the species. And others of the genus *Dianthidium* construct their cells out of a resin which they secure from certain plants, such as the sunflower, *Helianthus petiolaris*. Here it occurs in drops on the leaves and stems. Some of the species make their cells on rocks, others in the ground etc. Some are solitary; others are colonial. One of the latter species even keeps two nests going at the same time. See Custer and Hicks ('27). Still others, known as the burrowing bees, such as those of the genus *Melissodes* or *Anthophora*, dig out extensive galleries in the earth. These line their cells with a smooth mud-like material probably made by lapping the cell-walls with their tongues. Then there are the bees of the genus *Osmia* that dig tunnels in the earth, old logs etc. These construct their cells out of macerated plant leaves etc. And, finally, there are bees that make no nests at all. They are parasites on other bees. Among these we find the genera *Cœlioxys* (parasitic on *Mega-*

chile), *Triepeolus* (on *Melissodes* etc.), and others. They lay their egg alongside that of the host in the cell. Then, according to Fabre ('15), the parasite's egg hatches out and its first instinct is to seek out and destroy the egg of the host. It then develops, usually throughout the winter to come out the next summer as the adult. Thus each bee and each genus has its own peculiar methods of nesting. Many more interesting details can be obtained from Fabre's works. And many interesting facts remain yet to be found in nature.

The small bees of the genus *Perdita* are found chiefly in the arid south-western region of the North American Continent. Some have been found in Canada (*P. canadensis* Crawford and

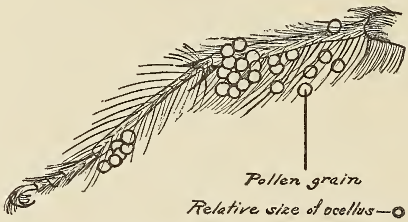


Fig 3.—The pollen grains on the hind legs of the female are larger than the ocelli. (Hind leg of female X33 diameters).

P. citrinella Grænicher); others in Mexico (*P. mexicanorum* Ckll).[8] Between these two countries the bees of this genus are abundant, especially in New Mexico. *P. albipennis*, a western form, is found from South Dakota and Nebraska through Colorado and New Mexico into Texas, according to Grænicher ('14).

Before Professor Cockerell ('96) started his work on this genus, only 17 species were known. By 1896 he had added 53 new species to the list. Of these, 26 were known in both sexes, 26 only in the male, 18 only in the female. The flower visiting habits of 50 species were known. Their nesting habits were as yet unknown. Fifteen years later, in 1911, he reported a list of

[8]Prosessor Timberlake informs me that the genus is recorded on the Atlantic coast from Guatemalo to New Brunswick; on the Pacific coast from Lower California to Victoria, British Columbia, at which latter place he has found an as yet undescribed species. He is at present describing some fifty new species, mostly from California.

149 members, over twice as many as were known in 1896. By 1922 the list had been further enlarged by at least ten more species. Up to this time, the nests of but two species had been observed: In 1910 Grænicher had reported that *P. maculipennis* made its nest in sandy soil in Wisconsin. And in 1920 J. Bequaert ('20) had stated that *P. octomaculata* was seen nesting in sandy soil at Forest Hills.

By 1896 only two species were found east of the Mississippi These were *P. octomaculata* Say, a northern type, and *P. obscurata* Cr., a southern species occurring in Georgia and Florida. However, by 1914, twelve eastern species were reported. Six of these were from Wisconsin.

According to Professor Cockerell and others, it may be laid down as a general rule that each species of *Perdita* visits, normally, but one species of flower. More than half of these flowers are *Compositæ.* These bees do not usually frequent the northern type of flowers but rather those that extend northward from the neotropical region. This, taken with the normal distribution of the genus, strongly suggests that in the main we have to do with a southern series of types which have spread northward and become largely differentiated since the glacial epoch. But we must look upon *P. octomaculata* as a survivor from pre-glacial times.

The great majority of the members of this genus fly in the late summer and autumn. Few have been seen both in spring and late summer but Viereck (Ckll '11) has collected *P. phaceliæ* in May and *P. pectidis* in April in New Mexico, these being previously known as September bees. And so in these cases there are apparently two broods each year or else the September brood hibernates through the winter. At White Rocks, but one brood of *P. opuntiæ* is found each year. Even by December I have been unable to find any cocoons spun by the larvæ. The cocoons shown in Fig. 1 are probably those of parasites.

Perdita opuntiæ is not the only bee that confines its visits to the cactus flowers. Professor Cockerell has shown that the genus *Lithurgus* and certain members of *Heriades* and *Ashmeadiella* are confined to their flowers for their pollen. Professor

Toumey has shown that certain species of cactus have almost lost the ability to produce seed but propagate by means of falling joints which take root, and yet their flowers are adapted to bees and are visited by a series of bees more or less peculiar to them. Thus *Ashmeadiella cactorum* Ckll. visits cactus at Santa Fé in July.

These bees are usually short of flight. Some claim that this is so because they are small. Others want proof for such statements and offer other explanations. Thus Robertson ('12) explains it by saying that the short flight is the result of the visiting of the few closely allied genera of plants. In order to visit a few genera they have to be where those few are abundant. And so each year they nest in the neighborhood of the flowers on which they depend. Being near to these flowers each season, they are therefore short flighted. Both opinions are probably right. Apparently but little actual field work has been done on this problem.

It is evident that there are other bees of this genus which are apparently limited by their environment as much as is *Perdita opuntiæ.* Thus M. H. Swenk and T. D. A. Cockerell ('07)

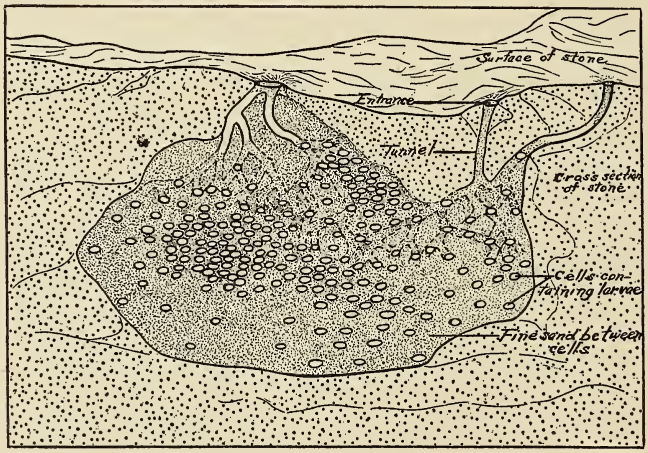


Fig 4.— A drawing explaining Plate II, lower figure. This is a vertical section through the sandstone. The cells are shown as though the sand between them were transparent. In reality they are in several different planes.

state that *P. crawfordi* Ckll. has never been taken away from the environs of the salt flats west of Lincoln, Nebraska. Perhaps in this as well as in other cases, similar geological limits are set on the bee, the same as on *P. opuntiæ.* Further investigation of this point would probably be interesting.

Various investigators have found evidences of adaptation to new conditions, of extraordinary splitting up into a great variety of forms and, in general, of considerable signs of evolution going on within this genus. Professor Cockerell thus states "we have indeed the process of evolution going on under our eyes, the puzzling forms being those which have only lately segregated themselves and have not yet developed striking peculiarities." Grænicher brings forth some evidence when he states that *P. maculipennis* obtains her pollen from the white melilot which was introduced from Europe. Here there occurred an adaptation to new conditions brought about by the fact that the native plant or plants visited originally by this bee did not occur in the type locality at the time the bee was found.

With these facts in mind, Professor Cockerell has advanced the following five possibilities of processes that may be going on in the formation of new species in the genus *Perdita*:

1. Mutations having no adaptive significance.
2. Results of the crossing of mutants.
3. The sorting out of certain characters as dominant (in the sense of prevalent) but not necessarily aided by natural selection or sexual selection.
4. The occasional coincidence of adaptive features (often physiological or such morphological ones as length of tongue) which favor a change of habits or environment and permit the insect to become attached to a different genus of plants.
5. The new type having been isolated on a new plant, or geographically or seasonally isolated will eventually settle down to a new position of stability (aided by natural selection) which will be sufficiently remote from that of the parent species to maintain it as a distinct entity in nature, and usually prevent crossing.

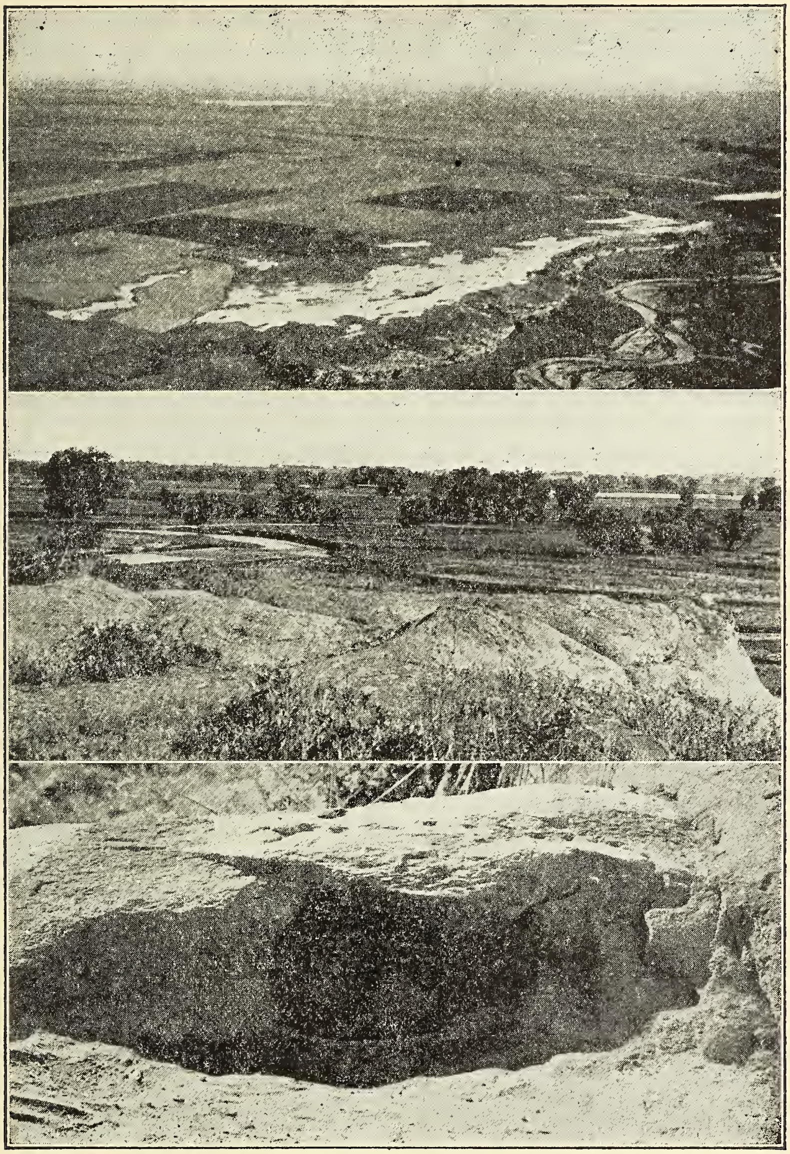
The complexity of the genitalia will cause slight modifications to result in physiological isolation.

In the case of the bee, *Perdita opuntiæ*, progressive excavation of the nest is probably continued year after year, by this means leading to the complicated galleries in the stone. In Fig. 1, the nest at the extreme right had four blind pockets which were not constructed into chambers. In other places, similar extensions were present. These, along with the old chambers, undoubtedly would have been used by the next year's brood. In places, as labelled in this same drawing, one could see a cocoon[9] or dead bee. So, by June 21, when the nest was chiseled out, the process of provisioning was near completion. By the first of July, the cactus flowers were beginning to disappear, and by the eighth not a bee of this species was to be seen at White Rocks. Just a very few of the cactus flowers remained. The bee had disappeared for the year. The larvæ were beginning their long period of development, waiting quietly through the long months of the hot summer and bleak winter in their cells of stone, inpreparation for the emergence next spring as adult bees.

Before this time, on June 20, I had covered the White Rocks from end to end mapping out the distribution of the bees as I found them in the cactus flowers. This covered a territory two and a half miles long by one quarter mile wide. Everywhere that I found the cactus flowers, numbers of these bees were present. This plant is a native of this country. Beyond a doubt, when the Indians used the White Rocks as a look-out station,[10] in the pre-pioneer days, the cactus plants were quite generally distributed all around the territory. Perhaps a long time before that there were numerous rock formations all over the West, in which the bee made its nests. As time passed on, these disappeared, leaving the White Rocks as an erosive remnant on which *Perdita opuntiæ* and its favorite cactus flowers were stranded. Perhaps extensive collecting would reveal this bee at some other sandstone formation where it had been similarly isolated. Up to this time, September, 1927, no such proof is

[9]Probably of a parasite.

[10]Numerous implements used by the Indians have been recovered from the White Rocks. These include, especially, mortars, pestles, etc.



CUSTER—PERDITA

available. The bee is still to be found only at White Rocks. Is it possible that it arose here in its evolution?

SUMMARY.

1. *Perdita opuntiæ* is a wild bee which has been reported from nowhere else but White Rocks, Colorado.

2. It is isolated here because it must make its nest in sandstone.

3. The isolation of White Rocks by large areas of tilled land prevents the spread of this bee.

4. It visits the flowers of but one plant species, the cactus, *Opuntia mesacantha* Rafinesque.

5. There are several entrances and about ten inhabitants to each nest.

6. The bees usually alight several times on nearby rocks before entering their nests.

7. In some cases, the inhabitants have the peculiar habit of disappearing into the sand to gain entrance to their nests.

8. *Perdita opuntiæ* is to be found at White Rocks during the latter part of May, all of June and early July.

9. This is apparently the first bee reported to make its nest in stone.

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Explanation of Plate II.

Above

The home of the Worker in Stone. This is a view from an aeroplane looking north-east. It shows the complete isolation of White Rocks. In the right corner runs the stream in double "S" formation. The white streak at the extreme right is the tail of the aeroplane.

Middle

The entrances to the nests are generally found on the upper surfaces of certain dome-shaped sandstone formations. In the background runs the stream which has carved the cliffs of White Rocks. Ten or twelve nests are present in this picture.

Below

A peculiar nest that was over-tunneled by the bees. This photograph was taken, after the sand containing the cells had been scraped away, in order to give depth to the drawing in Fig. 4. (Approximately one-fourth natural size.)

THE LARVA OF LEPTANILLA (HYM.: FORMICIDÆ)[1]

By George C. Wheeler,

University of North Dakota

Leptanilla revelierei sardoa Emery

Larva:Body long, slender ,subcylindrical, or thocephalic and straight except for the thorax which is slightly curved ventrally; with eleven distinct postcephalic segments. Diameter greatest at the sixth abdominal segment; decreasing slightly toward the posterior end which is rounded and terminates in a small hemispherical boss; and diminishing progressively to the anterior end, except for a slight constriction at the first abdominal segment. Relative diameters of the segments (beginning with the prothorax as the unit): 1.00-1.30-1.50-1.45-1.80-2.00-2.45-2.80-3.00-2.95-2.75. Relative lengths of segments: 1.0-1.9-3.4-3.1-3.6-4.0-5.3-4.0-3.7-3.3-7.7. (Fig. 1*A*)

Projecting downward and forward from the ventral side of the prothorax there is a curious structure suggestive of a plowshare. This is furnished with three hairs: a short, simple, slightly curved seta arising just back of the apex on the ventral side, and two longer pendulous hairs, which are curved at their distal ends and bifid at the tips, arising dorsolaterally just back of the middle of the structure. (Fig. 1*B* and *E*)

On either side of the fourth abdominal segment near the posterior border there is a bare circular area enclosed by a narrow heavily chitinized band, the whole structure (provisionally called "tympanum") being about 0.037 mm. in diameter. It is bordered by a fringe of stiff hairs, which are stouter and a trifle longer than those on the adjacent integument; there are also a few of these on the heavily chitinized band. Attached to the bare area near its posterior margin is an internal tube-like structure; this is twice bent and its diameter increases toward the inner end; its length is about 0.06 mm. (Fig. 1*D*)

[1]Contribution from the Zoölogical Laboratory of the College of Liberal Arts at Syracuse University.

Hairs of four types: (a) Minute, thin, somewhat flexuous hairs (length 0.01-0.03 mm.), which form a rather dense covering for the entire body, except the head, prothorax, "tympanum," and caudal boss; these are arranged in transverse rows encircling the body; they are spaced at distances roughly equal to their length, which is least at the anterior end and greatest at the posterior. (b) A few short, stout, rather stiff hairs, irregularly distributed and ranging in length from 0.02 mm. on the prothorax to 0.08 mm. on the last abdominal seg-

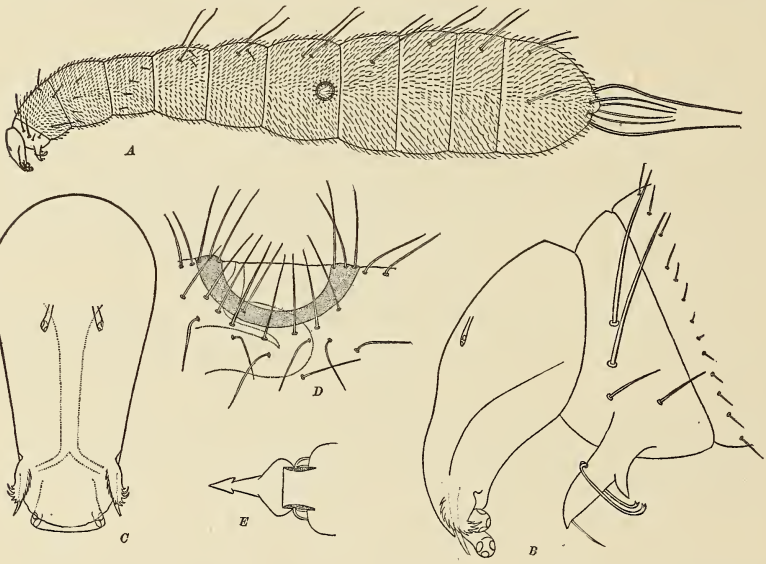

Fig. 1.—Larva of *Leptanilla revelierei sardoa* Emery: *A*, in profile, X60; *B*, head and prothorax in profile, X410; *C*, cephalic aspect of head, X400; *D*, "tympanum," dorsal vien, X580; *E*, cephalic aspect of plowshare-like organ on prothorax, X425.

ment. (c) Long hairs with rather flexuous tips arranged symmetrically in pairs on the dorsal surface, one pair each on the second to seventh (inclusive) abdominal segments; varying in length from 0.13 mm. to 0.16 mm.; four of the longest forming a ring around the base of the caudal boss. Just outside this ring there are attached (d) two extremely long (0.3 mm.) hairs; these six hairs converge apically and give the appearance of a caudal appendage.

Head (Fig. 1*C*) minute, naked, its outline pyriform when viewed from in front, twice as long as its greatest breadth (which is one-fourth of its length from the occipital border), narrowed at the base of the mouth-parts, with the occipital border broadly rounded. Antennal rudiments situated one-third of the length of the head from occipital border; long, narrow and apparently adnate to the head. Tentorium (?) conspicuous, in the form of a long, narrow, median bar, which is abruptly widened at the posterior end and furcate anteriorly, each division leading toward the base of a mandible.

Labrum semicircular, the margin finely undate, the basal angles produced outside the mandibles into stubby flaps which are toothed on their anterior and distal borders (Fig. 1*B*). Mandibles long, slender, slightly curved, acute, simple, feebly chitinized and directed downward and somewhat backwards along the sides of the labium. Maxillæ lobiform, each with three sensillæ. Labium narrowed at the base, broader at the distal border, which is smooth and slightly curved; with lobiform sense-organs at the anterior corners, each with three sensillæ; opening of sericteries not evident. Trophorhinium wanting.

This description is based on three larvæ, which have been cleared in potassium hydroxide (10%), stained with acid fuchsin, and mounted in balsam on slides. They are labeled "Sardegna: Golfo Aranci. I. 1909 A. Dodero."

I am indebted to Dr. Rafaelo Gestro of the Museo Civico di Storia Naturale of Genoa, thru the kindness of Dr. W. M. Wheeler, for this material.

The genus *Leptanilla* has always been more or less *incertæ sedis*. Emery, when he established it in 1870, placed it in the "Dorylidæ" near *Typhlopone*. Mayr, however, in a letter to Emery (date not given—see Emery 1904) dissented, maintaining that it belonged with the Myrmicinæ. Emery was evidently convinced, for in 1875 he removed it to the "Mirmicidei" in the neighborhood *Stenamma* and *Liomyrmex*. In 1877 he moved it to the vicinity of *Monomorium* and *Leptothorax* in the "Myrmicidei genuini" but marked it with a query to signify uncertain position. In 1881 Ern. André had it in the first tribe, "Myrmicidæ veræ," of the "Myrmicidæ" but mentioned its affinities with the "Dorylides."

Forel in 1893 did not mention the genus but might have meant to include it in the subfamily Myrmicinæ, when he said that the fourth tribe ("Myrmicii") included "les autres genres de la sous-famille des Myrmicinæ." And later (1901) he excludes it from the Dorylinæ when he says, "Donc, je maintiens la sous-famille *Dorylinæ* limitée aux genres *Dorylus*, *Aenictus*, *Eciton* et *Cheliomyrmex*." In von Dalla Torre's "Catalogus" (1893) it was still in the Myrmicinæ but near *Trigonogaster* and *Pheidologeton*. In 1895 Emery was still of the opinion that it belonged in the subfamily "Myrmicini" in the second tribe ("Myrmicii") near *Huberia* and *Phacota*. But nine years later (1904), after describing the female of *L. revelierei* Emery, he returned it to its original subfamily (Dorylinæ). In the following year, however, in Ashmead's skeleton it stood between "?*Liomyrmex*" and *Epipheidole* in the tribe Stenammini, subfamily "Myrmicinæ," family "Myrmicidæ". In 1907 Santschi described males of three species, which he referred to the Genus *Leptanilla* and claimed that their doryline affinities justified Emery's original allocation of the genus. It should be noted, however, that males of *Leptanilla* have never been taken with females or workers; hence it is not certain that those described by Santschi belong to this genus. In the "Genera Insectorum" (1910) Emery established for the genus a separate tribe (Leptanillini) in the subfamily Dorylinæ, where it seemed destined to abide in isolation; Wheeler (1910: "Tribe Leptanillii"), Forel (1917), and Forel (1921: tribe not given), and Wheeler (1922) have not disturbed it. But recently Wheeler (1923) has suggested that even further isolation may be necessary:

"Most myrmecologists recognize only five subfamilies of ants and regard the Cerapachyinæ as belonging to the Ponerinæ, the Pseudomyrminæ to the Myrmicinæ. It is probable, however, that future myrmecologists will increase the number of subfamilies. I believe that the tribe Leptanillini, which Emery includes among the Dorylinæ, will have to be separated out as a distinct subfamily (Leptanillinæ). Dr. George C. Wheeler finds that the larva of Leptanilla is very aberrant, and the characters of the adult are either quite unlike those of other Dorylinæ or only superficially similar and due to convergence, or similarity of subterranean habits." (page 335)

The larva of *Leptanilla* does bear certain resemblances to the known doryline larvæ (*Dorylus*, *Aenictus*, *Eciton*, *Cheliomyrmex*): the long, slender, subcylindrical, orthocephalic, nearly straight body, narrowed progressively from behind forward; the small, feebly chitinized mandibles; the absence of a trophorhinium on the mouth-parts. On the other hand, it differs in the constriction at the first abdominal segment; the long hairs on the abdomen, especially the extremely long pair at the posterior end; the absence of hairs on the head; the shape of the head, which in the Dorylinæ is suborbicular. But these differences become trivial and insignificant beside the four which not only differentiate it from the Dorylinæ, but also from all other known formicid larvæ (130 genera). *Leptanilla* is unique in the (1) possession of the plowshare-like structure on the ventral side of the prothorax, (2) the "tympanum" on either side of the fourth abdominal segment and (3) the toothed flaps of the labrum and (4) in the position of the mandibles, which are directed downward and somewhat backward along the sides of the labium instead of lying across the front of the labium with their apices nearly touching or crossed.

These aberrant characters of the larva of *Leptanilla* support the contention of Dr. W. M. Wheeler (quoted above) that the tribe Leptanillini should be removed from the Dorylinæ and raised to the rank of a subfamily.

Concerning the functions of these peculiar structures nothing is known. The plowshare-like structure on the prothorax might be an exudatorium; the "tympanum" suggests an auditory organ. If the larvæ of this rare ant (or of any related species) are ever collected again, they should be kept alive in an artificial formicary and studied for the purpose of solving these problems. Also some specimens should be suitably killed and fixed for histological examination.

It is interesting in this connection to note that another formicid subfamily has been based partly upon larval characters, namely, the Pseudomyrminæ established by Emery in 1899. It is now known that the characters he used (hypocephaly and the presence of antennal rudiments) are not distinctive. Valid characters were found, however, by Wheeler and Bailey (1920) in their study of the larvæ of *Pseudomyrma, Tetraponera, Pachysima,* and *Viticicola*: the straight cylindrical body and the trophothylax. And Wheeler (1920, 1922, 1923) has since recognized the group as a distinct subfamily.

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A NEW SPECIES OF WATER MITE FROM THERMAL SPRINGS

By Ruth Marshall,

Rockford College, Rockford, Illinois.

During the summer of 1927, Professor Charles T. Brues, of the Bussey Institution for Research in Applied Biology, found several water mites in collections made in thermal springs of Nevada in the course of his investigations upon the life in such habitats. He kindly sent these specimens to the writer for further investigation.

A search in the literature of the Hydracarina reveals very few records of their occurrence in thermal waters. Dr. Karl Viets, of Bremen, who has studied the group extensively, confirms this statement in a private communication to the author. The earliest account appears to be that of Plateau (2) who records the finding of *Hydrachna cruenta* in springs of a temperature of 46°C., at Luxeuil, France, in the course of experiments on the determination of the thermal death point of several fresh water arthropods. This record is quoted by Brues (1) in recent papers on life in thermal waters. The identity of this species seems to be in some doubt, but it is probably a widely distributed European form.

Two other records have appeared during the past year. Uchida (4) has described a new species, *Eylais thermalis* from a single specimen found in a spring of temperature 42°C., near Taihoku, in the island of Formosa. Dr. Iwan Sokolow (3), examining material collected near Lake Baikal, Siberia, in springs of temperature 45°C., found three individuals which he has described very fully and named *Thermacarus thermobius*, a new genus and new species. He has also erected for them a new family, *Thermacaridæ.* The American material is a new species belonging to this genus, to which the name *Thermacarus nevadensis* has been given.

Thermacarus nevadensis sp. nov.

Pl. III, fig. 1-9.

The body is obovate, slightly widest in the region of the third pair of legs. Females measure 2.50-3.00 mm.; the males are slightly shorter and slimmer, the smallest, a young adult, being but 1.90 mm. It is thus seen to be smaller than *T. thermobius*. The color of the specimens, preserved in alcohol, was dull olive green with some traces of red. Two individuals showed white irregular branching streaks on the dorsal side. The body is low, somewhat arched; dorsally and ventrally the integument is heavily chitinized to form two shields, the dorsal somewhat the smaller, united by a thinner layer. Heavy ridges on the dorsal side enclose two irregularly oval areas, one inside of the other (fig. 1). The double eyes of either side are outside of these ridges. The median sense organ is just within the larger area and is inconspicuous. The heavy integument shows in alcoholic medium a transparent, somewhat irregular layer, below which are low elevations irregularly scattered about on a basal layer; the latter shows rounded pores in groups of some ten to twenty enclosed in an irregularly polygonal meshwork (fig. 7).

The conspicuous feature of the ventral side is the great development of the plates (figs. 2, 8, 9), the epimera closely resembling those of the related species. The first pair of plates, the largest, are fused not only ventrally but also dorsally so as to form a shallow cavity, reaching to the body margin or slightly projecting beyond it in the male, which encloses the small capitulum and the palpi. The fused epimera bear many hairs. The three remaining epimeral pairs are somewhat triangular, except that the fourth in the male is rectangular. Posterior to the epimera in the new species is another plate, a large median one, heavily chitinized and bearing the so-called anal spot, differing in size and shape in the two sexes and in contour in individuals of differing ages, and completing the closure of the genital areas.

The genital area in the male (fig. 2) is nearly circular, past the center of the body and enclosed by the fourth epimera and the medial posterior plate. Its valves are heavily chitinized and support several long fine hairs. The female genital area is oval (fig. 8), situated a little above the center of the body and enclosed by the inner ends of the epimera as well as by the posterior plate. The valves of the opening are also heavily chitinized and bear hairs; they show more conspicuously than in the male a division into an anterior inner part and a posterior outer part, the latter showing numerous circular acetabula. One female (fig. 9), was found with the large ovipositor extended through the genital slit. This organ is a delicate, light colored structure within which could be seen the outlines of the nearly circular eggs.

The palpi (fig. 4, 5, 8) are very small and appeared always within the enclosure formed by the united first pair of epimera. They are flattened and are borne on the sides of a slender capitulum near the top. A conspicuous feature is the presence of two long curved doubly bifid bristles on the distal end of the second segment.

The legs are short, stout, increasing in length from first to fourth. The first three pairs are much like those of the related species and show the same partial union of the first two segments. They bear many heavy bristles, but these are somewhat longer than in the Asiatic form. All end in large double claws, orange red and beset with teeth on the curved side. The fourth leg in the female (fig. 6) is similar to the third but longer; in the male it is considerably modified (fig. 3) and doubtless used as a copulatory organ. The last three segments here are flattened, the fourth showing a plate-like expansion on the inner side; the last two segments are thickly beset with stiff hairs, the fifth being the longest and the sixth not much shorter, but broader with the claws lacking the teeth.

The types were secured in two collections from Nevada, a total of nine individuals.

Three males and four females were found in water of temperature of 43°C., fifteen miles north of Deeth; and a young male and a female in temperature 42.5°-45°C., in the Valley Hot Springs at Minden.

The new species is seen to be closely related to the Asiatic species but differs from it in several well marked characteristics. Specific characters of greatest importance in *T. nevadensis* appear to be the development of the heavy plate posterior to the epimera, the characters of the palpi with the large curved bifid bristles on the second segment; and the character of the fourth leg of the male with its last three segments elongated as well as flattened and richly supplied with stiff hairs.

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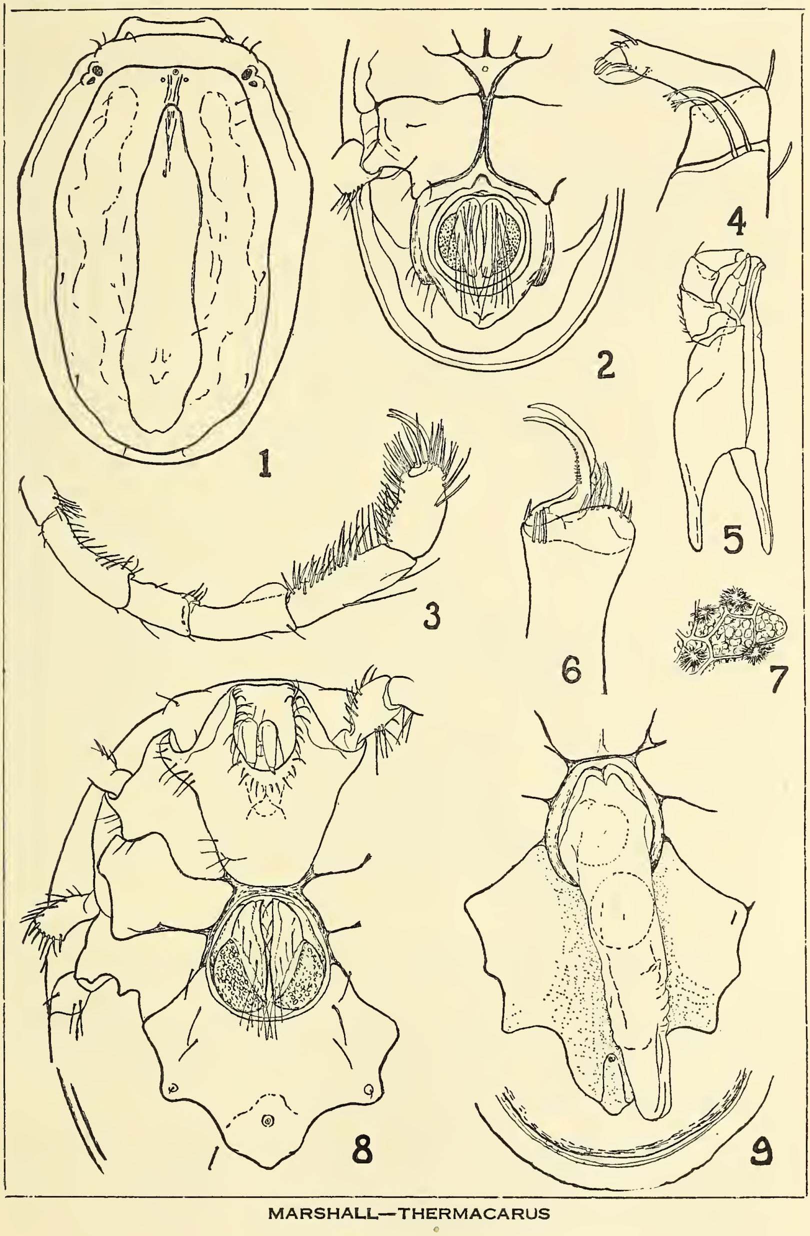
EXPLANATION OF PLATE III

Fig. 1, dorsal view, male
Fig. 2, ventral plates, male
Fig. 3, fourth leg of male
Fig. 4, palpus, right, inner side (first segment lacking)
Fig. 5, capitulum and palpus
Fig. 6, end of fourth leg, female
Fig. 7, detail of integument
Fig. 8, ventral plates, female
Fig. 9, ovipositor extended



MARSHALL—THERMACARUS

THE MALE GENITAL TUBE OF THE AMPHIZOIDÆ[1]

By J. W. Wilson

When Sharp and Muir (12) prepared their work on "The Anatomy of The Male Genital Tube in the Coleoptera" they were unable to procure specimens of the family Amphizoidæ. Since this family is one of the intermediate groups between the Carabidæ and the Hydrophilidæ, figures of the ædœagus will be

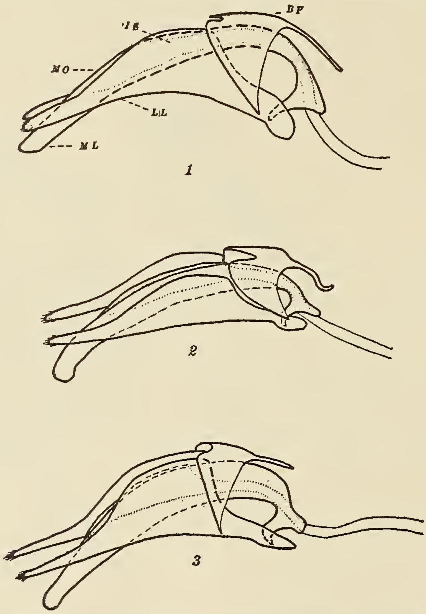


Fig. 1—Aedœagus of *Amphizoa insolens* Lec. from a lateral view; 2, ædœagus of *Amphizoa lecontei* Matth. same view; 3, ædœagus of *Amphizoa striata* Van Dyke.

of interest. The material was collected by Mr. P. J. Darlington during the summer of 1927. It includes the three species known from the Western United States, *Amphizoa insolens* Lec., *A. lecontei* Matth., and *A. striata* Van Dyke.

The ædœagus of Amphizoa is closely related to that of Pelobiidæ and Halipidæ. The median lobe (ML) is a simple

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 294.

cylindrical tube with a large median orifice(MO) extending the greater part of the length of the ventral side, internal sack (IS) simple and undifferentiated. The lateral lobes (LL) are large, produced, and coming together to form an articulation with the median lobe on the dorsal side. When retracted into the abdomen the ædœagus lies on its left side. The basal plate (BP) is small, attached to the lateral lobes by a short membrane, and rides over the lateral lobes. The structure of the ædœagi of the three species varies only in details of size and shape of the median lobe, the lateral lobes, and the basal plate.

The ædœagus of the Caraboidea Series is of two types, the less specialized being characterized by an undifferentiated internal sac. The Pelobiidæ, Halipidæ, Dytiscidæ, and Amphizoidæ possess such a simple sac. From a comparison of the figures by Sharp and Muir the Amphizoid ædœagus seems to be more closely related to the Pelobiidæ in the structure of the basal plate, and the size and shape of the lateral and median lobes.

The general shape of the Amphizoid ædœagus resembles that of *Dactylosternum subdepressum* Cast. which belongs to the Byrrhoid series of Sharp and Muir. In *Dactylosternum* the lateral lobes meet on the ventral surface, while in *Amphizoa* they meet and articulate with the median lobe on the dorsal surface. The basal piece in *Dactylosternum* is chitinized entirely, in *Amphizoa* the basal piece is not chitinized on the dorsal surface. This resemblance in shape then is only a superficial one.

THE NESTING HABITS OF THE PULP-MAKING BEE, *ALCIDAMEA PRODUCTA CRESS*[1].

By Phil Rau,

Kirkwood, Missouri.

It really seems sometimes that the various types of twig-dwellers and mud-dwellers among bees and wasps vie with one another to see which can produce a new or novel type of architecture, for certainly they have utilized almost as many different forms and materials in accomplishing their one supremely important task, i. e. providing shelters for their broods, as man has done in precisely the same task. Man has, up to the present time, constructed his domiciles chiefly of caves or excavations, structures of mud, modifications of mud and clay, cement, stone, wood, thatch and, to some extent, paper. So far in our studies of the architecture of our smaller fellow-creatures, we have accounts of their using natural crevices or caverns, excavations, various structures of mud, wax, thatch (grass-carrier), wood (pith-borers and carpenters), and to a large extent paper, and we may add to that list modifications of clay. *A. producta*, in nesting in hollow stems, uses vegetable matter in a very unusual way; she chews green leaves into soft pulp, and while this is still wet she fashions it into plugs and partitions that make cells for the young.

Grænicher, who has made observations on this bee says, "From Davidson's descriptions of the nest, we learn that the Californian *Alcidamea producta* builds its nests in the stems of the elder tree by excavating the broken twigs and constructing of pith and clay the partitions between the cells, as also those near the opening of the nest (the 'outer defense,' as Davidson calls them). In our region this bee makes the partitions out of pieces of chewed leaves, and never uses clay for this purpose. In this variation of habits, *Alcidamea producta* remains true to the habits in vogue within the family to which it belongs, since

[1]Indentified by T. D. A. Cockerell.

some species of *Osmia* utilize clay, while others resort to vegetable matter. On July 20, 1903, I witnessed ** a female *Alcidamea producta* obtaining her leaf material from a wild strawberry *** the leaves of this plant are rather hairy on the under side, and when thoroughly chewed they form a felt-like, pliable mass."

My St. Louis specimens also failed to behave in just the same way as Davidson's in California; this species, unlike other twig-dwelling bees heretofore reported, makes plugs and partitions of a tough, tightly compressed, green substance which under the microscope proves to be vegetable fibres, *i. e.*, portions of leaves chewed to a fibrous pulp and moistened with saliva, which makes wonderfully strong plugs. This material is packed down in layers to form the plug, so that each mouthful forms a distinct stratum (see four layers at (a) in fig. 1). This is tough and well-nigh impenetrable when dry; hence the new adults emerging from beneath this roof cannot bite through, and have adopted an unusual and ingenious method of effecting their escape.

A general description of the nest, and the details of a few typical courses of action will impart a better idea of this bee's ways. These bees nidify in tunnels of elder, sumac or rose stems. Whether they excavate their own burrows or utilize some old ones left by other twig-dwellers, I cannot say. No evidence has been found of previous occupancy of the galleries; in one or two cases we noticed that the nest rested on the very bottom of the cavity, and in as many others the gallery seemed much longer than this bee had any need of, so the meagre evidence is equally divided on this point. The silky cocoons are transparent to a degree that gives one a fairly good view of the organism within.

There is much irregularity in the dimensions of the cells and the partitions. A typical series of measurements is as follows—length of cells in inches: 1, 5/16, 5/16, 1/8, 7/8, 3/8; thickness of partitions: 1/8, 1/8, 1/16, 1/4, 1/4, 1/8; air-space 1 1/2; outer plug: 5/8. In fig. 1 is shown a nest of this species, natural size, in the twig of elder; at "a" one sees the tight plug on the top of the nest, already referred to, and 4 cells are to be seen below "p", which are the partitions made of the fibrous vegetable material.

The two really unique features of the nests of this species are the material constituting these parts, as described above, and the young bees' way of getting past these plugs which when dried are almost as impenetrable as cement.

Like many other species, these bees arrive at the final stages of their development and emerge successively from the topmost

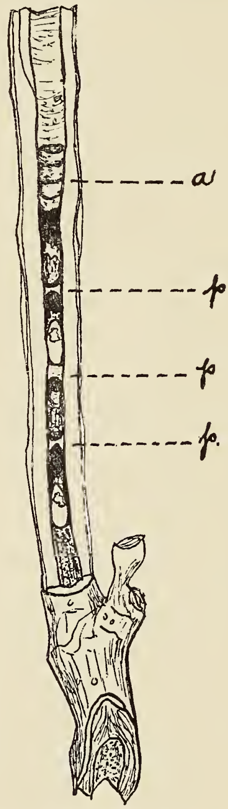


Fig. 1—Nest of *Alcidamea producta.* Natural size.

down, or in the reverse order of primogeniture. This sequence is apparent at the latter part of the pupal period from the pigmentation of the eyes. The organisms pupate with the head toward the exit.

A typical case in the details of behavior at the time of emergence was that in a nest found in a sumac twig in December, 1918. The stalk contained a hollow six inches in depth, at the very bottom of which were four cells, close together. The top was hollow for three inches, except that the orifice was plugged for an inch with chewed-up vegetable material. The twig was kept indoors, and on March 13 two adults emerged. These were the two nearest to the top. Quite unintentionally I aided these two in escaping from their cells, by splitting open the stem for inspection; they emerged by merely biting their way through the side of their cocoons, and escaped. Fully developed young adults could be seen through the transparent walls of the other two cocoons. Mica was sealed over the missing wall to the very top of the stem to compel these remaining bees to attempt to get out by crawling upward by their natural route.

On March 26th I found that the third consecutive bee had emerged from its cocoon. Early next morning it was busy biting its way upward; it entirely demolished the empty cocoon of no. 2 in its upward course and kicked the fragments back in a heap at the bottom. It then had its head against the partitioning plug, where it faced a harder task at breaking through. The next morning, the beginning of the third day, this bee, while apparently in the same position, was industriously attacking this roof, the one which the elder sister, no. 2, should normally have cleared away for it. Its own cell was clean; all debris had been kicked to the bottom. It was attacking not only the roof or partition, but also the surrounding pith against which it was built; it had already bitten out enough of the pith on the sides to enlarge the original cell considerably. It must be remembered that no. 3 was doing additional work. Had nos. 1 and 2 emerged normally, each biting the roof out of its own cell, she would not have had this additional work to do, since each bee has only to break through the roof of its own cell to reach liberty. Unlike certain wasps, e. g. *Trypoxylon politum*, which can instinctively remove but one covering, and, even if they have the ability to go through a second wall, would rather die than make the attempt, this bee had already shown that she could suit her action to the needs, and not do so by mere instinct, either, for already she had made attempts to get out by biting away the pith at the side.

As I watched her more closely at this part of her task I discovered that all of her biting and tugging was not for the one purpose of shredding the fibrous plug, but of moving it whole; even as I watched her she was, with jerk after jerk, working it slowly downward to a point where she had removed pith to loosen its pressure against the walls. I watched intently, doubtful of her success; but she knew her business better than I, and after an arduous session, a bite here and there and a jerk this way and that, she eventually succeeded in turning it up edgewise and pulling it downward as she crept past it, in a depression in the pith at the side; then she kicked it down among the other debris at the bottom. Thus my pretty theory, that she was digging in the pith at the sides to escape by going around the plug, like *Prosopis modestus*[2], was left in uncertainty, since now she had moved the whole plug bodily below, only cutting out enough extra space to permit the passing of her own body.

Thus the roof of her cell was disposed of. I should have made clear earlier that each partition comprises two parts or layers, each made of a separate mouthful of fibre; these discs, each about 1/8 inch thick, are near together but separate, one forming the roof of one cell and the other the floor of the cell above. Now that this bee had removed the roof of cell No. 2, she did not stop but went right on attempting to remove bodily the floor of No. 1 also, when a most interesting thing happened. She went to the left wall and bit out a small amount of pith adjacent to the disc, thereby enlarging the channel by perhaps 1/8 inch, again she attempted to remove the plug, but still it did not yield; so she went to the opposite wall and nibbled there a little also, and again tried to jerk the obstruction loose. Thus she continued for a half-hour, directing her blows upon the plug and her bites principally upon the left wall, and occasionally a few nibbles on the right wall; all the time the rasping noise made by her mandibles was distinctly audible. I was called away for a few minutes, and meanwhile the wonderful thing

[2]To be published later.

happened; when I again looked, she had bitten away so much pith at the left side, in her apparent attempt to loosen the unyielding plug, that she had opened a passageway around the side of it, through which she had escaped. This had led her directly into the bottom end of the empty cocoon above her and she accepted this as a passageway quite unhesitatingly. The channel had originally been only 1/8 inch in diameter, but she had dug out the pith at one side until at that point it was more than 1/4 inch. After this unusual exertion she relaxed for a few minutes of rest; she certainly looked very much at home as she lay there in the cocoon which fitted her perfectly—a replica of the one she had so recently left.

Eternal vigilance is the price of scientific data; had I not returned at that moment I should never have known her method. I expected that next she would go right on through the roof, but for twenty minutes she carefully cleaned out this cell, and with some difficulty pulled away the last bits of cocoon that adhered to the walls. There was no apparent need for this, except as a preliminary to attacking the wall to loosen the top plug. The old plug bottom that she had just passed still adhered to the walls and while her body now pushed it downward she made no further attempt to remove it; it was no longer in her way, so she went on directing her energy to the top plug and the pith on the left side near it. Her process of alternately biting and scratching out the pith, and belaboring the plug, was repeated, accompanied by the same rasping noises and occasionally the falling of bits loosened from the plug, showing that her efforts were not entirely for naught. Of course all this was making it easy for the fourth and last to emerge. Since No. 3 was doing the pioneer work that normally would fall to no. 1 and no. 2, and was succeeding manfully, it again brings to our attention the point that the first-born is not especially endowed with the ability to do worthy work, but it is all a matter of native intelligence, perseverance and strength. If this biting the way out is instinctive—chain instinct if you please—I wonder what happens to those which have no opportunity to use it,—those which merely follow the pioneers and have egress with almost no labor. Is it possible that it is not dependent upon instinct, but in the emergency each brings to the fore all its intelligence and resources to cope with the situation, and that those which do not, die?

At the last observation at 7 p. m., I found no. 3 'way up in the top of the channel, having in my absence successfully passed the hard plug by biting her way around it through the soft pith. This compartment was an empty gallery of 3 3/4 inches, and she had evidently lost no time in traversing the long open stretch. She was already at the very top, attacking the final plug at the orifice. This was the "outer defence," 1/4 inch thick and tightly packed, and I was sorry, for I knew she would have a distressing time with it.

At this time, 7 p. m., no. 4 was barely out of its cocoon, at noon it had been just half-way out; this shows that its progress was slow. Its movements showed, however, that it was struggling hard to make headway through the 3/4 inch of debris that its predecessor had caused to fall down upon it. It reminded me of a cyclone victim trying to free himself from below a pile of broken rubbish. By 8 o'clock the next morning, this one had succeeded in escaping from the debris and was up at the top, complacently waiting beside no. 3, while the latter was at work cutting her way through the last obstruction. Doubtless no. 4 worked during the night, yet I could not quite overlook the way in which she sat by without disturbing herself in the least, waiting as a matter of course for the older sister to break the way for her. Whenever I noticed them during the forenoon the division of labor continued the same; no. 3 bravely struggled with the plug, often dropping tiny bits of it below, and digging out the pith bit by bit at the left side, while no. 4 quietly waited for her to finish her job.

When I returned at 11 p. m. and examined the nest, I found that no. 3 was out of the nest, and on the floor of the jar—dead. With her jaws she had torn to bits the formidable final plug and thereby acquired her liberty, but with it had come exhaustion and death. In this case futile attempts had been made to bite away the pith beside the plug, although at the point where the plug was inserted it was sufficiently thick to make room for a passageway. No. 4 was also dead, in the same place where she was that morning. Whether exhaustion, delay or weakness caused her death I do not know.

One wonders if we may not have a case of the transitional or developmental state of a habit. Most bees in nests having real partitions, attack and perforate the partition itself; *Prosopis modestus*, we find escapes by cutting a new channel through the pith around the hard partition. The habit of this species of *Alcidamea* seems to be a reversion to a former habit, i. e., an attack upon the plug, modified by a new trick of removing bits of pith adjacent to the plug in order to loosen it, and this side cutting varying in amount from the removal of a few bits to the tearing out of enough of the pith in one place before the plug is dislodged to permit the passage of the insect's body, and in some cases the biting out of the pith at the sides without any evidence of attack upon the plug itself. One wonders whether *Prosopis* went through these stages of the arduous struggle with the hard discs before eventually adopting the easier method of detouring through the soft pith, and, if so, how long the species continued its struggle and suffering before is learned its lesson well.

Either the difficulty of the exit or the change of method or some such factor was costing the species a heavy toll of lives at emerging time. More than half of those I watched died before escaping from their secure imprisonment, or died of exhaustion immediately after gaining their liberty. Is this because of the difficulty of their situation, or must hardship or death always be the price of change?

Among the parasites which were found infesting the nests of these bees were *Stelis lateralis* Cress., [J. C. Crawford], *Epistenia osmiæ* [S. A. Rohwer] and *Stelis sexmaculata* Ash., [J. C. Crawford]. My twigs were gathered too late in the season to study the relation between parasites and host. A very important paper has been written by Dr. S. Grænicher[3] who was fortunate in finding nests with both parasite and host larvæ in the cells.

[3]Bull. Wisc. Nat. Hist. Soc. 3; 153-167, 1905.

TWO NEW CLAVICORNS FROM THE UNITED STATES.

By Doris H. Blake,

Bureau of Entomology, U. S. Dept. of Agriculture.

There have already been published three papers dealing with the insect inhabitants of the small, round, cream-coloured fungus *Polyporus volvatus* Peck, which grows on dead and dying conifers. Hubbard[1] gave a list of eleven species of beetles found in the fungus on pine trees of the Pacific Coast Range from the Columbia River northward into British Columbia. Hopkins[2] mentioned that the beetle *Dendroctonus piceaperda* Hopkins was found associated with the same fungus in the spruces of the northeast. Weiss and West[3] in their recent paper on fungus insects and their hosts mention this fungus, although they overlook the fact that *Cryptoporus volvatus* Peck and *Polyporus volvatus* Peck are identical and treat the names as representing distinct species. Accordingly, when the writer collected this fungus last summer in the Coast Range near San Francisco and sent it to the National Museum, Mr. H. S. Barber was interested to find in the material sent a new and large species of *Cryptophagus*, a genus not yet recorded as breeding in it. The writer is grateful to him for preserving the beetles and their immature stages and pointing out to her the biological interest attached to the fungus host.

In connection with the description of this beetle, the writer is also describing a related species from Florida that has long been recognized as distinct but never published. Beetles were reared in numbers by Dr. E. A. Schwarz, H. G. Hubbard, and H. S. Barber from the flowers of *Zamia floridana* A. D. C.,and there is consequently in the National Museum a large series of the adults as well as the immature stages. The species was labelled in the collection as a new species of *Hapalips* and perhaps distributed to other collections under that name, but it appears to belong rather to *Pharaxonotha*.

[1]Can. Edt., vol. 24, 1892, p. 250.
[2]Bull. 28, n. s., U. S. D. A. Bur. Ent., 1901, p. 23.
[3]Proc. Biol. Soc. Wash., vol. 33, 1920, p. 33.

Cryptophagus maximus, new species.

Large (4 mm.), elongate, slightly convex, shining, reddish brown with short, moderately dense, but fine and recumbent, yellowish pubescence and coarse punctation. Head coarsely punctate both above and below, and especially pubescent over frons; eyes moderately small; no trace of median or transverse sutures on frons; a triangular projection below antennæ and in front of eyes, ending in a sharp point on either side of maxillary palpi, the latter well-developed. Antennæ about one-third

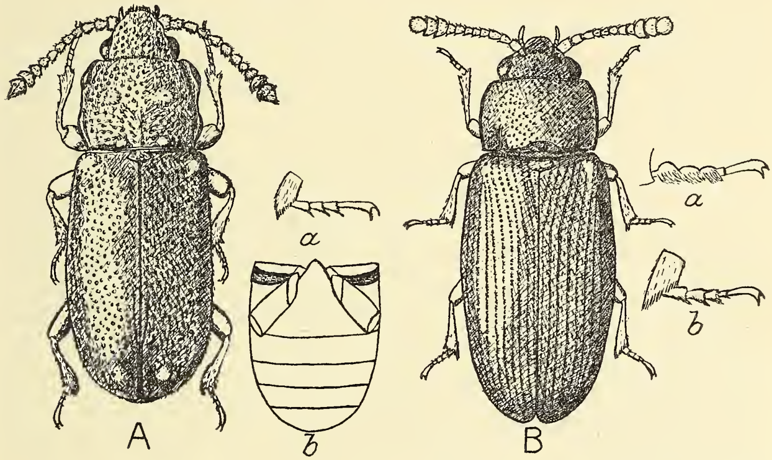


Fig. 1.—A. *Cryptophagus maximus*, (a) male hind tarsus, (b) ventral surface showing trochanters and abdominal segments. B. *Pharaxonotha zamiae*, (a) male (?) anterior tarsus, (b) hind tarsus.

length of beetle with loose 3-jointed club, the last two segments of club being approximately same width, slightly wider than first joint of club, and markedly wider than preceding segments; first antennal segment large, globose, second one-third smaller, third longer than any other except first. Prothorax somewhat wider than long with thickened lateral and basal margins; lateral margin at apical angle considerably thickened and reflexed forming an obliquely truncate apex, the sides narrowing and becoming subparallel behind, and again a little below middle projecting to form a subacute nodule, from this thickened nodule side narrowing to base and with a sharp corner at basal angle; pronotum slightly convex with flattened disc, two slight callosities smoother and less punctate on either side and slightly in advance of middle of disc, and at base two other small knobby callosities, also polished and impunctate, these more closely set; a transverse basal groove extending from near margin and slightly deeper at outer ends thus forming a fovea on either side, the basal groove interrupted at middle. Surface of pronotum coarsely and densely punctate with flat shining interspaces, and somewhat pubescent. Scutellum broad and short, rounded at base, finely punctate and pubescent. Elytra convex, elongate, subparallel, wider than prothorax with small rounded humeri and depression within; punctation dense, coarse, shallow; surface shining and with light, short pubescence; sutural margin wide and distinct. Near apex of each elytron a small polished callosity, frequently paler in color, these callosities not as apparent in male but still quite discernible. Body beneath shining, covered with short, dense pubescence and densely punctate, the punctures on metasternum coarse and becoming confluent, on abdomen much finer and denser. First abdominal segment nearly equal in length to second and third together, the second, third and fourth gradually diminishing in length. Femora attached obliquely to trochanters, the latter small and elongate. Tarsi 5-jointed except the hind tarsi of male, these 4-jointed. Each segment of tarsus with long, sharply pointed tuft of hair beneath, the segments slender and not lobed.

Length: 3.6-4.2 mm. Width 1.3-1.5 mm.

Type: Cat. No. 40795, U. S. N. M. Three ♀♀ and one ♂ paratypes.

Type locality: Mt. Vision, alt. about 150 meters, Inverness (on Tomales Bay), Marin County California.

Food plant: In fungus (*Polyporus volvatus* Peck) growing on fallen pine tree, collected 7 August, 1927, by D. H. Blake.

The sexual differences are quite apparent. The males have 4-jointed hind tarsi, and show a slight concavity in the last three ventral segments, which in the females are full and rounded. One of the two males is markedly shorter and broader in proportion.

The fungus (*Polyporus volvatus* Peck) was collected 7 August and sent directly to Washington where five adults and two pupæ were taken from the material.

This species is much larger than any other species of *Cryptophagus* known in this country. Nearly all the North American species, except a few little known ones from Alaska, have been included in a table of species by Casey, and none measures more than 2.9 mm., only three-fourths as long as *C. maximus*. In addition, the species is not as conspicuously pubescent as usual in the genus, and has none of the longer, suberect hairs characteristic of many species of *Cryptophagus*. There is no species in the Casey collection that is closely related to this one. *C. boulderanus,* while large, is quite conspicuously pubescent, and *C. valens,* another large species, is quite unlike it in color and pubescence.

Pharaxonotha zamiæ, new species.

Elongate oblong-oval, shining, castaneous, very inconspicuously and sparsely pubescent, appearing glabrous except under a high magnification, pronotum with impressed line at lateral fifth extending from base about one-third length of pronotum. Head subtriangular with clypeus anteriorly truncate but as seen from above rounded; frons depressed with a depressed line extending obliquely to side margin in front of antennal socket; eyes large; head coarsely and very densely punctate. Antennæ about one-fourth length of beetle, club 3-jointed and twice as wide as preceding segments, the two segments preceding club slightly enlarged. Prothorax transverse, with narrow darker margins on all sides; lateral margin arcuate anteriorly and posteriorly but nearly straight medially; a deep, margined, longitudinal, somewhat curved sulcus on either side at lateral fifth extending forward nearly one-third length of pronotum and ending abruptly, these sulci connected at base by a transverse groove widening considerably in middle of base of pronotum. Punctation coarse and dense but not as dense as on head, pubescence very fine and inconspicuous. Scutellum small, rounded, indistinctly punctate. Elytra a little wider than prothorax with sides subparallel, widest before middle and with well-rounded apex; narrowly margined, basal margin very distinct; humeri with a tiny notch at outer angle; striæ consisting of rows of coarse punctures, the first row converging from angle of scutellum to suture and joining suture at basal fifth, remaining striæ becoming less convergent and more parallel to suture; between these coarse rows of punctures on the interspaces another indistinct and sparsely placed series, all punctures bearing very inconspicuous short pale recumbent hairs only visible under high powered lens. Body beneath shining, punctate, more coarsely on metasternum, and with fine, short pubescence. First ventral segment about twice as long as second, second, third and fourth gradually decreasing in length, last wider and well rounded. Legs slender, rather short, tibiæ gradually dilated to apex, tarsi pentamerous, first three segments of tarsi very pubescent, the fourth segment being short, narrow and inconspicuous. Anterior tarsi of males (?) dilated and even more pubescent.

Length: 2.6-3.8 mm. Width 1-1.4 mm.

Type: Cat. No. 40796, U. S. N. M. 73 paratypes.

Type locality: Homestead, Florida.

Other localities: Larkins, Haw Creek, Crescent City, Biscayne, Naranja, Punta Gorda, Lake Worth, Miami, all in Florida.

Food plant: Reared from flowers of *Zamia floridana* A. DC. by E. A. Schwarz.

The type of the genus, *Pharaxonotha kirshi*, now known from Texas, Mexico, and Central America, was described by Reitter in 1875, having been found in drugs sent to Silesia from Mexico. The generic name suggests the character that differentiates this from allied genera,—the short, deep, impressed lines at the base of the prothorax. *Hapalips sculpticollis* Champ. also has impressed lines on the prothorax, and Grouvelle[4] in writing of *H. sculpticollis* states that he has not included this species in his table because he believes it ought to be put in another genus. *H. sculpticollis*, the only known specimen of which is before me, differs from the present species by having much longer impressions on the pronotum, very deep basally and connected by

[4]Memoirs Entomologiques 2, 1919, p. 91.

a deep, broad, transverse impression, and in the elytral sculpture, the interspaces being convex and appearing as ridges. The general shape of this beetle is also quite different. *Pharaxonotha kirshi* is a slightly larger, more elongate species, and is usually darker in colouring and more polished, being very shiny. In describing the genus *Pharaxonotha* in the volume of the Fauna of British India dealing with the Erotylidæ, Mr. Arrow states that the genus forms a link with the Cryptophagidæ, but that the stridulatory files and thoracic foveæ associate it with the Languriidæ. In both *P. kirshi* and *P. zamiæ* faint traces of these longitudinal lines behind the occipital line are to be found. Dr. A. G. Böving has shown me his unpublished drawings of the larvæ of *Languria* and the *Pharaxonotha* here described. The mouthparts of both are very similar and somewhat unlike the Cryptophagidæ. In some other respects *Pharaxonotha* is more like the Cryptophagidæ, and in the number of its ocelli it is like neither *Languria* nor the Cryptophagidæ.

THE WORKING HOURS OF ANTS.

By Ernest Seeman,

Duke University.

During the summer of 1927 the writer observed the periods of activity of two species of ants in North Carolina, and was surprised to find that one species, at least, continues to work throughout the night and, to some extent, during rains. The detailed observations may be summarized as follows:

July 22-A caravan, *Crematogaster lineolata* (Say), was moving back and forth from a nest, located between the flooring and sub-flooring of a porch, to the topmost branches of a maple tree, where a colony of aphids were being milked for honey-dew. The distance traversed was about 40 feet. The workers leaving the nest carried sand and bits of dried mortar from crumbling masonry; those moving in the opposite direction evidently transported honey-dew. The sand and debris were being used to build a shelter over the aphids. The column was actively moving when first observed at 4 p. m., and at 11 p. m., two hours after dark, appeared undiminished in numbers and activity. The average speed of the workers was about two feet per minute, which enabled them to cover 5½ feet or, one "ant-mile,"[1] 15 minutes being required to traverse the entire route of 40 feet. Thus an individual was traveling 360 ant-miles in a 12-hour period, if no time be deducted for loitering. As it is apparent from the observations below that ants may work not only 12 hours at a stretch, but for much longer periods, it will be seen that they possess great energy.

Between 11 p. m. and 3:30 a. m. of July 22 a thundershower occurred, abating by the latter hour. At that hour the ants' route was drenched with water, but the ants were found to be working in as large numbers and in as compact order as during the previous afternoon. About half their route ran underneath a floor, the remaining half extending across clay-covered ground

[1]An "ant-mile" is a convenient unit of measurement obtained by comparing the length of an ant's body with that of a man's in relation to a mile.

and up the maple tree. Slight showers were found to have no effect upon the ants' labor as they retreated to cover only during heavy, washing rains. When retreating, the food-bearers proceeded back to the nest and the majority of those that were outward-bound congregated at the end of the dry limit of the route. As soon as the rain abated they resumed activity. During their wait they did not rest, but moved about continually in the dry area.

July 23 (6 a. m.)—There appeared to be as many individuals in the line as ever, but the speed seemed a trifle slower, and a few individuals were loitering an inch or two outside the working-line. At 8 a. m. the line appeared to be going full speed; at 2 p. m., the same, except a half-dozen loitering in a fleck of sunshine (cool temperature had prevailed for some hours). The loiterers were never entirely still, however, frequently moving about in a small area. At 9 p. m. the line was as strong and rapid as ever, except where snails were crossing the route, which caused some ants to stop and feed on their slime.

July 24 (6. a. m.)—The line going full force; at 10 a. m. it was a little straggly. Weather sunshiny except that part of the course leading up the tree. At 5 p. m., the line unusually strong and more sand than usual being carried up.

No more observations were made at Durham until 21 days later. On August 14 (4:30 p. m.) the line was found to be as strong in numbers and movement as on the previous dates. At 8 p. m. the line was thicker than previously observed, and it was estimated to contain twice as many ants as it had contained at its lowest ebb. Instead of moving in single file, the line was five or six individuals deep in places. At 8:30 p. m. the marching ants appeared no less numerous. On August 15 (2 a. m.) there was still no diminution apparent. The weather at that hour was foggy, with diffused moonlight. On August 16 (6:30 a. m.) the line appeared to be moving at approximately half the strength of the night preceding. The weather was cloudy. On August 17 (daybreak) the line was moving in full strength.

No more observations were made this particular colony until some two weeks later. In the meanwhile, suspecting that this all-night work was not an unusual occurrence among ants, I made casual inspections of a nest of *Crematogaster lineolata* at Black Mountain, N. C. These inspections, made around 9 o'clock in the evening, never revealed under my flashlight more than a half-dozen ants wandering about on the flagstones near the nest. Their comparative scarcity may be accounted for by the fact that the weather was cold at this station.

After August 14 I attempted to discover other night-working species at Durham. At 10 p. m. of that date I detected two or three individuals of the small black ant *Monomorium minutum* var. *minimum* Buckley gathering dry grass seed. I subsequently baited several spots with honey. During the day this soon attracted Monomorium as well as a dozen or more individuals of the large brown ant, *Formica pallide-fulva* Latreille.

I then made an examination in the early morning, before daybreak, and at the baited stations found only Monomoriums. A further search of the locality, however, revealed the little black ants milking aphids on the tender shoots of an apple tree. The heart-shaped *Crematogaster* species was also found harvesting grass seed, but though extensive search was made, none of the Formicas could be found, nor have I yet found any of this species working at night.

Observations at Durham were then suspended until September 2, when at 8 p. m. the working line of the Crematogasters was still found to be operating in full force. On September 3 (8. a. m.) the line was straggling, there were fewer individuals working and I observed for the first time what might be called sleep on the part of these ants. In a section of the line 7 feet long I observed that there were now only thirty ants, hardly a fourth of the number observed on other occasions. Six of these were apparently sleeping but were probably not totally unconscious, or if they were, were easily awakened. As the line of march at this point traversed the under side of a floor the ants were traveling with their backs toward the ground. The resting individuals were motionless, with legs and antennæ tucked in, but when approached by passing workers for the usual kissing salute the dormant ones immediately held out their antennæ and a passerby would go on with no more than a slight touch, apparently respecting the siesta hour of its comrade.

On September 3 (10:30 a. m.) the traffic was even lighter, so that not more than twenty ants could be counted at work in the whole procession. This was by far the largest falling off in workers observed during the entire summer, either by day or night At this time seven sleepers were counted along the line, the remainder of the workers, whether asleep or awake, evidently being in the nest. On September 4, with warmer temperature, the line was again moving in full force. With lowering temperature the work gradually slowed down until on September 24, at sunrise, only one benumbed individual was out and at 7. a. m. (temperature 50) for the first time since the beginning of my observation in July, not a single individual was to be seen. On October 15, at noon, (temperature 59) six were out but moving slowly. This was the last appearance noted for the autumn.

In the spring of 1928 observations were made on the resumption of work by this colony. March 29, 6:00 p. m. (temperature 78) thirty-five individuals were seen to be following their old route. As the earth portion of the trail had been spaded under, it would appear that the ants followed the old route from memory and not as an odor-path. They followed exactly the same course up the tree but carried no building material, and by their movements appeared to be scouting. Until May 22, the last date of observation, the line continued to move steadily along the old trail except in very cold weather; and on the above date I observed that a few individuals were carrying sand up the tree, though apparently without any definite purpose, and as if they were merely acting upon a recollection of last season's activities.

It is realized that the foregoing observations are fragmentary and it is hoped that other observers will make a more extensive study of the subject. However, I shall venture to make a few surmises, rather than conclusions, from the limited data secured. The foregoing observations lead me to believe:

1. That excitement, caused by such circumstances as the discovery of aphids, or perhaps the building of a new nest, or

some other general disturbance, seems to occasion an outburst of prolonged activity among ants, at least in some species.

2. By the fact that the working line is considerably reinforced or diminished at certain times, it is possible that ants may work in relays, so that one portion of the colony may be resting in the nest while the other portion toils. Considering the fine point to which ants have developed their division of labor among various castes such a relay system could hardly be said to be beyond their powers. It may also be that ants require less rest than heavier animals, so that by a mere change in their rate of speed or by absorption of moisture or sunshine they receive renewed vitality.

3. The Crematogaster is probably a common night-worker, at least in North Carolina.

4. *Formica pallide-fulva* probably prefers to work in the sunshine rather than at night. The fact that this species is largely a flesh-eater may have some bearing on the matter, as its prey may be more available in daylight hours.

5. It is probable that temperature plays a large part in the working hours of ants. Just as an ant-colony suspends work above ground in winter, with the exception of infrequent journeys of occasional community foragers, it seems reasonable to suppose that any perceptible drop in temperature would lessen activity. Altitude, also, probably affects the work of ants. I attempted to make some observations in this regard at the summit of Mount Mitchell (6711 feet) during the summer, but was unable to find any ants at all, even during the day. It is probably too cold and high there, as none of the night-serenading insects ,such as katydids or crickets, were to be heard.

SOME CUBAN CICADIDÆ, CERCOPIDÆ AND MEMBRACIDÆ

By J. G. Myers.[1]

The material on which the present notes are based was collected largely during parts of February, March and April, 1925, while the writer enjoyed the privilege of an Atkins Fellowship at the Soledad Laboratory. The chief species of importance to cane culture were dealt with in an earlier paper.[2] For some of the specimens I am indebted to Dr. George Salt, who took them after my departure. The Cicadidæ, Cercopidæ, and Membracidæ are now considered, while the Fulgoroidea, in which a number of life-history studies were made, are reserved for a later contribution. Owing to travelling, the study of my Cuban material has been interrupted for two years.

CICADIDÆ.

see corrections p. 190

Tibicen (*Diceroprocta*) *biconica* (Wk.)

A single female of this species was taken by Dr. Salt at La Milpa, near Cienfuegos, 3rd July, 1925, and two recent last nymphal exuviæ at the same place a week previously. It has been recorded under the name of *Cicada bicosta* Wk. (which is a mainland form) as ovipositing in the leaf stalks of coconut palms (*U. S. Dept. Agric., Div. Entom.*, Bull. VI, pp. 20-23, 1902).

[1]Studies from the Biological Laboratory in Cuba (Atkins Foundation) of the Harvard Institute for Tropical Biology and Medicine.

[2]*Contr. Harvard Inst. Trop. Biol. Med.*, III, pp. 69-110, 1 fig. 1926. Other papers on these collections are in *Ann. Ent. Soc. America*, Sept. 1927, and, in collaboration with Dr. Salt, *Trans. Ent. Soc. London*, (1926), pp. 427-436, pl. xciii. The Homoptera in general of Cuba have been recently dealt with by Osborn, *Journ. Econ. Entom.* XIX, pp. 99-106, 1926; and *Ann. Ent. Soc. America*, XIX, pp. 335-366, pls. 30, 31, 1926; while the Cercopidæ (*Psyche*, XXXII, pp. 95-105, 1925) and the Membracidæ (Bull. *Brooklyn Ent. Soc.*, XX, pp. 203-214, pl. 1) have received comprehensive taxonomic treatment from Metcalf and Bruner.

Odopœa walkeri (Guér.)

A single female was captured by Dr. Salt at La Milpa, near Cienfuegos, 24th June, 1925, and two nymphal exuviæ collected on the same date.

The following species of cicadas have so far been recorded from Cuba. Doubtless many more remain to be discovered.—

Tibicen (*Diceroprocta*) *biconica* (Wk.), *List Hom. Brit. Mus.*, I, p. 120, 1850.

Juanaria poeyi (Guér.), *in* de la Sagra, *Hist. fis nat. Cuba*, p. 425, 1857.

O. sagrœ (Guér.), *op. cit.*, p. 426.

O. walkeri (Guér.), *op. cit.*, p. 426.

Proarna chariclo (Wk.), *List Hom. Brit. Mus.*, I, p. 146, 1850.

Juanaria mimica Distant, *Ann. Mag. Nat. Hist.*, (9), VI, p. 455, 1920. An endemic genus.

Uhleroides cubensis Distant, *Ann. Mag. Nat. Hist.*, (8), IX, p. 644, 1912. Endemic genus.

CERCOPIDÆ.

Monecphora bicincta fraterna (Uhl.).

2 specimens only, Soledad, 1st, 7th July, 1925, G. Salt. This was not seen by me during the dry season.

Leocomia balloui Metcalf and Bruner.

This froghopper was taken in some abundance by sweeping bushes in the Trinidad Mountains, at Mina Carlota. Usually the undergrowth was too mixed for one to ascertain a definite food-plant. In one case it was swept from *Asclepias curassavica* L.,[3] but this seemed exceptional. So far as present knowledge indicates *L. balloui* is definitely a hill species, not occurring below about 1200 feet.

Leocomia collina sp. n. (Figs. 1-2).

A tawny species, the tegmina obscurely mottled with paler, the crown long and acute. Sexes closely similar.

[3]For this and other plant determinations I am indebted to Mr. C. A. Weatherby, of the Gray Herbarium.

Head (Fig, 1, 1) considerably narrower than pronotum, the crown greatly produced, with the slightly upturned edge not quite in line with the eyes. Area between ocelli somewhat elevated. Ocelli nearer to each other than to eyes, about their own length

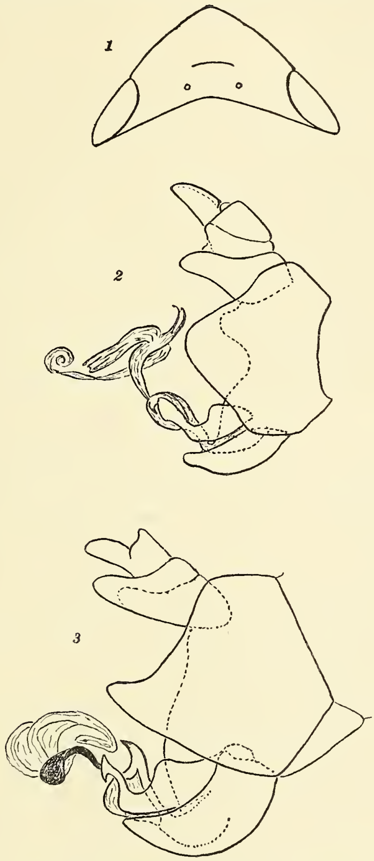


Fig. 1.—1, *Leocomia collina* sp. n.; 2, same; 3, *Dasyoptera variegata*.

from posterior margin of vertex. Frons flat, the cross-ridges visible only laterally. Pronotum just twice as wide as medianly long, widely subangulately excavated posteriorly. Scutellum 1.2 times median length of pronotum, apex long acute, with incurved sides. Tegmina 2.4 times as long as greatest width; veins very indistinct. Spines on hind tibiæ very stout.

Colour pale brown thickly covered on body and tegmina with short brown pubescence. Indications of a paler fascia about middle of tegmen and at about three-quarters. Hind wings infumated.

Length 4.3 mm. (holotype), 4.2 (allotype), measured to tip of closed tegmina.

The ædeagus is an extraordinary structure—very long and tubular, with the distal half more or less membranous, bent back on proximal half, to the Xth segment, to the under surface of which and to a conspicuous swelling of the membrane beneath, it is apparently fastened by hook-like projections. Part of this hooking apparatus is a long spirally coiled membranous arm. The proximal more chitinised part of the ædeagus is elbowed as it leaves the membrane of the pygophor, and more distally bears on each side a stout basally directed hook. In the figure (fig. 2) for the sake of clearness the lateral appendages of only one side are shown.

Described from 11 specimens, Mina Carlota, Trinidad Mts., Cuba, March, 1925 (Nos. 637. 641. 643. 647, 658, 664).

Holotype, allotype, Museum of Comparative Zoölogy, Harvard University.

Paratypes, Collections of British Museum and the writer.

This species differs from the genotype in having a large spine on the middle of the hind tibia, as do all the Cuban representatives (Metcalf and Bruner).

Judging from the descriptions, it differs from *L. grisea* M. & B. in its smaller size, the middle spine of hind tibia being much more than twice as long as basal one, the pronotum much longer than crown and differently shaped; from *L. balloui* M. & B. in its longer vertex and in colour; from *L. nagua* M. & B. in being larger and more slender in all proportions; from *L. mæstralis* M. & B. in having head much narrower than pronotum; from *L. pileæ* M. & B. in colouration and in the long vertex; and finally from *L. fulva* M. & B. in its smaller size, in the absence of straight sides to the vertex, and of carina to the pronotum.

L. collina was swept from mixed bushy undergrowth, and on two occasions from lantana (*Lantana camara* L.).

Dasyoptera variegata Metcalf and Bruner.

The male of this species, belonging to an interesting monotypic and endemic genus, was taken for the first time, and the external genitalia are herewith described and figured (fig. 3). It will be seen that their structure is a further specialisation and elaboration of that of *Leocomia*, as exemplified by *L. collina.* The ædeagus is extraordinarily complicated, with an apical semi-membranous portion which I have not been able completely to elucidate, in the one example available.

The male genitalia of the Cercopidæ afford most excellent taxonomic characters, especially in the ædeagus and the genital styles. The Xth segment is relatively simple in *Leocomia* and *Dasyoptera*, but in the common *Philænus lineatus* (L.)—an example from Massachusetts—this is produced into great caudo-ventral processes homologous with and resembling those of the Cicadidæ, but more flaring, whereas in cicadas they are usually parallel and sometimes fused, when they form the so-called "uncus" of American taxonomists.

The ovipositor of the female *Dasyoptera variegata* is extraordinarily small and weak—even more so than that of *Leocomia.*

The holotype of this species, and only other recorded specimen, was taken in eastern Cuba, at an elevation of 6770 feet on Pico Turquino. Curiously enough I did not find either of my two examples in the main range of the Trinidad Mountains, where *Leocomia balloui* and *L. collina* were both abundant. Both specimens were swept from miscellaneous underbushes, below the 1000 feet level, one at the Hanabanilla Falls (G. Salt) and the other in the wooded hills east of Soledad, on 7th April and 10th March, respectively.

Lepyronia robusta Metcalf and Bruner.

During the dry season this was the only abundant Cercopid—in fact the only adult—collected on the lowlands.

Sweeping wayside roughage and the coarse grasses, especially *Panicum maximum* Jacq., of the *potreros* nearly always, at least in February, yielded this species in great numbers. It occurred sometimes on *Panicum barbinode* Trin., also, but not in the lush stands of this species which grew in damp places. *L. robusta* is essentially an inhabitant of the drier pastures, whence, however, it tended to disappear towards the end of February, save in places where the Guinea grass was more closely grazed and consequently (?) greener.

Clastoptera sp.

An undetermined species of this genus occurred in some numbers on the imported shrub, *Acalypha Wilkesiana* (Mull.) Arg., in the Soledad Botanical Garden during February. Efforts to rear it to maturity, either in sleeves or in the laboratory, were unsuccessful owing to wholesale destruction by a small parasitic wasp. When this has been determined, observations upon it and its host and an interesting Drosophiline inquiline larva will be published.

MEMBRACIDÆ.

Only one species was collected during the dry season—or such part of it as was spent at Soledad. Two others were taken in the rainy season by Dr. Salt.

Goniolomus tricorniger Stål.

One example only, Soledad, G. Salt, 6th June.

Monobelus flavidus (Fairm.)

One specimen, Soledad, 9th June, G. Salt.

Stictocephala rotundata Stål.

The only abundant Membracid during my stay. It occurred plentifully during February in company with the still more common Cercopid, *Lepyronia robusta*, on the rough growth of *Panicum maximum* in the dry potreros. It was swept also from *Panicum barbinode* in considerably damper situations than those to which the froghopper was confined. Some examples were taken on mixed non-gramineous weeds, among which *Commelina nudiflora* L. bulked largely, on the edge of cane-fields and on *guardarayas*. It was beaten from adjacent undetermined bushes in the Botanical Garden and other Soledad localities, and from young leafy shoots of the tree, *Guazuma tomentosa* Kth. So far as can be ascertained from collections of the adults only, it would thus appear that this is a highly polyphagous species.

I found it at Soledad only during February and March, but Dr. Salt took it there on 20th June, and at San Nicolas (Habana) on 15th April.

BIOLOGICAL NOTES ON *NEMERITIS CANESCENS* (GRAV.) (ICHNEUMONIDÆ).

By P. W. Whiting,

University of Pittsburg.

On September 7, 1926 at Lowell, Massachusetts, in a grain and feed store heavily infested with *Ephestia kuehniella* Zeller and *Plodia interpunctella* Hb. there were observed a large number of females of *Nemeritis canescens* (Grav.) No males were to be found.

Six of these wasps were set with Ephestia larvæ and descendants were reared during the winter through six generations. Females only were produced totalling 3953. Since all of these except the 415 of the first generation were reared from bred virgins and since no males could be found among the numerous specimens in the store, the species appears to be almost or quite thelytokous.

Dissection showed that many eggs may be laid within the tissues of one caterpillar although only one maggot develops. The caterpillar is not paralyzed but feeds and grows normally and usually spins a cocoon. Ordinarily the full-grown maggot ruptures the skin of the caterpillar and spins its own brownish cocoon within the white silken tube of the latter. Not infrequently, however, the caterpillar is able to form a chrysalis in which case its chitinous covering left intact encloses the cocoon and pupa of the wasp. Adult wasps may be kept alive for several days if fed on honey and water.

There have been bred from single females from five to 43 offspring, but it is very likely that this number might be considerably increased. Whenever a large number of caterpillars are supplied to one wasp, however, numerous moths appear so that many caterpillars escape being parasitized

No data were collected on the duration of the different stages of development, but under variable conditions of room-temperature records were taken of times of setting parents and of collecting progeny. Maximum periods for a complete generation thus ranged from 27 to 48 days inclusive with frequencies given in two-day intervals as follows:—44, 59, 126, 151, 143, 100, 88, 48, 20, 20, 15. These numbers show that the generation extends on the average slightly over a month, but may be somewhat shorter, while laggards may extend the time considerably.

THE JURASSIC INSECTS OF TURKESTAN

By T. D. A. Cockerell,

University of Colorado.

In 1920 a very remarkable deposit of fossil insects of Jurassic age was discovered in the vicinity of Galkino, in Turkestan. The locality is within the territory of the so-called Cossack Republic, and is reached by the railway running east from Arys. Many of these insects have already been described by Martynov in Bull. Acad. Sci., Russia, ('25), but when I recently visited the Museum of the Academy at Leningrad, I was shown an amazing series of specimens, which when made known will profoundly influence many of our ideas concerning the age and evolution of various insect groups. The publications of Martynov on the Jurassic and Permian fossil insects will certainly be among the most important contributions to entomology in the next decade.

My wife and I had meant to visit the Galkino locality, but when we tried to make the necessary arrangements at Tashkent, so many difficulties presented themselves that it was impracticable to do anything. However, I was kindly permitted to study and describe some of the Galkino specimens in the Middle Asian Museum at Tashkent. Mr. Yankowsky, the director of the Museum, is a keen entomologist, especially interested in Lepidoptera. The Galkino collections at Tashkent have mostly been collected, and partly studied, by Mrs. N. Y. Besobrasoff, of the Faculty of Physics and Mathematics, Central Asian State University. I am much indebted to her for courtesies in connection with my work. I made notes on seven of the most interesting fossils, but for the present describe only three. Some of the others, as for instance a cockroach with the head extended forward beyond the oval prothorax, not concealed as in modern forms, will probably be described from other specimens by Martynov. A very large Palæontinid, the anterior wings about 38 mm. long, hind wings about 18, is extraordinarily like a cicada, but shows a straight ovipositor, about 5.5 mm. long, projecting from the apex of the abdomen. A dipterous insect is of extremely modern aspect, with two large dark spots on the wings, much as in modern mycetophilidæ.

Hymenoptera.

Martynov described from Galkino a very interesting Tenthredinoid related to the Xyelidæ, which we have long regarded as a primitive group. It actually shows the lanceolate cell (really two cells, of course) contracted below and with an oblique cross vein as in modern forms. The antiquity of this structure is astonishing. In the Museum at Tashkent I found a second species of the same genus, which I propose to call *Anaxyela martynovi.* It is 13 mm. long (excluding ovipositor); black, parallel-sided, stout; width of thorax about 3.3 mm. of abdomen about 3.5 mm; head transverse, thorax oval, abdomen with the sutures rather boadly pallid; ovipositor straight, 4.5 mm. long, about 0.6 mm. broad, sharply pointed but not gradually tapering; wings ample, hyaline, with black veins (venation as shown in fig. 1), stigma small, lanceolate, defined by a slight infuscation above radius; anterior wing about 10.3 mm; radial cell 5 mm. black beyond this creamy white (exactly same on both sides, so evidently natural coloration); length of antennæ about 3.5 mm., or perhaps more. Martynov's *A. gracilis* has the head and body about 9.2 mm., but the ovipositor much longer in proportion, being half the length of head and body.

Neuroptera

An exceedingly large and broad anterior wing may stand as *Besobrasovia* (new genus) *latissima*. I showed my sketch to Dr. Martynov, and he had nothing like it. It is of triangular shape, with rounded apex, 72 mm. long, width across middle about 48 mm., outer margin gently curved, about 58 mm.; costa straight, broad costal field (about 6 mm. broad near base) crossed by slender oblique veins about 1.5 mm. apart, but breaking up along the costa into very numerous fine veins; Sc and R running parallel about 2 mm. apart, and Rs about 2 mm. below R and also parallel with the others, the Rs emitting below eight very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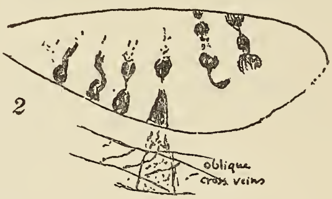

Fig. 1.—*Anaxyela martynovi* sp. nov., wing.
Fig. 2.—*Besobrasovia latissima* gen et sp. nov., wing.

oblique branches before the subapical region, these branches about 6.5 mm. apart at points of origin, but from one to the other, as they run subparallel, is only about 3 mm. In the submarginal region, about 13 mm. from margin, these branches regularly fork, and apically there are very many fine parallel veins. The media has at least three branches below. The cubitus, arising at base of media, forks at about 9 mm. from base of wing, and is further subdivided beyond. The anals are obscure. The specimen bears the numbers 162, 2903. The venation agrees closely with that of *Kalligramma hœckeli* Walther, from Solnhofen, but the apex is much less rounded, and the fine close cross-veins are lacking. There is apparently closer affinity with such species as *Brongniastiella inconditissima* Handl., also from Solnhofen, but it differs from that genus by the fewer oblique nervures below radius, and also in shape. In the Turkestan deposits at Kapadac-may, a genuine *Kalligramma* was found, and this has been described by Mrs. Besobrasoff. It is of great size, the anterior wing about or nearly 50 mm. broad in middle, and showing well the fine close cross-veins so characteristic of the genus. The hind wing also shows the large ocelliform mark. The ocelli of the hind wings are curiously similar to those of the orthopterous genus *Tanusia* and *Pterochroza*, from Brazil.

Orthoptera

The interesting genus *Absitus* of Martynov consists of long-horned grasshoppers of considerable size, with transversely banded wings. The males are said to have a well-developed musical apparatus. The genus was founded on *A. fasciatus* Martynov but to my astonishment when I called on him, Martynov produced drawings of a whole series of species, all showing the same general type of marking, though with much diversity in details.

However, still another species, not represented in his series, is preserved in the museum at Tashkent. I will call it *Aboilus besobrasovæ.* Figure 2 shows the pattern of the broad tegmen, so far as preserved, and a detail of the venation, with the characteristic oblique cross-veins, in the region of the black cuneiform mark shown just above. The insect is about 52 mm. long, with heavily spotted or banded tegmen which probably had a length of about 70 mm., but the apical part is not visible. The outline is not well shown, and the figure does not pretend to any exactness on this point. The ovipositor, not previously known in the genus, is well preserved, directed obliquely downward, about 18 mm. long and 2.5 mm. wide in middle (lateral view), straight ensiform. Hind tibiæ about 27 mm. long and 1.5 wide in middle, posteriorly with only small spines. Wings (tegmine) pallid, with heavy black markings directed transversely, the largest being long-triangular or wedge-shaped, about 8 mm. long. Width of tegmen at fourth transverse band 22.5 mm., at third band 19.5 mm., at second band 17, and at first band 14 mm. The first dark band is about 12 mm. from base the second about 9 mm. beyond it, the third about 5 mm. beyond that, the fourth about 5.5 mm. further, then the fifth and sixth after shorter intervals. These bands consist of series of broad spots or markings, either separated from one another, or united by slender isthmi. In an area about 27 mm. long and 8 mm. broad, where the abdomen of the insect was, the marking is absent, though it must have been originally present. The third and fourth bands are especially characteristic, having wedge-shaped marks with their bases on anal margin of wing, and above them, but separated from them, ovate spots, more or less pointed at the ends. The two outer bands consist of a series of large suboval spots united by slender or short bands.

I am much indebted to Mr. Uvarov at the British Museum for calling my attention to similar characters in modern species. Thus the oblique cross-veins are beautifully shown in the genera *Pseudophyllus* and *Cratylus*, which however lack the color markings. The cross-banding and spotting is well seen in other living genera, as in the Cystophyllid *Sanaa imperialis* White from India, which is beautifully shown in colors on one of the post-cards issued by the Museum. Much more like *Aboilus besobrasovæ* in markings is *Typhoptera donovani* Donovan, also from India.

Although it has nothing to do with the fossils, I venture to add a note on the extraordinary features of the South American *Catasparata histrio* Brunner, *Mimetica picteti* Kirby and *Typhophyllum mutilatun* Walker which were shown to me by Uvarov. The tegmina are exactly like dry leaves, in some cases appearing as if spotted by fungi, but the extraordinary thing is that the males (only the males, as Uvarov noted) have on the costal margin a semicircular incision exactly as if cut by a *Megachile* bee. *Megachile* is of course richly represented in the same country. The simulation is perfect, but its biological significance is not so clear.

NOTES ON THE LIFE HISTORY OF *PELECIUM SULCATUM* GUÉRIN[1].

By George Salt.

On the ninth of December, 1926, while searching for insects at the edge of a banana plantation near Sevilla, Department of Magdalena, Colombia, I came across a beetle pupa lying about 5 cm. deep in the soil of a grassy area a few metres distant from the bananas. The pupa was casually examined and then isolated in a vial. Early on the morning of December eleventh it was found to be accompanied by a small, spindle-shaped larva which appeared to be eating it. Twice the larva was moved a few millimetres off, and each time it made its way back and lay with its mouthparts touching the pupa. By noon the larva had grown enormously and had turned slightly darker in colour. On the morning of December twelfth it had completed its meal and was about 8 mm. long and 2.5 mm. in maximum diameter, tapering to each end. Nothing remained of the beetle pupa but its shrivelled skin; it had been completely consumed in twenty-four hours or a very little more. On December fifteenth the larva seemed about to pupate but failed to do so, and three days afterwards was dead and mouldy.

Some months later, in the same general locality, a similar larva was found eating a soft young leptodesmid millipede in its transformation chamber in the damp soil of a banana field. It completed its meal, lay for some days quiescent, and then pupated. After a pupal period of five days it emerged as an adult beetle which Mr. Howard Notman has kindly identified for me as *Pelecium sulcatum Guérin*, one of the Peleciinæ (Dupuis, 1913), an aberrant group of Carabidæ. As nothing seems to be known of the immature stages and life history of any member of the subfamily, and as, in the course of my work, several other larvæ, pupæ, and adults of this interesting beetle were obtained, I venture to offer these very sketchy notes.

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 293.

In all, six larvæ were found, four devouring soft millipedes, one eating a beetle pupa, and one, taken by my assistant, was reported to me as feeding on a chrysomelid larva but the host was not brought in for identification. It was attempted to raise all the larvæ and no specimen was preserved, so that only a field description of the stage can be given. The full-grown larva is dirty white in color, with a gray, median, dorsal line extending from the thoracic segments to the posterior tip of the body. The length varies, probably with the size of the host, from 7 to 10 mm., the form is always stout and spindle-shaped, the head-capsule elongate. The three pairs of thoracic legs are so short in comparison with the unwieldy bulk of the body that at this stage, at least, the larva is incapable of active or extended movement. As eggs were not obtained, the full duration of the larval stage is unknown. The period of active feeding, however, is very short. The specimen first mentioned completed its meal of a beetle pupa and became 8 cm. long in a little over twenty-four hours. Another which fed upon a soft millipede grew in length from 4 mm. to 9 mm. and increased several times in bulk in about forty-eight hours. Only one of the six larvæ was successfully brought to maturity.

When first formed the pupa is entirely whitish, but it assumes darker colours as it matures. Twenty-four hours after pupation the eyes are faintly gray, in another day they have become brown, and after seventy-two hours are entirely black. At the end of the fourth day the eyes are black, the mandibles brown, and the posterior tarsi darkened. The duration of the pupal stage in the only specimen that was raised from larva to adult was five days. Two pupæ found in the field, whose age at collection I estimated from the colour to be one or two days, emerged four days later. The pupal period, therefore, is in the the order of five or six days. Eight pupæ in all were found in the field; naked, in small cavities four to eight centimetres deep in the soil. Only two of these emerged as adults; injury at the time of excavation accounting for the high mortality.

When it first emerges the adult beetle is still cream-coloured, but rapidly darkens and in a day is quite black though the chitin at that time is not yet completely hardened. One adult specimen, entirely black though still somewhat soft, was found in an oval cavity in the soil together with fragments of a millipede which had probably served as its host. Nothing was observed of the habits of the adult beetle; it is able to move fairly quickly but does not impress one as a particularly active insect. Adult specimens vary greatly in size, probably with the size of the host.

In this brief outline notice has been taken of the late larval stage, the pupa, and the adult; the egg and the early larval periods remain unknown. This lacuna in our knowledge is unfortunate. Indeed, one of the most interesting questions in the life history remains unsolved; the problem, namely, of how the Pelecium larva comes to its host. There are two possibilities; either the female beetle lays her egg upon the intended victim, or the very young larva itself seeks out its prey.

In 1905, Silvestri described the life history of a lebiine carabid, *Lebia scapularis* Fourcroy, which feeds in the larval stage on the pupa of the elm leaf beetle, *Galerucella luteola* Müller. He found that the young larva of the Lebia is of an elongate form, with well-developed mandibles and legs, and able to move about with agility. In this stage it seeks and attacks a pupa of Galerucella. Eating voraciously, it soon becomes fusiform in shape, increases considerably in size, and, although retaining its anatomical characters, loses its ease of movement, its legs, now comparatively short, scarcely serving to move it slowly even when aided by vermicular movements of the abdomen. Later, it constructs a cocoon and therein transforms to a second stage larva, a pupa, and finally to the adult.

Silvestri's account of Lebia suggests that Pelecium likewise has a small, active, primary larva which itself seeks out its prey, and then, on account of its great increase in size, loses its power of rapid movement and becomes the fat, fulsiform, inactive larva I have described. As far as my observations go, however, Pelecium has not a distinct secondary larval stage such as Silvestri describes for Lebia, and it certainly does not construct a cocoon in which to pass the pupal period.

A competent coleopterist, my friend Mr. P. J. Darlington, now in Colombia, writes that he has obtained larvæ and adults of *Pelecium sulcatum*; and it is to be hoped that the curious life history indicated by my own fragmentary observations will soon be completely elucidated.

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SOME COLOMBIAN PHORIDÆ FROM THE NESTS OF STINGLESS BEES.[1]

By Charles T. Brues.

Dr. George Salt recently gave me a series of several species of Phoridæ which he collected in the neighborhood of Santa Marta, Colombia during the course of some studies on the biology of certain stingless bees.

One of the species is undescribed, and as Dr. Salt wishes to refer to it in the account of his investigations, I take this opportunity to describe it.

Melittophora, gen. nov.

A member of the Platyphorinæ as defined by Schmitz. Body very broad and much flattened, with stout legs and fully developed wings in the female.

Head (Fig. 1, A) in front view slightly more than half wider than high, strongly flattened and closely applied to the thorax; the occipital margin acute and the posterior surface

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 295.

concave; eyes small, distinctly pubescent. Front clothed with fine short hairs, longer along the lower margin; bristles small, twelve in number, distributed as follows; one at lower lateral angle, one just next the edge of the antennal cavity, one next the eye margin at middle of front, one near upper angle of the eye and four near upper margin in line with the lateral ocelli. Antennæ widely separated, oval in outline, with a nearly apical, bare arista. Proboscis well developed, nearly as long as the head-height; palpi small, but little longer than thick, with five moderately long bristles near the tip. Ridge between eye and

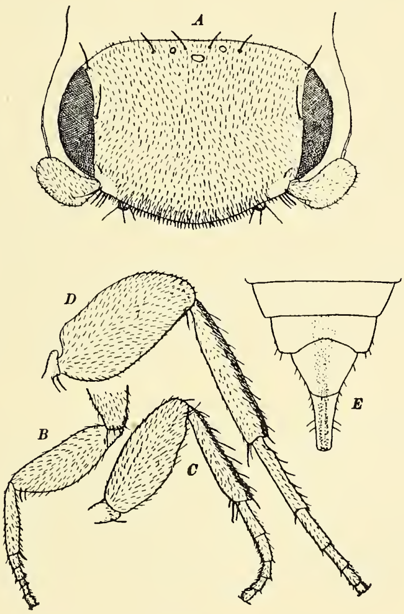

Fig. 1.—*Melittophora salti* sp. nov., female. A, front view of head; B, C, D. fore, middle and hind leg; E, apex of abdomen.

mouth opening with about eight very long and stout downwardly directed bristles, the two next the proboscis on each side closer together and weaker than the others; only the four on each side nearest the antennæ are long enough to be visible in front view. Ocelli well developed, the median one larger. Thorax broad, the mesonotum nearly one half wider than long with about four bristles along each lateral margin. Scutellum very short and broad, fully four times as wide as long, with ten bristles along the posterior margin, placed as a series of four toward each side, with a widely separated pair at the middle. Abdomen very broad at the base, triangularly narrowed apically, and but little longer than wide at base; not hairy or bristly; second segment about four times as long as broad, twice as long as the third; third to fifth of about equal length; fifth with the apical margin concave; sixth subtriangular, as long as wide at base and as long as the second. The upper surface of the abdomen is nearly flat, except at apex, as the sixth segment bends down strongly. Ovipositor heavily chitinized, directed downwards and backwards, one-half as long as the abdomen. Legs very stout and short; the hind femora much flattened, more than one-third as broad as long; tibiæ with setulæ, but without any spines. Wings fully developed, very thin and transparent; costal vein reaching to the middle, with very short, closely placed bristles; first vein straight, meeting the costa near the tip; third vein not forked, but slightly thicker apically; last section of costa one-fourth as long as the preceding. Fourth to seventh veins very pale and delicate, scarcely discernible, the fourth curved at base, straight apically; fifth and sixth slightly sinuous, seventh curved.

Type species *M. salti* sp. nov.

This genus is related to Euryphora and Microplatyphora but differs from both in the chitinized ovipositor and the presence of fully developed wings in the female. It resembles the former more closely in the form of the greatly thickened legs, but the hind tibiæ are without large bristles.

Milittophota salti sp. nov.

♀ Length 1.4-1.6. Black, including the halteres. Legs very dark brown or piceous. Wings hyaline, very highly transparent, the heavy veins black. Front and mesonotum subshining, clothed with very fine, microscopic, appressed hairs. Abdomen similar, but less noticeably shining, except at apex. Setulæ of hind tibiæ delicate, about nine in number, about half as long as the width of the tibia; in addition the anterior surface of the tibia is clothed with very minute short bristles, grouped more or less distinctly into transverse rows.

Type and paratypes from Rio Frio, Magdalena, Colombia, October and November 1927 (George Salt); in nests of *Trigona amalthea* Olivier.

Pseudohypocera Malloch

Proc. U. S. Nat. Mus., vol. 43, p. 439. figs. (1912).

Pseudohypocera nigrofascipes Borgmeier

Zeits. Deutscher Ver. Wissensch. u. Kunst, São Paulo., Jahrg. 3, p. 132 (1922)

Borgmeier, Arch. Mus., Nac. Rio Janeiro, vol. 25, p. 183 (1925)

There are a number of specimens of both sexes. The apical abdominal segment of the female is usually retracted, but when exserted it is seen that although the sixth and seventh segments are soft and membranous, the eighth is heavily chitinied to form an ovipositor. This is about twice as long as wide, slightly narrowed apically. Below the surface is faintly longitudinally aciculate, and above with a triangular smooth space basally and convergent aciculations apically. It is considerably flattened in cross section.

Rio Frio, Magd., Colombia; Sevilla, Magd., Colombia; August (George Salt), in nests of *Trigona amalthea* Olivier and *Melipona interrupta* Latr.

Aphiochaeta scalaris Loew.

This common and widespread species in the American tropics, is represented by numerous specimens. Rio Frio, Magd., Colombia, June-July (George Salt).

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PSYCHE

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NEW PLASTOCERIDÆ AND A NEW CEBRIO (COLEOPTERA)

By H. C. Fall,

Tyngsboro, Mass.

The little family of aberrant Elaterids known as the Plastoceridæ contains thus far only twenty described species from within our faunal limits, and these are very sparingly represented in the great majority of collections. The wingless females especially are very rarely taken, and in a series of one hundred of more individuals in my own cabinet only three are of this sex.

With the exception of *Euthysanius blaisdelli* Tanner, described two years ago,[1] no new species of this genus or of Aplastus has been made known in over half a century. Descriptions or five new forms in these genera, and of a new Aphricus are offered in the following pages. The types of all these are in my own collection.

Euthysanius horni n. sp.

Body above, legs and antennæ pale reddish brown, metasternum and abdomen more flavate; integuments shining, pubescence very short, pale and suberect.

Antennæ of male flabellate as usual, the terminal joint perceptibly though only slightly shorter than the branch of the 11th joint. Head densely punctate, a transverse impression between the eyes which is posteriorly angulate at middle; eyes prominent, separated on the front by a little more than twice their width as viewed from the front.

[1]Pan Pacific Entomologist, April, 1926, p. 188.

Prothorax nearly trapezoidal, length along the median line about one-tenth greater than its width at middle; sides almost perfectly straight, only just perceptibly flaring at the hind angles, the width across the tips of the latter two-fifths greater than the apical width; surface evenly convex with only the faintest trace of the antemedian impressions so conspicuous in *lautus*; punctuation fine and not dense, the punctures separated on the average by about their own diameters.

Elytra slightly more than three times as long as wide, and one-fourth wider than the thorax across the tips of the hind angles; striæ barely visibly impressed except toward the sides and apex, the intervals nearly flat and with fine punctures which are not much larger than those of the striæ.

Propleura finely not densely punctate, becoming smoother internally; metasternum and abdomen more closely punctate. Legs slender, tibiæ straight, outer margin not sinuate.

Length 17 mm.; width 4.2 mm.

Described from a single male specimen taken at Olancha, Owens Valley, California, June 19, 1917 by G. R. Pilate.

Smaller, a little narrower, and paler in color than *lautus*, the disparity between the lengths of the terminal joint of the antennæ and of the branch of the preceding joint less marked, the prothorax more elongate with straighter sides and less divergent hind angles, much sparser punctuation, more obtuse lateral margins, and less impressed elytral striæ. Furthermore in *lautus* the propleura are densely punctate and the middle tibiæ (especially) are distinctly sinuate; not so in the present species. *Horni* agrees more nearly in size with *pretiosus* but the latter has a very much stouter thorax, the width across the tips of the strongly flaring hind angles subequal to the width of the elytra at base, and the punctuation much sparser.

I am very much inclined to believe that the species here described is that figured by Horn (Trans. American Ent. Soc. vol. IX, Pl. I, fig. 2) and alluded to by him in the accompanying text as a possible variety of *lautus*. The relatively longer terminal antennal joint and non-sinuate middle tibiæ as compared with the figure of *lautus* on the same plate are in agreement with the present species, though here the sides of the thorax are straighter and hind angles less divergent than in the figure.

Notwithstanding Horn's statement that in *lautus* the thorax is "always longer than wide at middle" it is not so in any of my dozen specimens, nor is it true of either of the two examples in the LeConte collection, in both of which the length at middle is approximately one-seventh less than the median width.

Euthysanius imparoculatus n. sp.

Smaller than the other known species of the genus; rufotestaceous, beneath a little paler, thorax moderately shining, elytra duller. Terminal antennal joint very distinctly shorter than the branch of the preceding. Head coarsely densely punctate; eyes much less convex and less prominent than usual, separated across the front by four times their own width.

Prothorax subcampanulate, very nearly as long as the width across the middle; sides rounded in front, straight and parallel in the middle third, the hind angles strongly divergent; surface rather finely not closely punctate, the punctures separated by from one to two times their own diameters.

Elytra at base slightly wider than the distance across the base angles of the thorax; sides parallel in basal two-thirds; striæ feebly impressed, punctuation about as usual. Propleura sparsely finely punctate, polished. Tibiæ not sinuate.

Length 15.5 mm.; width 4 mm.

White Mts., Gila Co., Arizona, July 1-15, 1925 (Poling). A single male.

This is a very distinct species, separable at once from all others known by its coarsely punctate head and non-prominent eyes. In the present species and also in *lautus* the scutellum is minutely notched at tip; there is scarcely a trace of this notch in either *pretiosus* or *horni*.

Aplastus scabripennis n. sp.

Elongate, parallel, brown, head and elytra dull, thorax shining, pubescence grayish moderately conspicuous.

Head densely rather coarsely punctate, antennæ long, strongly serrate, the 8th joint attaining the tip of the hind angle of the thorax; joints 2-3 small, subequal, together two-thirds as long as the 4th.

Prothorax slightly wider at middle than its median length, sides straight and moderately diverging to the hind angles which are more strongly divergent and carinate; disk convex, median line feebly impressed, punctuation somewhat finer than on the head, rather sparse at middle, the punctures there separated by from one to two times their diameters, closer toward the margins. The sides are evidently though feebly margined.

Elytra nearly parallel sided, three times as long as wide, very feebly obsoletely striate, intervals densely scabrous punctate.

Last ventral segment one-half longer than the preceding, feebly sinuate each side of the apex which is narrowly subtruncate. Middle and hind tarsi distinctly longer than the tibiæ.

Length 16 mm.; width 3.9 mm.

California (Camp Nelson, Tulare Co., Aug. 28, 1913); a single male example.

By Horn's table this species is to be associated with *optatus*, from which it differs by the almost obsolete elytral striæ and the densely scabrous punctate and dull interspaces. In *optatus* the 3rd antennal joint though small is plainly longer and wider than the 4th; only very slightly so in the present species.

Aplastus piceicollis n. sp.

Form slender, head and pronotum piceous, elytra ferruginous brown, strongly shining throughout, the pubescence sparse and very fine.

Head closely strongly punctate; antennæ strongly serrate, 8th joint reaching tip of hind angle of thorax, 2nd joint very small, transverse, 3rd subtriangular, very nearly twice as long as the 2nd and distinctly longer than wide, the two together about two-thirds the length of the 4th joint.

Prothorax about one-seventh longer on the median line than the median width; sides straight, barely visibly diverging to the flaring hind angles which are strongly produced and finely carinate; front margin briefly sinuato-truncate at middle, thence straight and oblique to the front angles; disk finely sparsely punctate, median line obsoletely impressed; sides finely margined.

Elytra three and one-half times as long as wide, very slightly attenuate posteriorly, finely striate, intervals finely not densely punctate and shining.

Prosternum longitudinally obtusely carinate in posterior half. Last ventral segment barely visibly sinuate each side of a narrow apical truncation; legs slender, tarsi slightly longer than the tibiæ.

Length 15.5 mm.; width 3.5 mm.

California (Monache Meadows, Tulare Co., 8000-8300 ft., July 15-18, 1913); a single male collected by G. R. Pilate.

Allied to *optatus* by the margined sides of the prothorax but more slender, with longer 3rd antennal joint, and with the prothorax distinctly longer than wide. The dark color of the head and thorax may or may not prove constant and the same may be said of the prosternal carination.

Aplastus productus n. sp.

Moderately elongate, distinctly attenuate posteriorly, brownish ferruginous, moderately shining, finely pubescent.

Head closely rather coarsely punctate; antennæ moderately strongly serrate, 8th joint reaching the hind angle of the thorax, 2nd and 3rd joints very nearly equal, each wider than long, together about two-thirds as long as the 4th.

Prothorax about nine-tenths as long on the median line as the median width, sides nearly straight and moderately divergent, the hind angles relatively short and only slightly more diverging than the sides; punctuation fine, nearly evenly dispersed, the punctures separated by about twice their diameters as a rule; disk rather strongly evenly convex, sides finely margined.

Elytra not quite three times as long as wide, distinctly attenuate from the humeri, sides nearly straight as far as the apical fourth, striæ fine but distinctly impressed, intervals moderately punctate.

Prosternum not at all carinate; last ventral deeply sinuate each side of the apex which is produced to form a subtrapezoidal lobe nearly as long as wide and having its apex distinctly emarginate; middle and hind tarsi noticeably longer than the tibiæ.

Length 14.5 mm.; width 3.8 mm.

California. A single male from Fresno Co.

This species like the two preceding falls near *optatus* by Horn's table, but it differs conspicuously from all of these by the short hind angles of the thorax and the remarkable apical ventral process.

Aphricus tenuis n. sp.

Very elongate, parallel, dark fuscous brown, moderately shining, pubescence fine, short, grayish and not dense.

Antennæ long, filiform, attaining the apical third of the elytra, joints 2-3 small, the latter slightly longer, together about two-thirds as long as the 4th; 4-11 very gradually increasing in length and diminishing in width, nearly parallel sided, the 4th about two and one-half times as long as wide, the 11th about seven times as long as wide and two-thirds longer than the 4th. Front feebly concave, margin acute, narrow and only slightly reflexed, oblique at sides, subtruncate at middle, rather finely and not closely punctate; eyes moderate.

Prothorax scarcely wider than the head, one-fourth longer than wide, sides straight and parallel almost throughout, a little incurved at apex and with moderately divergent hind angles which are very finely feebly carinate; side margins fine and entire, gradually obliquely descending toward the front; surface very finely sparsely evenly punctate, integuments polished.

Elytra elongate, parallel, a little more than three times as long as wide, three and one-third times as long and not quite one-fourth wider than the thorax; punctate striate, the striæ scarcely impressed except slightly so at base, intervals sparsely finely punctate.

Prosternum and propleura finely sparsely punctate, metasternum and ventral segments more closely punctured, the terminal segment especially more densely so. The terminal segment is obliquely subsinuately narrowed through the greater part of its length, paler in color at apex which is narrowly subtruncate and clothed with more yellowish pubescence; it has a submarginal impression each side near the base.

Length 6-8.2 mm.; width 1.4-1.75 mm.

Described from a series of seven specimens taken in the Pinal Mts., Arizona, 5000 ft. (O. C. Poling collector).

There are no obvious secondary sexual characters in the series at hand, but one example, from the exposed genitalia is certainly a male, and it is highly probable that all are of this sex.

I am by no means entirely satisfied as to the propriety of referring this species to Aphricus, from the type (*A. californicus*) of which it differs in the following respects. Tarsal joints 1-4 decrease rapidly in length, the basal joint subequal to 2 and 3 united and joint 2 subequal to 3 and 4 united; in Aphricus joints 1 and 2 are subequal while 3 and 4 are only slightly shorter. In the present species the side margins of the thorax are distinct and entire, in Aphricus they are in great part obliterated. In the present species the middle coxæ are very narrowly separated and the metasternal process between them is very acute; in typical Aphricus the middle coxæ are more widely separated, the metasternal process wider and obtuse at tip. In this connection it should be remarked that the side margins of the prothorax may be either present or absent in Aplastus and that while *Aphricus luteipennis* agrees with *californicus* in tarsal structure and non-margined thorax, it has the more approximate middle coxæ and acute metasternal process of the present species. The mandibles in the present species are acute at tip nearly as in *californicus*, but with the tooth of the inner margin less remote from the tip. The prosternal lobe is extremely short and obtusely rounded, the prosternal sutures nearly straight, single, and not excavate in front, the coxal plates scarcely toothed at the insertion of the thighs, and the sixth ventral segment not visible, all as in *A. californicus*.

Cebrio speratus n. sp.

Moderately elongate, parallel, dark brown and somewhat shining above; antennæ, legs and body beneath rufo—to fulvo-testaceous. Head densely strongly punctate, labrum broadly angulate emarginate. Antennæ moderately serriform, passing the hind angles of the thorax by about four joints, 3rd joint slightly more than half as long as the 4th, median joints scarcely one-half longer than wide.

Prothorax at middle about one-fifth wider than the median length, sides feebly arcuate to nearly straight, converging slightly toward the front, lightly sinuate before the hind angles which are small and strongly divergent; surface rather finely punctate, the punctures distant on the average by their own diameters or a little more.

Elytra nearly parallel sided, four and one-half times as long and one-third wider than the thorax; striæ rather feebly impressed, the strial punctures not or with difficulty distinguishable from those of the closely punctate intervals.

Prosternal intercoxal process narrow or sublinear, last ventral segment evenly rounded at apex.

Length 12.5 to 14.5 mm.; width 3.6 to 4.2 mm.

Described from a series of twelve specimens from Hope, Arkansas (June 18—July, Miss Louis Knobel) and Winnfield, Louisiana (June 15, G. R. Pilate). The type is from the first named locality; all examples are males.

This species is allied to both *bicolor* and *antennatus*. From the former it differs in being generally smaller, with more finely and less closely punctured thorax, more feebly impressed elytral striæ, narrower prosternal process and unemarginate last ventral. Concerning a specimen sent to Mr. Schaeffer for comparison with his type of *antennatus*, he writes—"Differs from *antennatus* in being less elongate, the punctuation of the thorax finer and less close, the hind angles more strongly divaricate, the antennæ shorter with the joints less strongly produced apically."

MODIFICATION OF THE NEST-BUILDING HABITS OF POLISTES.

By Phil Rau,

Kirkwood, Mo.

The shape of the nests of *Polistes* is not determined by the iron-clad instincts of the builders. Under pressure of emergency, *Polistes* builds cell upon cell, regardless of the shape of the nest as a whole. One often finds elongated nests of *P. pallipes* (fig. 1.) that have been built in the space between two boards in a shed. The builder is obliged, if she is to use the chosen location, either to limit the size of her nest or modify it; she has proven herself capable of adapting her handiwork to new requirements.

Figures 2 and 3 show two nests of the same species, *P. pallipes*, that were built in the narrow space behind closed shutters; one was on an old building at Creve Coeur Lake, Mo. and the other at Clifton Terrace, Ill. In the nest in figure 2 where horizontal expansion was impossible, the wasps built a sky-scraper, piling tier upon tier of cells, all of these slanting upward toward the horizontal, whereas the normal cells fall vertically. The nest, illustrated in fig. 3, likewise adapted to narrow space, shows the same tendency in construction, but in this case some of the cells slant sufficiently toward the vertical to show that the workers were trying to give the larvæ homes which nearly approached the normal position. A third such nest had a dozen large cells built horizontally in a haphazard way on top.

Not only in *P. pallipes* do we see such digressions, but in *P. annularis* also. I have examined two large nests of *P. annularis*, where I found from three to five cells that were being fashioned about the roof at the base of the petiole. These, however, were not large, and in all probability merely showed the building instinct misdirected, *i. e.* the workers were probably adding paper pulp to strengthen the petiole and so far forgot themselves as to fashion cells at the wrong place. "Gross ist die Macht der Gewohnheit." Certainly *P. annularis*, in extending her nest, does not need to build skyward, for her nests are in the trees, where she has ample space wherein to expand normally.

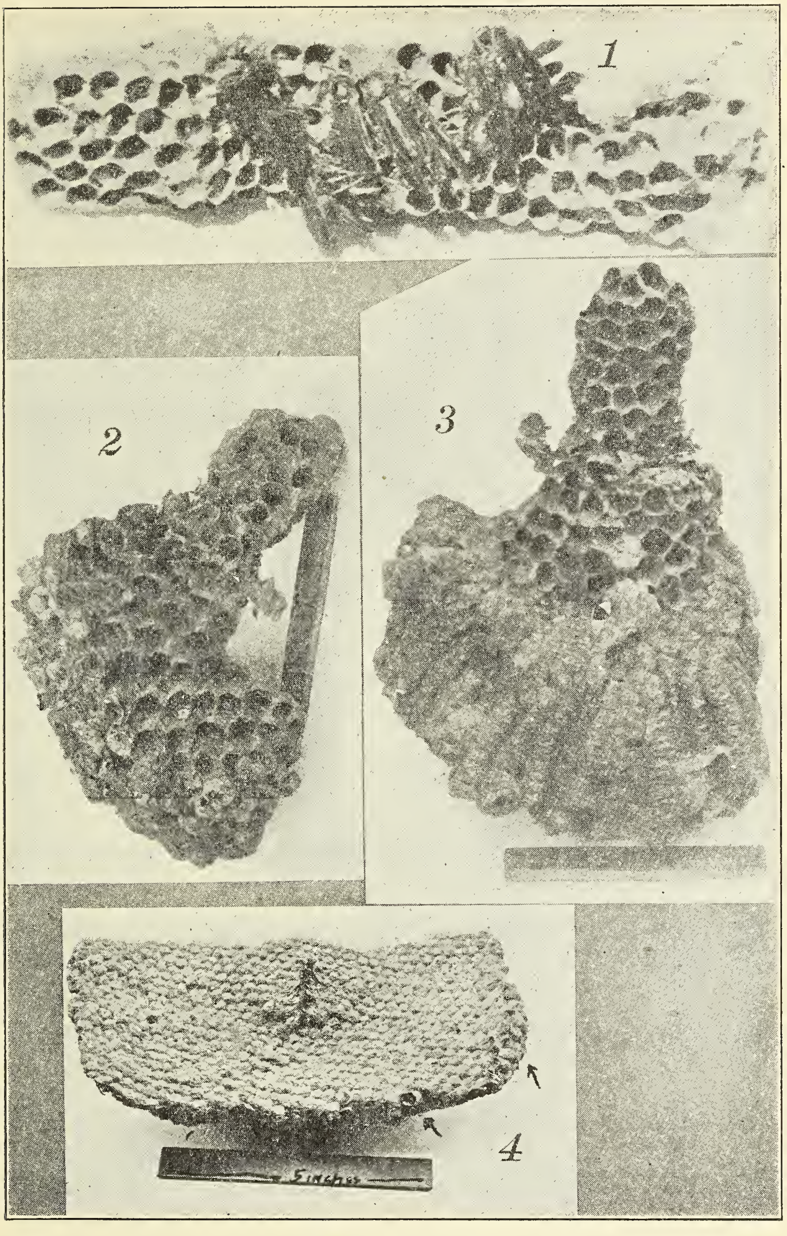
The *P. rubiginosis* nests were usually built in the dark space between the weatherboarding and the inside wall of an old house. One was also placed in a narrow space between two upright timbers, and as the nest grew to fill the entire space it took on the peculiar oblong shape. But the space was apparently not sufficient, for on the back of the nest a row of 10 cells (arrows in fig. 4) was begun. The shape of the normal nest is probably round with the petiole in the center. In this case, the petiole had not sufficient strength to hold the mass, and as the season neared its close, the nest fell and lodged on a joist below.

Thus, to the credit of at least some species of *Polistes*, let it be said that wasps do not yield to defeat when the nest has outgrown its quarters, but they make the best of the situation and continue building. Let it be said, too, to the discredit of some members of these species, that they have not the foresight to choose sites large enough to accomodate the growing family, but that too late they discover their cramped quarters.

These nests reveal the formation of a habit which may some day be developed with some degree of permanency. They show that the wasps have discovered, or stumbled upon, the fact that both sides of the wall or roof can, in emergency, be used to support cells. Alas! it is too much to hope that we may in our brief lifetime see the crystallization of a disgression, adaptation or new economy like this into a regular habit. That type of nest, *i. e.*, with cells attached to both sides of the main supporting-platform, thus making them open in opposite directions, is made by *Belonogaster junceus* of the tropics.

One small nest of a *P. pallipes* queen which differed from the normal in its method of attachment to its support was observed. It was only a quarter-inch below the roof of a railway shed, yet it was attached to a vertical timber; hence the petiole, which is usually vertical and straight, made a horizontal beginning and turned sharply downward elbow-wise. It is obvious that a nest could never attain any considerable size in that position.

Vespa builds combs in tiers and *Polistes* builds but a single



RAU—POLISTES

comb. One nest of *P. rubiginosis* was built a second year in the same site as the first, in the narrow space between two boards in an old refrigerator car. The result was that the second comb was attached to and below the first, giving the nest the appearance of the combs of *Vespa*. This was merely an accident due to the narrowness of the space, combined with the persistence of the *rubiginosus* queens in returning to their old home in the spring. But it is just by such accidents that new habits get a foot-hold. In another place, I found a nest in the narrow space between the inner and outer walls of a barn. Here one tier of cells was built below the other, much after the manner of comb-building in tiers by the Vespine wasps. This may point to the rise and evolution of the habit of arranging combs in tiers. Who knows but that *Vespa* at one time may have built single combs as do *Polistes* to-day, and who knows further but that a similar accident of crowding may have caused her to build tier below tier until to-day we have this practice fixed in the habits of the *Vespa*?

Explanation of plate IV.

Fig. 1. *Polistes annularis* seeking shelter from the cold in an old nest of *Polistes pallipes*

Fig. 2. Nest of *Polistes pallipes* built in a tight corner.

Fig. 3. A sky-scraper nest of *Pollistes pallipes.*

Fig. 4. Nest of *Polistes rubiginosus.*

THE RECONSTRUCTION OF DESTROYED NESTS BY POLISTES WASPS.

By Phil Rau,

Kirkwood, Mo.

Eight nests of *P. pallipes* and one of *P. variatus* were removed from the wall of a shed on July 21. The adult wasps were driven away when the nests were knocked down, but soon all of them settled again upon the old location of their homes. After only three days I found that each group had reconstructed its nest on the identical spot where the first one had been removed. Each of these nests already contained from 14 to 22 cells, and almost every cell contained an egg. Here, in case of hasty construction to replace a lost population, we see the economy in the method of building many shallow cells at first instead of few very deep cells. In the one nest of *variatus*, having seven adults, there were 22 cells. This shows that complete families, when disturbed, quickly rebuild, but notes elsewhere show that queens seldom do.

On June 15 and 16, when only queens were on the nests, all the station sheds along the railroad tracks were repainted; in the process, six new *P. pallipes* nests were knocked down at the station of Wickes, but not one was rebuilt that summer.

At Cliff Gave, on June 29th, I found a queen mother working on a newly begun nest with only six shallow cells. This tiny nest was unusual at this time of year, when all the other nests already had workers; but it showed at least that one queen did not lose courage in a calamity, but had the impulse to build anew.

A *P. pallipes* nest was knocked down from the ceiling of an open pavilion at Meramec Highlands in the latter part of July; on August 6 the wasps were busily rebuilding. I got the nest, and found it to be composed of shallow cells of less than one-third normal depth, 30 in all, and all but one containing an egg. Twenty of the cells contained also from one to three drops of various sizes of the transparent, jelly-like material described elsewhere. It is interesting to note that they made 30 cells one-third size instead of 10 full-sized cells, thereby giving the eggs the advantage of much-needed time at this late season, while the paper in all could be added from time to time as it was needed. This method is commonly followed by queens also.

On August 8, I took a nest and left four workers behind. The nest was rebuilt in the identical spot, and during the eight days following, twelve shallow cells were constructed; at the end of that time, each had an egg, and in the angle opposite the egg was a drop or two of clear honey. This seems an excellent accomplishment for four individuals in eight days.

One of these colonies of *P. pallipes* even made a third nest, when the second was taken down for study, but not on the identical spot; the third nest was placed two feet distant from the old site.

TROPHALLAXIS IN *POLISTES PALLIPES*.

By Phil Rau

Kirkwood, Mo.

Wheeler,[1] in his paper on the origin of social habits, has given us some very interesting data on the mutualistic relationship between the mother or adult workers of insects and their larval brood. His data show that the relationship is clearly cooperative for ants, and he gathers from various sources similar data for other insects, and coins the word *trophallaxis* to encompass this phenomenon.

In the orphan nests of *Polistes pallipes* we have often seen behavior substantiating Dr. Wheeler's data, in a species where this type of behavior has not yet been recorded. The details more than substantiate the observations on other insects, because the behavior we record can be only purely instinctive, since the observations were made on orphan colonies, with the queen and older workers gone before these individuals had come to light, and hence there was no possibility for the habits to be learned from others.

On two occasions, I noticed that the foster-queen, just after feeding the larvæ, would stand on the nest and make a prolonged grating noise by rapidly vibrating her body, wings and legs. The noise was one which I had never before heard, and which is probably a signal to the larva, for immediately after this performance she would poke her head into each of the cells. I suspect that by this process she obtained a drink of saliva, but I have no proof of this except that her mouth parts were protruding and in motion when she withdrew her head. I suspected that she was going in for this purpose, and put my eye close enough to see when she came out of one cell; a large, glistening drop of liquid was in her mouth, which she soon swallowed. My

[1]Wheeler, W. M. A study of some ant larvæ, with a consideration of the origin and meaning of the social habit among insects. Proc. Am. Phil. Soc. **57**: 293-343. 1918.

next move was to see if this liquid was used by the adult for food, or if it was collected, a drop at a time, and placed with the eggs in other new cells. Wheeler says that the females feed the young in exchange for the saliva which they emit at the time of feeding, but here we saw the saliva emitted long after they had been fed. I wonder if a worker can get a drink whenever it taps the head of a larva just as I can cause a large drop to come by teasing it with the head of a pin.

On one occasion two foster queens, after feeding the larvæ, went into the cells after sounding a noisy warning, evidently for the purpose of obtaining saliva. I watched very closely, and this time was able to see the method. The queen (so she will henceforth be called) stood on a nest with her head at the opening of a cell and her antennæ inside, probably touching the larva. Her head was then rapidly rammed or beaten against the wall of the cell; the whole body was in motion, seeming to actuate the head, and this rapid vibration of the head against the paper wall caused the strange sound. In one cell this drumming was repeated six times, and the duration of each round of it was one-fourth to one-half minute. After each trial the queen thrust her head into the cell, but obtained no saliva. I too could peer in by coming close beneath the nest, and there I found that after each serenade by the queen, the mouthparts of the larva were in agitated motion as if making effort, and a very small, glistening drop appeared on the mouth. In all probability the amount was not sufficient to satisfy the demands of the queen, for only after the sixth trial did she thrust her head far in and keep it there. These noises must have stimulated some others near by, for they too responded with a glistening drop in the mouth; into one of these cells she entered without the preliminary music. In most of the others, however, the warning was given but once. The queen's antennæ probably also acted as a stimulus, but her body always obstructed my view at that moment so I could not clearly see this. This first foster-queen had no exclusive patent rights on this scheme, for the second one used precisely the same methods.

This fact that the honey-dew, coming from the mouths of the larvæ, is lapped up and relished by the workers, is not new, but has been recorded for other species of *Polistes* and other insects. Janet was able to prove in 1903 that the secretion is a product of the salivary or the spinning glands, and that it flows from an opening at the base of the labium. This act as I have observed it in orphan colonies must have been purely instinctive, since the individuals certainly had never been taught this trick, and the larvæ responded readily to the noisy tapping. They freely gave up this honey-dew also without associating this action with the noisy vibrations, for teasing the mouth-parts with a pin-head caused the same response. It is quite likely that, as Wheeler has so ably shown, this behavior is the cause of the beginning of the social habit. There is, however, another phase to the condition of trophallaxis, in the hypothesis that it might be absolutely necessary for the larva to rid itself of the substance that the workers so willingly take. In larvæ of this and various other species, there is no provision made for ridding the body of excretory products. During the period of feeding, the larvæ, being confined in close quarters, have no place for refuse. In most of the *Trypoxylon* wasps and in mud-daubing wasps, *Sceliphron cœmentarium*, this excretory material is passed from the body in one mass, just before pupation; it is spread and moulded to form a shell or cocoon covering the body. In *Polistes* cells, after the adults have emerged, there always remains up against the roof of the cell, a hard reddish mass of chalky material which is the sum total of the excretory products accumulated during the life of the larva. The thought comes to me, if the solid excretory matter leaves the body in that form what becomes of the liquid excreta? In the plant-lice, we know that the honey-dew, so much relished by the ants, is waste matter; why should that emitted by *P. pallipes* larvæ not likewise be excretory material? The only difference at once apparent is that one insect is relieved by delivery of this liquid from the posterior end, and the other by way of the anterior aperture of the body—a small digression when one considers how Nature disregards the method to gain her ends economically.

The question still remains, probably never to be solved, whether the *Polistes* nurse feeds the larvæ in order to get the honey-dew, or whether she relieves the larvæ of their moisture to save their lives and has in time acquired a taste for it, but one can feel amply sure that the larva does not give this honey-dew because it loves the nurse or because it purposes to wheedle its keeper for a good meal. The larva at the slightest stimulus gives up its drop, perhaps only because it wants to rid itself of so much irritating material.

A NEW SPECIES OF CONICEROMYIA FROM CUBA (DIPTERA; PHORIDÆ.)[1]

By Charles T. Brues.

In 1923 Borgemeier described from South America a remarkable genus of Phoridæ to which he gave the name of Coniceromyia. It is characterized by the extremely elongated, pointed antennæ of the male which bear an apical arista. The male also has the front tibiæ remarkably modified in the type species, with a large bristle near the base followed by a deep emargination of the tibia. Later ('24) he added two other species, one of which has the front tarsi much flattened in the male, with a long, finger-like process extending from the edge of the basal joint. Furthermore, the costal vein is strongly thickened in both sexes.

Recently while in Cuba at the Harvard Biological Laboratory, I had an opportunity to visit the San Juan Mountains, which lie to the southeast of Soledad where the laboratory is located. In the material collected there I find a species of Coniceromyia, represented by both sexes, quite different from any of the South American forms.

It may be distinguished as follows:

Key to the Species of Coniceromyia.

1. Anterior tibia with a series of three large stout bristles on the basal half; front tarsi of male greatly widened, the first joint with a long slender projection from its edge near apex (Fig. 1, *b*). . . . . *C. cubensis* sp. nov.
   Anterior tibia with only one large bristle, placed before the middle, or with two in this position... . . . . 2.
2. Thorax dark fuscous in color, anterior tibia with a series of two bristles before the middle. . . . . . . *C. fusca* Borgm.
   Thorax yellowish or ferruginous, anterior tibia with a single large bristle before the middle, sometimes with a much smaller one immediately next to it . . .. 3.

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, no. 300

3. Dorsal face of anterior tibia of the male with a series of seven small bristles forming a series between the large bristle and the apex; first tarsal joint with a long slender projection from its edge. . . . . *C. anacleti* Borgm.
   Dorsal surface of anterior tibia of male without a series of bristles in this position. . . . . *C. epicantha* Borgm.

Coniceromyia cubensis sp. nov.

♂ Length 2.0 mm. Black, including the antennæ; four posterior femora piceous; front legs and all tibiæ and tarsi yel-

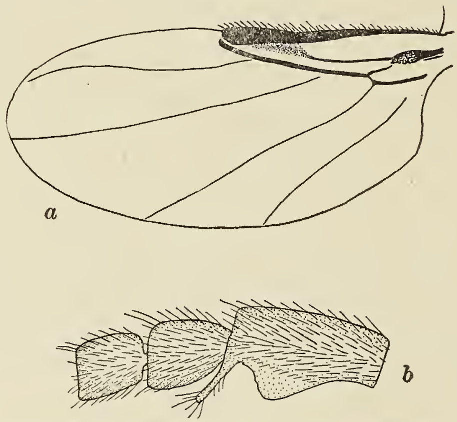


Fig. 1. *Coniceromyia cubensis* sp. nov. *a*, wing; *b*, base of front tarsus.

lowish brown; halteres white; palpi yellow. Wings hyaline, with a brownish tinge, stronger toward the costa, the costa at extreme base and most of the first vein yellow. Front shining, one-fourth broader than high; with a fine, clearly impressed median line; ocelli on a raised triangle. Bristles large and strong; two post-antennals very close together, reclinate and slightly divergent, about half as large as the other bristles; lower frontal series of four equidistant, their bases forming a line which curves gently downwards medially; upper frontal row forming a similarly curved series, the median pair a little closer to one another than to the lateral bristle; they are placed high on the front, so that the median pair form an equilateral triangle with the anterior ocellus; ocellar row of four. Eyes distinctly pubescent; postocular cilia strong. Cheek with three, large, downwardly directed macrochætæ; palpi with moderately short bristles. Third antennal joint pyriform, pointed at tip, three-fourths as long as the eye; arista terminal, as long as the antenna. Mesonotum shining; with one pair of dorsocentral macrochætæ. Scutellum nearly half as long as wide, with four marginal bristles; one bristle above and several below the prothoracic spiracle. Mesopleura entirely bare. Front tibiæ simple, not notched, nor emarginate, with a series of three large bristles, one at the basal fifth, another at the second fifth and the third just beyond the middle; all tarsal joints widened, the first with a triangular extension along the inner edge and a slender, projecting process at the tip (Fig. 1, *b*) as in *C. anacleti* Borgm. Middle tibia with a pair of very large bristles near the basal fourth on the posterior surface and another, not quite so large externally before the tip. Hind tibia with one large bristle just before the middle behind, one externally at apical fourth and three terminal spurs. Abdomen large, dull above, with none of the segments lengthened. Costa half as long as the wing, (Fig. 1, *a*) its bristles very short and closely placed, very slender at base gradually thickened beyond and very broad at apex; first vein thickened just before tip; third vein stout, of even thickness; fourth vein unusually close to the costal margin, slightly curved at base; fifth, sixth and seventh veins nearly straight.

Female. Length 1.3 mm. Similar to the male, except that the antennæ are small, oval, with dorsal arista and the fore tarsi are simple, with the second to fifth joints slightly broadened.

Types from the San Juan Mts. near San Blas, Province of Santa Clara, Cuba, February 1927.

The female is very much smaller than the male, but this undoubtedly represents only individual variation as there are no morphological differences aside from the secondary sexual characters of the antennæ and front tarsi.

As indicated in the preceding key, this species is distinguishable from the three known South American species by the presence of a series of three large bristles on the anterior tibia; from *C. anacleti* and *C. epicantha* by its dark color, and from *C. fusca* and *C. epicantha* by the appendage of the first tarsal joint of the front leg. This peculiar structure is present in *C. anacleti*.

SOME CUBAN PHORIDÆ WHICH VISIT THE FLOWERS OF *ARISTOLOCHIA ELEGANS*.

By Charles T. Brues.

During a stay at the Harvard Biological Station at Soledad, Cuba some time ago, Mr. Robert M. Grey, the Curator of the Botanical Garden showed me a beautiful group of Aristolochia vines which are grown in one corner of the garden near his house. He told me that they were regularly visited by small Diptera which he thought were Phoridæ and since I have been interested in the members of this family for many years we searched in the few flowers present at that time in hopes of finding some flies. None were to be found, but Mr. Grey promised to send me some at the season when the Aristolochias bloom in greater profusion. He did not forget his promise and I received recently a series of specimens which include two common species of West Indian Phoridæ. These are *Dohrniphora venusta* Loew and *Aphiochæta scalaris* Loew, both present in apparently about equal numbers.

It is of course well known that various small insects, particularly Diptera, enter the flowers of Aristolochia through the corolla tube which in some species is lined with reflexed hairs that prevent the escape of the visitors until the withering of stigmas and the opening of the anthers. Then the barricade of hairs withers likewise and the insects escape. As the flowers are protogynous, cross fertilization is affected by the first entrance of the insects if they come from another flower, and they later leave with pollen acquired toward the end of their imprisonment.

Several observers have recorded the insect visitors of a number of species of Aristolochia (Spengel, Hildebrand, Delpino, Correns, Carr[1]) and find that most of the insects are small Diptera of various kinds. Verrall (British Flies, vol. 1, p. 47) noted in England that *Aristolochia clematitis* is visited most commonly by gall midges (Itonididæ), although Müller and Delpino found

[1]References to many earlier publications are contained in Knuth's well known Blütenbiologie vol. 2, pt 2, pp. 366–372; Carr's account is in the Entomologist's Monthly Magazine, vol. 60 (1924) p. 258).

Ceratopogonidæ, Chironomidæ, Scatopsidæ and Oscinidæ in the flowers. These families are represented in the flowers of other species of Aristolochia quite generally and in several species Phoridæ have been found. The specific names of the Phorids are unfortunately not reliable in any of these old accounts.

Carr found, however, in *Aristolochia sipho* a Phorid, *Aphiochæta dahli* Becker commonly present together with several other small flies of other families. All the flies sent by Mr. Grey from the Cuban flowers of *Aristolochia elegans* are Phoridæ, as indicated above.

A NEW SPECIES OF THAUMATOMYRMEX FROM CUBA.[1]

By Wm. S. Creighton.

The genus *Thaumatomyrmex* has hitherto been known from two species, *T. mutilatus* Mayr and *T. ferox* Mann. *T. mutilatus*, the type of the genus, was first described by Mayr in 1877 from material collected in Santa Catharina, Brazil. Unfortunately there are no field notes accompanying the description, even the collectors name having been omitted. Although Mayr was the first to describe this bizarre genus it seems altogether likely that the credit for its original discovery should go to Von Ihering. This worker began his observations and collecting in Rio Grande do Sul in 1880, seven years prior to Mayr's description. Von Ihering's publication appeared in 1894 and in it Emery, who prepared the taxonomic section, figured for the first time the head of *T. mutilatus*. I have been unable to find any references to this ant, in Von Ihering's rather voluminous field notes which form the major part of the paper. In 1920 Dr. W. M. Mann while collecting in Honduras, took two workers of a second species, which he described two years later as *T. ferox*. These specimens were found "in a depression in a half rotten log near a stream in the forest" (San Juan Pueblo).

The discovery of a third species in Cuba is of interest since it definitely places the genus with a number of genera known to be indigenous to the Antilles and to the tropical portions of the continent as well. The importance of a rare ant such as *Thaumatomyrmex* in the study of distribution will be obvious to anyone who has been confronted by the ever increasing problem of "tramp" species. Additional interest lies in the circumstances under which the new species was secured. These, while by no means conclusive, at least offer a hint as to the habits of the ants of this genus. In the fall of 1927 the writer enjoyed the privilege of spending two months at the Harvard Tropical Research

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 296.

Laboratory at Soledad, Cuba. Toward the end of that period a trip was made to the Mina Carlota, a pyrites mine in the Sierras to the south of Cumanyagua. The country in the vicinity of the mine is characteristic of the Cuban mountains; heavily wooded and excessively steep slopes with numerous limestone outcrops. The shells of land snails, always in evidence wherever the limestone occurs, were present in the greatest abundance, there being certain areas in which the ground was literally carpeted with the empty shells. Mr. W. J. Clench, Curator of Conchology of the Museum of Comparative Zoology, made a large collection of these, and on the return of the party to Soledad the new *Thaumatomyrmex* was discovered among the shells which had been spread out for sorting. Only one specimen was found and since the time was too short to permit a return to the Mina Carlota, no search could be made for other specimens. It may be that the occurrence of the ant in the snail shells was entirely fortuitous and yet it does not seem unlikely that the extraordinary mandibles are in some way connected with a diet of snails. At least there is an analogy in the pronounced, though less striking, modification of the mandibles of certain snail-eating beetles of the genus *Cychrus*.

Thaumatomyrmex cochlearis sp. nov.

Worker. Length: 4 mm.

Head subquadrate, plainly longer than broad, the occiput very feebly impressed in the middle; the sides behind the eyes somewhat converging toward the occiput; the two prolongations of the genæ anterior to the eyes strongly divergent, the maximum width of the head occurring at the insertion of the mandibles. The eyes large and convex, composed of about fifty very distinct, coarse facets. Antennal lobes prominent, ending in front in distinct angles. Antennal scapes stout, increasing in thickness throughout their anterior half, their tips just reaching the occipital border. First funicular joint slightly longer than the succeeding two together; joints 2-7 distinctly transverse, the following three increasing in length; the terminal joint approximately as long as the four preceeding joints together.

Mandibles composed of a short basal portion from which project three long spines. Outermost spine evenly curved and tapering towards its tip which just reaches the opposite side of the head when the mandibles are retracted Median spine less curved and about two thirds as long as the outermost. Innermost spine straight, one third as long as the outermost. Clypeus slightly concave. Prothorax, seen from above, with strongly convex sides, considerably broader than the remainder of the thorax and separated from it by an impressed suture; in profile

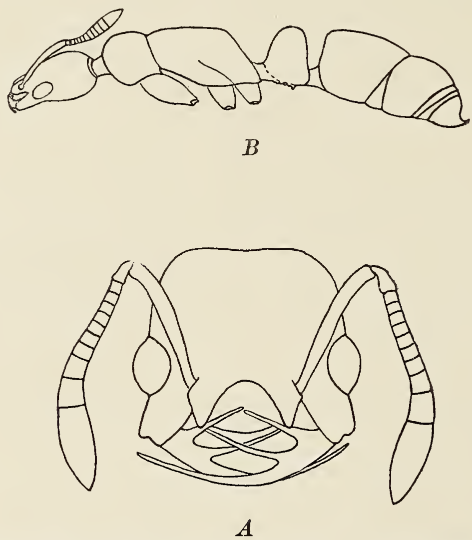


Fig. 1. *Thaumatomyrmex cochlearis* sp. nov. worker. *A*, dorsal view of head; *B*, profile view.

subquadrate, slightly convex above. Mesonotum greatly reduced, barely one tenth as long as the pronotum. Epinotum about one and one half times as long as the pronotum, its basal face, in profile, feebly convex, much longer than the declivious face from which it is separated by a well marked angle. Petiole, seen from above, trapezoidal, widest behind, slightly wider than the epinotum; in profile slightly higher than the epinotum, the summit convex, passing by a curve to the somewhat slanting anterior face and more abruptly to the almost perpendicular posterior face. The lower surface with a serrate lamina which ends posteriorly in a blunt tooth. Gaster large with a flat, perpendicular anterior face; constriction not pronounced; sting short and stout.

Head with numerous fairly coarse punctures interspersed with delicate striæ which together with the punctures give it a submatte appearance. Clypeus and dorsal portions of the forward-projecting lobes more plainly striate, without punctures. Thorax more shining, punctures somewhat sparser, the striæ confined to the sides of the epinotum. Punctuation of the petiole as in the thorax, without striæ. Abdomen much more shining, the punctures noticeably sparser.

Hairs long, brownish yellow. Sparse on the head, somewhat more numerous on the thorax and petiole, abundant on the gaster. Those on the appendages short, fine and appressed.

Piceous black; mandibles, antennæ, frontal lobes, legs and the tip of the gaster brownish yellow.

Mina Carlota, Cuba. December 2, 1927.

Through the courtesy of Dr. W. M. Wheeler I have been able to compare the new species with a cotype of *T. ferox* Mann. Mayr's description together with Emery's figures allow a fairly satisfactory comparison with *T. mutilatus.* The new species appears to be intermediate in structure between the two, although sufficiently distinct from either to amply justify its specific status. The head of *T. cochlearis* is plainly longer than in *ferox* but shows a similar dilation anterior to the eyes, a condition which is not present in *mutilatus.* The occipital angles are distinctly more acute in the new species giving the head a more quadrate appearance than in either of the previously described forms. The mandibles of *cochlearis* are similar to those of *ferox* but the terminal spine is shorter and the median spine feebly arcuate rather than sinuate. Both *cochlearis* and *ferox* may be separated from *mutilatus* by the absence of the rudimentary fourth spine at the base of the third. *Cochlearis* further differs from *ferox* in the longer basal face of the epinotum, the shorter mesonotum the noticeably narrower petiole and the very different sculpture. In this last it appears to approach *mutilatus* in which the sculpture is even more pronounced.

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1911 Genera Insectorum, Plate 2, Fig. 5, 5b.

SOME CORDIA AND TRIPLARIS INSECTS.

Owing to unavoidable delay in the preparation of a comprehensive paper on the myrmecophytes of the Neotropical Region and their insect tenants, it has seemed advisable to publish at this time three short papers kindly contributed by Mr. H. S. Barber, Dr. W. M. Mann and Prof. T. D. A. Cockerell on some of the undescribed forms belonging to the complicated biocœnoses which center about the peculiar ant-trees, *Cordia alliodora* Ruiz and Pavon and *Triplaris americana* L.

W. M. Wheeler.

I. A NEW BOLIVIAN SILVANID BEETLE FROM THE MYRMECODOMATIA OF CORDIA.

By H. S. Barber,

Bureau of Entomology, Washington, D. C.

Since Dr. Wheeler (Zoologica Vol. 3 pp. 35-134) described the remarkable biological relationships between *Coccidotrophus socialis* Schwarz and Barber and mealy-bugs of the genus Pseudococcus in the myrmecodomatia of *Tachigalia paniculata* Aubl., Dr. W. M. Mann has discovered a second species of Coccidotrophus in Bolivia, in the hollow swellings at the forking of the twigs of a different ant-sheltering tree, *Cordia alliodora* Ruiz and Pavon. The beetle must have been living under adverse conditions, since it was encountered only once among a great many of the hollow swellings which were opened, but according to Dr. Mann, it was attending Coccids as described by Wheeler for the species from British Guiana.

Coccidotrophus cordiæ sp. nov.

Similar to *C. socialis* but larger and more robust: head, pronotum and elytra relatively much broader; antennal club broader.

Length 4.3-4.9 mm., width 0.8-0.9 mm. Habitat, Bolivia.

Head transverse; front feebly convex, shining, densely, finely, shallowly punctulate, the punctures becoming microscopically ocellated and more densely placed posteriorly and laterally. Pronotum seven-eighths as wide as long, widest at the prominent anterior angles, five-sixths as wide at base, surface transversely convex, finely punctate, median line impunctate. Scutellum large, twice as wide as long, one-fifth as wide as elytra, surface shining with transverse postmedian elevated line and posterior marginal stria. Elytra as wide as pronotum at anterior angles, three times as long as wide, shining,punctate-striate, intervals impunctate, apices separately rounded. Male with last sternite longitudinally broadly concave and strongly tumid at sides near apex, hind femora armed with tooth at middle of upper carina of inner edge: female with depressed and elevated areas of last sternite more feeble.

Type, allotype, and one paratype No. 26488, U. S. N. M.

Described from a male and two females collected with scale insects in hollow swellings at fork of twigs of *Cordia alliodora* Ruiz and Pavon (probably var. *boliviana* Chodat and Vischer) near Huachi, on the Rio Beni, approximately latitude 15°40′ south longitude 67°20′ west.

II. A NEW MICRODON FROM PANAMA.

By Wm. M. Mann,

National Zoological Park, Washington, D. C.

Dr. Wheeler has recently given me two pairs of an interesting *Microdon* from Panama. The species is apparently new and a description follows.

Microdon wheeleri, new species.

Female. Length 8 mm.

Form rather long and slender. Color testaceous, with the ocellar tubercle, pronotum, sides of vertex, metanotum and tip of abdomen strongly infuscated. Shining, coarsely and abundantly punctate. Everywhere with long golden-yellow semirecumbent pile, which at the anterior border of head is thicker and forms a brush.

Frons about twice as long as broad, broadest a little below antennal insertions, sides slightly convergent anteriorly, anterior border broadly concave. Vertex separated from frons by a very feeble transverse impression, strongly convex, at middle with a large, elongate tubercle bluntly projecting in front, bearing the ocelli. Eyes hairless. First antennal joint slender, as long as second and third together, second joint subcampanulate and about half as long as the third which is suboval and broadly rounded at apex; arista two-thirds as long as third joint. Antennal insertions enclosed by a circular elevated carina, which above projects horizontally and is angulately produced at middle. Scutellum broadly rounded at apex, excised at sides and bispinose, the anterior spine slender and acute, the posterior broad and truncate at tip. First abdominal segment twice as broad as the thorax, remainder of abdomen elongate and strongly narrowed apically. Posterior tibiæ at apex and the tarsi strongly incrassate, with a heavy brush of coarse, black setæ on outer border. Wings yellow, clouded apically, veins brown. Halteres yellow.

Male. Black, with black pilosity, except the terminal joint of antennæ, the frons, apical half of abdomen, front and middle tibiæ and all the tarsi, which are reddish brown, with yellow hairs.

Transverse impression between frons and vertex strongly impressed. Anterior border of frons narrowly and more deeply excised than in the female. Scutellum at sides with subequal spines on either side of the convexity.

Pupal case. Length 6.5-7 mm., width 2.75-3 mm.

Yellowish, transparent, not reticulate. Subcylindrical. Anterior spiracles slender, slightly arcuate, about as long as their distance apart at base, black in color, with coarse, unequal, fossulate punctures and, on apical third, several circular impressions. Posterior spiracle rugulose basally and rather strongly carinate.

Red Tank, Canal Zone, Panama. March 28, 1923.

Type and allotype—Cat. No. 26478, U. S. N. M.

Described from two females and two males, reared by Dr. Wheeler from pupæ collected in nests of *Crematogaster* (*Orthocrema*) *brevispinosa* Mayr. subsp. *tumulifera* Forel in *Cordia alliodora* Ruiz and Pavon.

The long and slender puparia, without reticulations and with their heavily fossulate anterior spiracles are very different from any other Microdon pupæ I have seen.

The adults are remarkable for their slender form, elongate front, the large ocellar tubercle and the laterally excised scutellum. The pile is unusually coarse, especially at the front of head and on the thorax, and is mostly a rich golden yellow. The coloration, as described for the female, may not be fully mature. Dr. Wheeler tells me that all the specimens were yellow at the time of emergence and darkened gradually.

III. BEES COLLECTED BY DR. W. M. WHEELER AT FLOWERS OF TRIPLARIS.

By T. D. A. Cockerell.

University of Colorado, Boulder, Colo.

The bees collected by Dr. Wheeler at *Triplaris americana* flowers in the Panama Canal Zone include seven species, which may be readily separated as follows:

Eyes hairy; three submarginal cells. 1

Eyes not hairy, two submarginal cells, or the second evanescent. 2

1. Abdomen mainly dark (Fort Clayton, Feb. 28, two workers at *Triplaris*). *Apis mellifera* Linnæus.

   Abdomen with basal portion fulvous (Balboa, March 27, one worker at *Triplaris*). . *Apis mellifera* var. *ligustica* Spinola,

2. Two submarginal cells, bounded by strong dark veins; anterior tarsi (male) with a hollowed boat-shaped structure (♀ would have ventral scopa)........................
Megachile poculifera Cockerell

Second submarginal cell bordered by pale or evanescent veins; no such modification of anterior tarsi.................3.

3. Comparatively large robust bees; abdomen banded with orange; head black..................................4.

Small bees; abdomen not banded with orange or head red. 5.

4. First abdominal segment with a continuous orange band...
Melipona fulvipes triplaridis Cockerell.

First abdominal segment with two orange spots...............
Melipona orbignyi phenax Cockerell.

5. Head red, mainly black on vertex; scutellum red.........
Trigona pectoralis panamensis Cockerell.

Head black..6.

6. Clypeus with two reddish bars on disc; scape largely dark; larger species. (Three workers at *Triplaris*, Balboa, March 26)................*Trigona cupira* F. Smith...

Clypeus without reddish bars on disc; scape red; smaller species (Eight workers at *Triplaris*, Balboa, March 26)...
Nannotrigona testaceicornis (Lepeletier)

Melipona fulvipes triplaridis Cockerell, 1925.

Worker. A little larger than usual, with the orange abdominal bands broader. Triangular supraclypeal mark, line down middle of clypeus, stripe at each lower corner of clypeus and narrow band along orbits extending about half-way up front, all cream-color; scutellum entirely black except a yellow transverse line at apex; wings longer and more dusky; femora and tibiæ black; middle basitarsi black, and hind ones except apical corner; apex of abdomen with much white hair. Two workers; at *Triplaris*, Balboa, March 26-27.

A distinct race of the wide-spread *M. fulvipes* Guérin, common in Central America and the West Indies.

Melipona orbignyi phenax Cockerell.

Found by A. H. Jennings at Las Cascadas, C. Z. Dr. Wheeler obtained three males and four workers at *Triplaris*, Balboa, March 26-27. He also took seven workers at Ancon; five are labelled "on Cordia." The worker has a dark clypeus as in typical *orbignyi*. Typical *M. orbignyi* Guérin comes from the southern parts of tropical South America.

Trigona pectoralis Dalla Torre, race **panamensis** Cockerell.

Four workers at *Triplaris*; Balboa, March 26-27. The specimens belong to the race or subspecies *panamensis*, having the hind tibiæ fringed with dark hair. The U. S. National Museum has typical *T. pectoralis* from Mexico, D. F.

Megachile poculifera Cockerell.

Two males at *Triplaris*, Balboa, March 27. A characteristic feature of this species is the tooth on under side of middle femur in the male. In the Brazilian *M. curvipes* F. Smith, it is the hind femur that carries the tooth.

M. poculifera is evidently widely distributed; four males are before me, collected at Guaymas, Mexico in April (E. P. Van Duzee). The original type was labelled Mexico (Baker 1785). Baker's note-book appears to have been lost, but it is fortunately known (see original description of *Prosopis crenulata* Ckll., 1905) that 1785 signifies that it was collected by H. H. Hyde at Medellin, State of Vera Cruz, Mexico.

The Triplaris referred to above is *T. americana*, and the Cordia is *C. alliodora*.

BEES COLLECTED BY NATHAN BANKS IN THE VICINITY OF THE PANAMA CANAL.

By T. D. A. Cockerell.

About one-half of the species collected are as follows:

Melipona orbignyi phenax (Cockerell)

Bella Vista, Aug. 7. I now conclude that *M. orbignyi jenningsi* Ckll. was described from the male of *M. phenax*, the latter (from Ecuador) having priority of place.

Melipona fulvipes triplaridis Cockerell

Barro Colorado, Aug. 2. Larger and more robust than the type of *triplaridis*, but otherwise the same.

Euglossa piliventris imperialis Cockerell

Barro Colorado, Aug. 15. Male

Euglossa cordata (Linnæus)

Barro Colorado, June 20, July 25, Aug. 2

Centris pœcila Lepeletier

Red Tank, June 30. Male. Gribodo (1893) described the male of *C. pœcila* from Panama.

Centris tarsata Smith

Barro Colorado, July 24. Female. Agrees with one from Guatemala. Friese considers it a form of *C. lanipes* (Fabricius).

Centris inermis Friese

Red Tank, June 30. Female.

Exomalopsis zexmeniæ Cockerell

Mt. Hope, July 8. Female *E. paitensis* Ckll., 1926, from Peru, is perhaps too closely allied to *E. zexmeniæ* and is probably to be considered only a southern race. Northward (Pt. Isabel, Texas) *E. zexmaniæ* has dark hair behind ocelli, but the Panama form has it very pale reddish. In *E. paitensis* this hair is creamy white.

Melissodes tepaneca panamensis subsp. n.

Female (type). Size and appearance of *M. tepaneca* Cresson, but thorax above with very bright fox-red hair, the disc of mesothorax with a large patch of short black hair, not reaching sides. Head very broad; eyes grey or green (doubtless green in life); clypeus densely rugosopunctate; face and cheeks with dull white hair; some long black hairs behind ocelli, and back of this, the occiput has bright fulvous hair; flagellum bright ferruginous beneath except at base; tegulæ clear ferruginous; wings dusky; lower part of pleura in front with sooty hair; legs with fulvous hair, black on anterior basitarsi in front; scopa of hind legs large; bright ferruginous hair on inner side of hind tarsi; abdomen with dense fulvous bands, second segment with bands at base and middle; fourth with black hair at extreme base, and a little in middle apically; fifth with all hair black except at extreme sides, sixth with black. There is black hair on outer side of middle tibiæ apically, and around hind knee-plate. Male. The single male with the same data, might well pass as *M. tepaneca*. Clypeus lemon yellow; labrum and base of mandibles cream-color; antennæ very long, flagellum bright ferruginous beneath; hair of thorax above fulvous, without any black patch.

Cristobal, Aug. 10 3 ♀. 1 ♂. I thought at first to refer this to *M. tepaneca aschenborniana* Ckll., based on the male from Guatemala, but the fifth segment has black hair in middle, and the hair between the basal and median bands on second segment is dusky yellowish, not black. It also differs from *M. costaricensis* (*Tetralonia costaricensis* Friese). I am not sure that this may not be *Melissodes cajennensis* (Lepeletier) based on the male from Cayenne, but in the absence of females from that region it is impossible to reach any conclusion.

Hypanthidium taboganum Cockerell

Ancon, Aug. 6, male. Bella Vista, Aug. 7. Female. Mr. H. F. Schwarz (American Museum Novitates, 253) has recently treated this as a variety or race of *H. mexicanum* (Cresson). This cannot be correct as I possess a male paratype of *H. mexicanum* and find it to differ radically in the sculpture of the first two abdominal segments, which have stronger, sparse or well separated punctures.

Dianthidium banksi sp. n.

Female. Length 5 mm. (abdomen curved downward); narrow, head and thorax very coarsely punctured; markings of head, thorax and abdomen red, probably yellow in life; red marks of head confined to band along inner orbits, from level of middle of clypeus to more than half way up front, and an entire occipital band not going much below tops of eyes; scape red in front third antennal joint yellow on outer side, flagellum red beneath; tubercles with a small spot; anterior margin of mesothorax with a very broadly interrupted red band; scutellum and axillæ red; tegulæ black; wings very dark; anterior legs yellowish ferruginous in front; middle knees and tibiæ in middle reddish; hind legs black; abdomen finely punctured; first segment with a large red spot on each side, second with a short transverse stripe on each side, third to fifth with entire bands; ventral scopa white. The sides of metathorax are smooth and polished.

Barro Colorado, June 20. Resembles *D. quadrimaculatum* Ckll. (Bolivia) in most respects, differing conspicuously by the black tegulæ and mainly black scape. Resembles *D. gualanense* Ckll. (Guatemala) by the black tegulæ, but differs by the light scutellum and axillæ. The three species are very closely allied.

Ceratina reducta sp. n.

Female. Length about 5 mm.; head and thorax highly polished, smooth, dark olive green; abdomen very faintly greenish, hind margins of segments 3 to 5 obscurely reddish; legs ferruginous, femora dusky, with a more or less evident pale stripe in front. Head round seen from in front; mandibles red in middle; labrum pale red, binodose; clypeus with a very broad ivory-colored band, broadly rounded above, somewhat constricted in middle; short pale stripes at sides of front betewen antennæ and eyes; large pale yellow bands on cheeks, broad above, attenuate below; cheeks almost wholly impunctate; scape light in front, flagellum obscurely reddish beneath; disc of mesothorax impunctate; tubercles pale yellow; tegulæ light ferruginous; wings dusky hyaline, nervures and stigma dark; abdomen beneath with thin pure white hair.

Taboga Island, June 29. Related to such species as *C. quinquemaculata* Ckll. (Guatemala), but on account of the small size, color, and reduced markings, at first suggesting alliance with the smaller members of the *C. dupla* group.

Ceratina viridula Smith

Taboga Island, June 29.

Colletes rohweri Cockerell.

Las Sabanas, July 7, female. *C. rohweri* was described from a male collected at Zaruma, Ecuador. The present female agrees well except in the usual sexual characters, and the lack of distinct bands on the abdomen, but these appear to have been denuded, the specimen being old, with ragged wings. The abdomen is of the fusiform type; the very broad hind tibiæ are covered with black hair on outer side; the thorax above shows much black hair, but there is a dense band of white hair between mesothorax and scutellum; tegulæ very dark brown; wings strongly stained with brown; flagellum obscure reddish beneath except at base; malar space very short; mandibles red apically. In Swenk's table (1908) it stands near *C. intermixtus* Swenk, but is quite distinct. It is somewhat allied to *C. motaguensis* Ckll. (Guatemala).

Halictus townsendi Cockerell

Gamboa, July 9, two males; Ancon, Aug. 4, two females; Cristobal Aug. 10, two females; Red Tank June 30, July 1, two females. The females vary greatly in the size of the head. This is hardly more than a race of the North American *H. armaticeps* Cresson.

Subgenus Chloralictus Robertson

The small bees referable to this group are not readily differentiated without the aid of the microscope. In the following key the characters are mostly microscopic.

Tegulæ closely punctured; front densely punctured; malar region with two little tubercles; flagellum light brown beneath except at base; antennal joints 3 to 5 all short, transverse, much shorter than those following; mesothorax coarsely microscopically tessellate, with rather close fine punctures; area of metathorax with strong but irregular rugæ, going from base to apex; scutellum and posterior face of metathorax roughened; hind spur with four long oblique teeth; first abdominal segment smooth and polished, with microscopic transverse lineolation, the base hairy; basal corners of second and third segments, and fourth very broadly right across, with minute appressed plumose hairs. . . . . *Halictus gœthalsi* sp. n.

Tegulæ not punctured; hind spur with few strong spines. 1

1. Area of metathorax large, not sharply defined, microscopically reticulate, with short plicæ at base only; front very densely punctured; antennal joints 3 to 5 short, the following increasingly longer, but 6 not greatly longer than 5; mesothorax microscopically tessellate and rather closely punctured; scutellum rather sparsely punctured; hind spur with three large spines or teeth. . . . . *Halictus lesseppsi* sp. n.

Area of metathorax with strong rugæ from base to apex; scutellum in middle with a broad band of small crowded punctures, and on each side of this a sparsely punctured area. 2

2. Larger and more robust; mesothorax dullish and coarsely punctured, the surface microscopically tessellate, the punctures closer posteriorly, on posterior middle of disc they are separated on the average by less than a puncture width; antennal joints 3 to 5 not very short, 6 not much longer than 5; hind margin of third abdominal segment very narrowly testaceous. . . . . . . *Halictus gorgasi* sp. n.

Smaller, with mesothorax shining, not coarsely punctured, the punctures sparse on disc; front densely punctured; antennal joints 3 to 5 successively longer; base of second and third abdominal segments with thin bands of appressed plumose hairs, broad at sides, on 2 rapidly narrowing, reduced to a few isolated hairs in middle, on 3 narrow (about 3 hairs deep) in middle. . . . . *Halictus balboæ* sp. n.

To my surprise all these small *Chloralictus* prove new.

Haclitus goethalsi sp. n.

Female. Length 4 mm. or rather more, anterior wing 3 mm.; head and thorax dark green, dull, the clypeus shining; head longer than broad, face rather narrow, clypeus produced; mandibles reddened apically; flagellum obscure reddish brown beneath except basally; mesothorax finely punctured, median groove very distinct; area of methathorax entirely dull, plicatulate; posterior face small; tegulæ very dark; wings greyish, stigma dilute brown; legs dark; abdomen black, shining, white-pruinose at basal corners of first three segments and all over fourth; hind margins of segments obscurely brown.

Bella Vista, Aug. 7, 1924. Compared with H. *pseudotegularis* Ckll., it is larger, and the head is not so round seen from in front. In the Sandhouse table it runs nearest to *H. ellisiæ* Sandh. from Massachusetts, but is of course different. Miss Sandhouse in her description says the wings of *H. ellisiæ* are clear hyaline, but in the table places it with those having more or less dusky wings.

Haclitus lesseppsi sp. n.

Female. Length about 5.5 mm., anterior wing about 3.5 mm.; robust; head and thorax brassy green, moderately shining; abdomen black; mandibles red, bright in middle, extreme base black, tip dark; flagellum ferruginous beneath except at base; tegulæ polished, dark reddish-brown; wings strongly dusky, stigma very dark brown; legs black, with the tarsi bright ferruginous; head broader than long, clypeus little produced; clypeus well punctured, and with coppery tints; supraclypeal area polished, brassy; a shining space above and laterad of each antenna but greater part of front dull, dark green; cheeks broadly rounded, shining with thin white hair; mesothorax moderately shining with coppery tints in middle, punctures distinct under lens, parapsidal grooves distinct; scutellum and area of metathorax shining, postscutellum dull and dark; hair of thorax above dull white, inconspicuous; abdomen shining, very thinly hairy, but quite without hair bands or patches.

Bella Vista, Aug. 7, 1924. Several species are more or less similar to this ,as follows:

H. exiguiformis Ellis agrees in area of metathorax with basal plicæ, and is really a very similar species, but it does not have the clear red tarsi. *H. tropicior* Ellis has the red hind tarsi, but disc of mesothorax is posteriorly sparsely punctured, and not tesselate, but smooth and polished. *H. lesseppsi* has it tesselate all over. *H. chrysonotus* Ellis also has red tarsi, but the area of metathorax is unlike that of any of the Panama species; the mesothorax is much more shiny than in *H. lesseppsi.* The tegulæ are quite a different color from those of *H. balboæ. H. tenax* Sandh. (Colorado) has a similar metathoracic area, but is otherwise different. *H. umbripennis* Ellis (Guatemala) has a red stigma and is quite distinct. *H. deceptor* Ellis (Guatemala) has plicæ of metathoracic area weak and only going one third of way toward margin, but is otherwise quite different. *H. indistinctus* Crawf falls near here by area of metathorax, but legs are all dark. *H. exiguus* Smith differs by the much longer head, smoother and more polished mesothorax, and pale stigma.

Halictus gorgasi sp. n.

Female. Length about 6 mm.; wings short, anterior wing about 3.6 mm.; head and thorax dull brassy green, with very little hair; head broad, clypeus not much produced; apical half of mandibles dark red; clypeus short; clypeus and sides of face with very strong punctures; front dull, very densely punctured, the punctures tending to run into striæ; apical part of flagellum dull red beneath; mesothorax dull, very strongly and coarsely punctured, with slight coppery tints; scutellum more finely punctured, and shining on each side of middle; area of metathorax coarsely wrinkled; posterior face of metathorax dullish, coarsely sculptured, more or less striate, its lateral margins sharply defined; tegulæ very dark brown; wings stained with reddish; and nervures pale dull reddish-brown, the stigma decidedly of the pale type; mesopleura dull and very rough; legs black, with white hair; abdomen black, with very little hair (no bands or spots), extreme apex dark reddish, hind margins of segments obscurely reddish.

Bella Vista, Aug. 7, 1924. Distinct by the coarse sculpture. In the Sandhouse table (1924) it runs to 67, but after that does not fit in well. It could however be compared with *H. crassiceps* Ellis, *H. perpunctatus* Ellis or *H. cattellæ* Ellis, which are species of temperate North America, differing in various respects.

Halictus balboæ sp. n.

Female. Length about 5 mm., anterior wings 3 mm.; head and thorax very dark green, except that the mesothorax and scutellum are brassy green and shining, the mesothorax more brassy that the scutellum; hair thin and pale; clypeus rather sparsely punctured, apical half black and just above the black a rosy zone; mandibles basally black, apically red; head broad sides of face striate-punctate; flagellum obscure reddish beneath; except at base; mesothorax shining and sparsely punctured; area of metathorax glistening, strongly plicate; posterior truncation small, well defined; tegulæ very dark brown; wings hyaline, slightly dusky (greyish, not at all reddish); stigma and nervures dull pale reddish brown; legs black, with pale hair, small joints of tarsi slightly reddish; abdomen shining black with narrow thin hair-bands at bases of second and third segments; apical part diffusely hairy.

Bella Vista, Aug. 7, 1924, three females. *H. hypochlorus* Ellis is superficially similar, but differs by the narrower, submetallic, abdomen, with hind margins of segments more or less reddish.

H. cubitalis Vachal is large (6.75 mm.) and from the meagre description apparently distinct. It is however nearer to this than to any of the other Panama species.

Megalopta fornix panamensis Cockerell

Barro Colorado (Dodge).

Augochlora vesta terpsichore (Holmberg)

Red Tank June 31; Bella Vista, Aug. 7; Ancon, Aug. 9. This is identical with the form from Guayaquil, Ecuador, referred to *A. vesta terpsichore*, in Jn. N. Y. Ent. Soc. 1914. pp. 324 and 327. If it is different from Holmberg's bee, there is at present no way to show wherein the difference lies.

Augochlora nigrocyanea Cockerell

Ancon, Aug. 6 one female.

Augochlora quiriguensis Cockerell

Barro Colorado (Dodge). One female. This has the mesothorax black with green margins, to this extent agreeing with the variety *sidæfoliæ* Cockerell. It is intermediate between the typical form and the variety.

Augochlora cordiæfloris Cockerell

Gamboa, July 9. One female. Compared with the type (from Mexico), it differs by the golden green mesothorax, but this appears to be only a variation.

SOME EXPERIMENTS ON THE NERVOUS PHYSIOLOGY OF DRAGON-FLY LARVÆ.

By C. E. Abbott,

Elgin, Illinois.

A number of students of insect physiology have attacked the problem of nervous control. In 1911 Hilton, while making purely morphological studies of certain insects, discovered that the supraœsophageal ganglion consisted largely of sensory elements, whereas the subœsophageal ganglion was rich in motor nerves. But as far as I am aware, the only work of a functional nature that has been done in connection with dragon-fly larvæ is that of Baldus (1924).

During the past summer it was my good fortune to be located in Madison, Wisconsin, where it was possible to obtain and observe many larval specimens of Anax junius and Aeschna umbrosa. I took this opportunity to study the nervous physiology of these insects.

Before considering the experiments, it is necessary to say something about the gross anatomy of the nervous system. Besides the brain and the subœsophageal ganglion, this consists of three thoracic and seven abdominal ganglia. The prothoracic ganglion lies midway between the bases of the first pair of legs. The other thoracic ganglia are very close to each other; both are near the middle pair of legs. The first abdominal ganglion lies in the second segment of the abdomen, and the remaining ganglia lie in the segments following, so that the seventh or terminal ganglion lies in the eighth abdominal division. Each ganglion is connected to the adjoining parts of the body by a pair of lateral nerve fibers. The thoracic ganglia are all large, as also is the terminal abdominal ganglion, but the remaining nerve masses are small. With the exception of the brain, the entire nervous system lies so near the ventral surface of the animal that it is visible through the chitin. The subœsophageal cannot be seen from without. It is located near the base of the labium. The brain is visible through the dorsal surface of the head.

To study the function of various parts of this sytem it is only necessary to destroy various parts of it with a needle or a fine knife. Moreover, the vitality of the larvæ is so great that such an operation does not seriously interfere with the vital processes. In all of the experiments, larvæ four to five centimeters long were used.

The prothoracic ganglion of a larva was crushed with a needle. For half an hour after the operation the insect remained motionless. When once it recovered, it could be induced to crawl by gently stroking the dorsal surface of its abdomen. The first pair of legs, limp and powerless, were not used in the process. In the water the larva moved the mildde and rear legs convulsively and irregularly. The mouth-parts moved when touched. Respiratory movements were normal. There was no response to visual stimuli.

The mesothoracic ganglion of a larva was destroyed. After the passage of the shock period the first and last pairs of legs responded to stimulation. The paralysis of the middle pair of legs made crawling practically impossible. Like the preceding larva, this one did not respond to visual stimulation. It also gave little evidence of volition.

The metathoracic ganglia of two different larvæ were destroyed. Both insects gave evidence of shock, disturbance of equilibirum in the water, lack of volition, and inability or disinclination to respond to visual stimuli. Both made some effort to crawl. The rear legs were completely incapable of action and did not respond to stimuli. In the water the first and second pairs of legs moved convulsively. One insect was fairly active; the other seemed almost dead.

The first abdominal ganglion of a larva was destroyed. Although the respiratory movements were somewhat labored and weak after operation, the animal was otherwise quite normal.

The destruction of the third abdominal ganglion of another larva had even less effect than the preceding; the behavior of the insect differed in no way from that of a normal animal.

Destruction of the fifth abdominal ganglion of another insect resulted in a temporary cessation of respiratory movements.

In the case of a larva with the seventh abdominal or terminal ganglion destroyed the effects were more marked. Not only were the respiratory movements much altered, but the movements of the cloacal spines were completely inhibited.

The last two abdominal ganglia were successively destroyed, and later the entire abdominal part of the nerve cord was removed. Immediately after the destruction of each single ganglion there was a suspension of respiratory action. Later these movements became normal. The removal of all abdominal ganglia led to a complete and permanent cessation of all respiratory movements. There was also a marked decrease in volition, and no responses to visual stimuli.

The subœsophageal ganglion of a larva was destroyed. This inhibited the movements of the mouth-parts; otherwise the insect was normal.

In another case the brain of a larva was cut through in a median plane. The larva tilted its body to the right, and crawled and swam in circles in the same direction. Its reflexes were quite normal.

When the brains of several larvæ were removed through large holes in the heads, and the openings closed with asphaltum, a strong shock effect was produced. After that, responses were normal. The breathing, at first irregular and spasmodic, soon became normal. When resting on a solid surface out of water; the larvæ responded by movements of the abdomen or by crawling. The mouth-parts, and the legs, exclusive of coördinated actions such as crawling, moved spontaneously. Swimming movements were not strong, and probably resulted simply from normal respiratory movements. There was no volition and no response to visual stimuli.

The results of Baldus (1924) with *Aeschna cyanea* seem to have been similar to those just described. Baldus states that he was able to keep larvæ alive for long period with no heads at all. Most of my specimens did not live over forty-eight hours. But my results agree very well with those of Baldus: namely that the brain of the larva, while important, is not as essential to the animal as that of a vertebrate to its possessor. From the above data it is possible to draw the following conclusions:

1. The abdominal ganglia of dragon-fly larvæ control respiratory movements and abdominal movements generally, but this control is so distributed between them that the destruction of one or two does not permanently interfere with respiration.

2. The seventh or terminal abdominal ganglion not only has a greater part of the control of respiratory movements than do the other ganglia, but it also is the seat of the reflex involving the movements of the cloacal spines and probably of the cloacal valve.

3. Each thoracic ganglion controls the actions of the legs attached to its segment. It also has something to do with equilibrium.

4. The subœsophageal ganglion controls the reflexes of the mouth-parts, and without it they cannot act. But the ganglion itself *receives no direct stimuli*, excepting possibly, those that come through the mouth-parts themselves. Its responses are initiated by stimuli which come through the brain or from other parts of the nervous system.

5. The brain is the sensory, directive, and associative center. Without it responses to visual stimuli cannot take place, and all coördinated spontaneous movements are inhibited. It also serves in some way as an organ of balance and orientation. The mouth-parts cannot act selectively without the brain. In short, the *real* brain of the insect consists of both the sub and the supraœsophageal ganglia. The former is the motor, the latter the sensory mechanism.

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A NEW PROTODONATAN FROM THE GRAND CANYON.[1]

By F. M. Carpenter.

Through the kindness of Dr. David White of the United States Geological Survey I have had the opportunity of studying three fossil insects, which he collected about a year ago in the Hermit Shale (Lower Permian) of the Grand Canyon. Two of these specimens are so incompletely preserved that their exact affinities cannot be determined; one appears to be the posterior half of the abdomen of an Odonate insect, and the other, a forewing of a blattid. The third fossil, however, is a nearly complete wing of a Protodonatan, described below as *Typus whitei*, n. sp., and is particularly interesting because of its close relationship with *Typus gilmorei* Carp., also from the Hermit Shale[2]. This latter species, which is based upon a specimen collected by C. W. Gilmore in 1926, is the only fossil insect previously known from the Grand Canyon.

The order Protodonata was originally established by Brongniart in 1884, and later extended by Handlirsch to include a series of Odonate insects, occurring in the Carboniferous and Permian formations of both hemispheres. Although the order has usually been considered to be directly ancestral to the Odonata, the recent researches of R. J. Tillyard have led him to conclude that these two orders are parallel groups, derived from a common stem, the Carboniferous Megasecoptera. The meganeurid genus, *Typus* Sell., includes only the genotype, *T. permianus* Sell., from the Lower Permian of Kansas, in addition to the Grand Canyon species. All three of these species were large in comparison with most living insects, having an expanse of about eight inches, but were small beside the 28 inch *Meganeura monyi* Brongn., from Commentry. The new species is a little smaller than the genotype.

[1]Contribution from the Entomological Laboratory of the Bussey Institution of Harvard University, no. 299.
[2]Carpenter, F. M. Proc. U. S. N. M., 71, art. 23. 1927.
[3]Sellards, E. H. Amer. Journ. Sci., (4) 22: 249-258, 1906.

TYPUS WHITEI CARPENTER

Typus whitei, n. sp.

Described from a nearly complete forewing, with the following characteristics: wing rather broad, with a pointed apex, and reduced anal area; hind margin greatly curved. Length of wing, 9.3 cm.; estimated width, at middle of wing, 2.2 cm. Rs arising close to the base of the wing, not far from the origin of R1; R2 and R3 diverging well beyond the middle of the wing; M+R straight at base, but diverging downwards after the origin of R1; Cu2 and 1A deeply undulated, the curves of these veins corresponding; 2A straight; Cu2 reaching the hind margin of

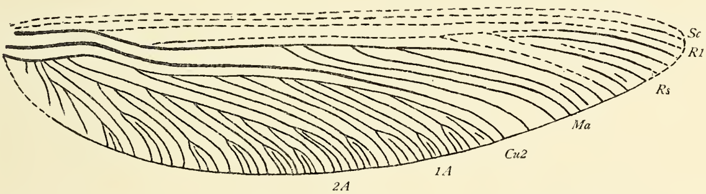

Fig. 1. Venation of *Typus whitei* new species from the Hermit Shale of the Grand Canyon.

Sc, subcosta (concave); R, radius (convex); Rs, radial sector (concave); Ma, anterior media (convex); Cu2, Posterior cubatus (concave); 1A, first anal (convex); 2A, second anal (concave).

the wing at a point about two-thirds the wing-length from the base. The costal margin has been entirely macerated away, only the apical parts of Sc and R1 remaining. There are a few cross-veins visible between the bases of M+R, Cu2, and 1A.

Holotype: catalogue number 71713, United States National Museum; collected by Dr. David White on the Bright Angel Trail, Grand Canyon National Park, Arizona, under the auspices of the Carnegie Institution.

Horizon: Lower Permian.

At first glance this wing might be taken for the hindwing of *T. gilmorei* Carp., since it is slightly shorter and broader than the latter. But the reduced anal area is not at all characteristic of a hindwing of the Protodonata, as far as the order is known to us, and the differences in venation can hardly be explained in this manner. The most obvious of these differences is that the undulations of Cu2 and 1A in *T. whitei* exactly correspond, which is not true of *T. gilmorei*.

This new fossil, being much better preserved than the type of *T. gilmorei*, shows very clearly the position of the origin of Rs, which was obscure in the latter specimen. In all probability the origin of Rs in *gilmorei* was similar to that in Dr. White's specimen, and not as suggested in my description of the former.

Explanation of plate 5.

Photograph of holotype of *Typus whitei*, n. sp., from the Hermit Shale of the Grand Canyon. (x 1.5).

SOME CUBAN CICADIDÆ, CERCOPIDÆ AND MEMBRACIDÆ.—A CORRECTION.

By J. G. Myers.

In the list of Cuban cicadas (*Psyche* XXXV, p. 120) there is an error due to a misplaced correction in the proofs. The second species should be omitted entirely, the third should be *Odopœa sagrœ* (Guér.), while the sixth should read as follows.—

Juanaria pœyi (Guér.) *in* de la Sagra, *Hist. fis. nat. Cuba*, p. 425, 1857; syn. *Juanaria mimica* Distant, *Ann. Mag. Nat. Hist.*, (8) IX, p. 644, 1912. To Mr. Wm. T. Davis is due the credit of discovering this synonymy.

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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VOL. XXXV. DECEMBER 1928 No. 4

MICROTRIMERIA COCKERELLI, A NEW GENUS AND SPECIES OF SOUTH AMERICAN MASARIDS (HYMENOPTERA)

By J. Bequaert,

Department of Tropical Medicine, Harvard University Medical School, Boston, Mass.

The wasp to be described in the present paper presents a number of features of more than usual interest. It not only adds one more species to the very small number of Masaridinæ known from the Neotropical Region; but it also extends the range of this subfamily of wasps to entirely new territory. Moreover, it differs in so many respects from the described members of the group, that it represents a distinct natural division, which I believe is of equal rank with the several genera that are at present recognized in this subfamily.

Microtrimeria, new genus.

Finely sculptured species. Eye with a deep, triangular sinus. Clypeus shallowly emarginate at apex. Mouthparts apparently as in *Trimeria,* in so far as they can be seen without dissection: labrum short; labial palpi of 3 long segments; maxillary palpi rudimentary or absent. Antenna (in female) of 12 distinct segments; flagellum uniformly fusiform throughout, the apical segments not set off as a club. Parapsidal furrows present, complete. Tegula elongate, its posterior lobe reaching the base of the scutellum. Scutellum with a median, raised portion and a lateral, depressed rim, completely covering the postscutellum when seen from above. Posterior surface of propodeum vertical; its lateral angles broadly rounded, not mucronate. Middle tibia with two apical spurs; larger posterior tibial spur trifid at apex. Tarsal claws simple. Abdomen sessile; tergites not conspicuously divided into a basal, constricted and an apical, wider portion. Forewing not plaited; venation as in *Trimeria.*

Genotype: *Microtrimeria cockerelli,* new species.

Microtrimeria cockerelli, new species (Fig. 1).

A small, minutely sculptured species; black, with numerous ivory-white markings and slightly amber-yellow wings; fasciæ of the abdomen deeply bisinuate.

Total length: ♀, 7.5 mm.; of wing, 5 mm.

Female.—Head broadly elliptical in front view, about one and one-fifth times as wide as high; seen from above, a little less than twice as wide as long, not broader than the thorax; occipital margin almost straight. Vertex and cheeks margined throughout by a sharp, even carina. Cheeks wide and distinctly swollen in their upper half, where they are still much narrower than the upper part of the eye in profile and are not in the least angular; gradually narrowed in their lower half, which is not

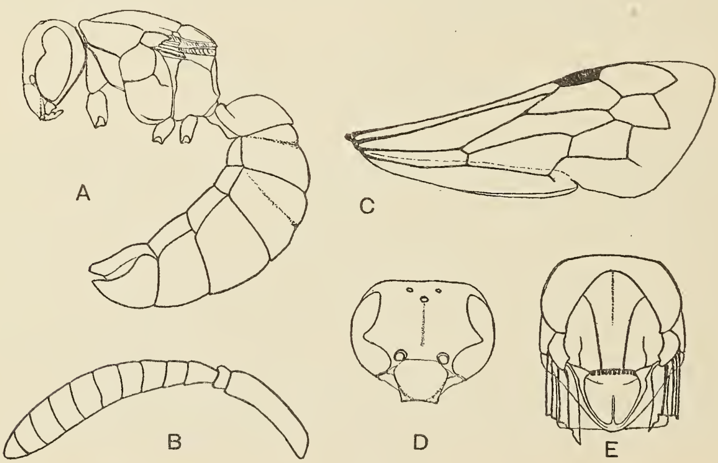

Fig. 1. *Microtrimeria cockerelli* J. Bequaert. Female: A, body in profile· B, antenna; C; fore wing; D, head in front view; E, thorax from above.

depressed; the marginal carina broadly and evenly rounded, not forming an angle. Inner orbits about one and one-third times as far apart on the vertex as at the clypeus. Front hardly swollen, with a slight longitudinal median groove over its upper two-thirds, beginning at the anterior ocellus. Ocelli large, in a flattened triangle; the posterior pair a little nearer to each other than to the inner orbits, about twice as far apart as they are from the anterior ocellus and about equally distant from the occipital margin as from the inner orbits. Interocellar area flat. Vertex not swollen, without fovea. Antennæ about five times as far apart as they are from the inner orbits; the area between them flat, without ridge, carina or depression. Clypeus irregularly hexagonal, with longer upper and lower margins, but little wider than long, very slightly convex in the middle, flattened toward the base, moderately depressed on the sides in its apical third, but without lateral grooves; the anterior, free portion a little longer than the basal, interocular part; the upper margin straight; the lateral margins forming rounded angles which are far removed from the inner orbits; the truncate apex about three-quarters of the maximum width of the clypeus, margined by a narrow, thickened rim, with a slight inward curve, forming right angles with the lateral margins; the lateral angles blunt, flat; owing to the sides of the clypeus being depressed at the apex, the apical margin appears triangularly emarginate when the head is seen from below. Antenna short, of twelve segments; the flagellum much swollen, gradually incrassate from the base to about the middle; scape almost uniformly swollen throughout, nearly half the length of the flagellum; second segment small; third segment about twice as long as the second, about one and one-third times as long as wide at the apex; the fourth a little over half the length of the third, wider than long; the fifth to eleventh much wider than long; the twelfth about as long as wide, bluntly rounded at apex; all the segments perfectly normal. Mandibles of the knife-like type, somewhat decussate, much shorter than the length of the eye, stout and but little curved; the apex forming a blunt, broadly rounded tooth; the inner margin with two shallow notches separating low, blunt teeth; the notches being the ends of two deep grooves which run over the outer surface of the mandible to near its base. Thorax rectangular, stubby, slightly narrowed anteriorly and a little more posteriorly; about one and one-fifth times as long as its greatest width and about as high as wide. Anterior margin of pronotum with a very slight outward curve, rounded off, without carina or rim; the humeral angle not projecting, broadly rounded; the lateral margin broadly curved and with a fine, sharp carina extending from the humeral angle to the mesopleuron and forming the upper border of the epicnemia for the front legs. Mesonotum but little longer than wide, pentagonal in outline with the anterior third produced and the anterior angle semicircularly rounded; very slightly and uniformly convex; with deep, continuous parapsidal furrows and a finer, incomplete furrow on each side in the posterior third and parallel with the tegulæ; a fine median impressed line in the anterior half. Tegulæ much longer than wide, narrowed posteriorly, reaching the base of the scutellum on the sides; post-tegulæ not developed. Scutellum very large, broadly triangular, completely covering the post-scutellum, which is hidden when looked at from above, with a median, raised portion, the margin of which is thickened and connected at the apex with a slight, median, longitudinal ridge which runs over the apical two-thirds; on each side of this median ridge the surface of the scutellum is flattened, but not distinctly grooved; the base is deeply depressed and the mesonotal suture bears a number of foveolæ; the marginal area of the scutellum forms an abruptly depressed, flat plate, which is broad on the sides and narrows gradually toward the apex, where it is but indistinctly divided from the median, raised area. Post-scutellum very short, transversely elliptical, not visible from above; its surface vertical and in a plane with the concavity of the propodeum. Mesepisternum divided from the epimeron and with a complete suture separating the upper from the lower plate; anterior and posterior areas of the mesopleura abruptly constricted to form the edges of deep epicnemia for the front and middle legs; these depressions, however, not bordered by sharp prepectal carinæ (as in the case in *Trimeria buyssoni*); no prepectal suture is present, but the impressed line which marks the sternopleural suture is well marked. Propodeum short, squarely and vertically truncate behind, not swollen on the sides; dorsal areas broadly separated from each other by the postscutellum; concavity wide and shallowly depressed, with a fine, longitudinal median carina which runs from the postscutellum to the much thickened lower (apical) margin; superior, lateral and inferior ridges broadly rounded; lateral angles not produced, rounded; ventral areas fused with the metapleura. Lateral scales of the articulation of the abdomen narrow, broadly rounded. Abdomen moderately elongate, of almost normal shape, the several segments not conspicuously constricted basally. First tergite transverse, as wide as the second, broadly rounded in profile and not angular between the anterior, sloping part and the posterior, horizontal area; the horizontal portion about three times as wide as long. Second and third tergites with a slightly depressed, transverse line (or constriction) in or before the middle, more pronounced on the second tergite; last tergite normally convex; all the sternites normal, the apical one convex throughout, with a deep, narrow notch at apex; apex of first to fifth tergites with a narrow, translucent margin, which, however, is not raised nor set off by puncturation. Legs moderately stout, of normal shape; middle femora and tibiæ not appreciably swollen nor flattened; all coxæ and trochanters unarmed and of normal shape; front tarsi of normal shape, slender; anterior tibial spur strongly curved, slender, acute; middle tibia with two spurs of unequal length; larger posterior spur trifid at apex; tarsal claws simple. Wings with the venation of *Trimeria*: two closed submarginal cells; the medio-cubital cross-vein (*m-cu*) attached basad of the submedian vein ($M4+Cu$); radial cell very broad, not appendiculate; forewing not plaited; posterior lobe of hind wing well developed.

Body entirely covered with dense, microscopic puncturation (not visible with a hand lens); in addition with scattered fine punctures, which become larger, deeper and denser on the thorax and still coarser over the raised portion of the scutellum; the depressed apical margin of the scutellum with fine longitudinal striæ. The puncturation is still distinct on the first tergite, but becomes very faint and sparse on the succeeding tergites and on the sternites. Apical half of the clypeus granular. Head and thorax dull, the abdomen a little more shiny. Pilosity very sparse and short, grayish.

Black. Apical half of the mandibles, inner side of the front femora, inner side of all tibiæ, tibial spurs, tarsi, center of tegulæ, and extreme apex of abdomen, more or less ferruginous. The following markings are ivory-white: a transverse spot covering the upper third of the clypeus; upper two-thirds of the inner orbits, including the ocular sinus and extending to opposite the posterior ocelli; upper half of the cheeks (broadly separated from the white inner orbits); broad anterior margin of the pronotum (a little produced behind on the sides, but not reaching the mesopleura); a small triangular spot in the hind corner of the pronotum, close to the tegula; a median, rectangular spot in the posterior third of the mesonotum (between the parapsidal furrows); a line on each side of the mesonotum, close to the tegula; scutellum (except for the apical, depressed rim and a broad, semicircular, basal spot); entire upper plate of the mesepisternum; dorsal lateral areas of the propodeum, covering the lateral angles and extending slightly into the concavity and over the ventral areas; tegulæ anteriorly, posteriorly and along the inner margin; apical margins of the first to fifth abdominal tergites, the fasciæ deeply emarginate on each side of the middle (on the fourth and fifth tergites the median portion is nearly as wide as the sides, but it is considerably narrower than the sides on the second and third, while the first is but narrowly margined with white in the middle and has the sides abruptly and very extensively white); a small spot in the hind angles of the third to fifth sternites; an elongate, narrow spot on the anterior (outer) face of the middle and hind coxæ; outer apices of all the femora; a stripe on the outer face in the basal half of the front tibiæ; and outer face of middle and hind tibiæ. The under side of the sixth to tenth antennal segments is more or less spotted with ferruginous to dirty white. Wings subhyaline, fairly uniformly tinged with amber-yellow, a little more smoky in the radial cell; veins ferruginous, the costa paler; stigma amber-yellow.

Male unknown.

Peru: Payta, August 28, one female collected by Professor

T. D. A. Cockerell. Holotype in the Museum of Comparative Zoölogy, at Cambridge.

Microtrimeria finds its nearest relatives in the Neotropical genus *Trimeria* and the South African *Masariella*. From *Trimeria* it differs in the presence of parapsidal furrows, the two apical spurs of the middle tibiæ, the rounded, not mucronate propodeum, and the absence of constriction at the base of the abdominal tergites. From *Masariella* it may be separated by the rounded, not mucronate nor angular propodeum, the uniformly fusiform flagellum (in the female of *Masariella* the apical segments are set off as a distinct club), the simple tarsal claws, and the venation (the medio-cubital cross-vein in *Masariella* ends opposite the submedian vein, or even a little apicad). According to Bradley (1922, Univ. California Publ., Ent., I, No. 9, p. 399), the parapsidal furrows are absent in *Masariella*, but I find them well developed in the genotype, *M. alfkeni* (du Buysson), as well as in two other species, *M. saussurei* (Brauns) and *M. spinolae* (H. de Saussure).

The only other Neotropical genus of Masaridinæ[1], *Ceramiopsis* Zavattari, agrees with *Microtrimeria* in the presence of parapsidal furrows, in the rounded lateral angles of the propodeum, and in the middle tibiæ bearing two apical spurs. It differs conspicuously in the shape of the abdomen (the first segment being narrowed at the base into a neck) and in the mouthparts (maxillary palpi of 6 segments; labial palpi of 4 segments).

I agree with Bradley in placing *Masaris saussurei* in *Masariella*. *Masaris spinolœ* (de Saussure), of which I have studied a male and a female, should likewise be transferred to that genus. In both these South African species the scutellum is strongly produced behind, completely hiding the postscutellum when viewed from above, the mesepisternum is completely divided by a suture into an upper and a lower plate (a character also present in *Masariella alfkeni*), and the parapsidal furrows are well developed. In *Masaris vespiformis*, on the other hand, the post-

[1]As I have shown in a recent paper (1928, Ann. Mag. Nat. Hist., (10) II, p. 143-145), the genus *Paramasaris* P. Cameron (Syn.: *Zethoides* P. Cameron, *Plesiozethus* P. Cameron, *Metazethoides* W. A. Schulz) should be removed from the Masaridinae and placed in the subfamily Gayellinae.

scutellum projects considerably behind the scutellum, the mesepisternum is not divided by a suture, and the parapsidal furrows are absent. Since, according to Brauns, *Masaris discrepans* Brauns is exceedingly close to *M. saussurei* Brauns, there can be little doubt that all South African species thus far placed in *Masaris* are more correctly placed in *Masariella*, as was suspected by Bradley.

Having had an opportunity to study the female of *Trimeria buyssoni* Brèthes, I may add a few notes on the generic characters in that sex. I suspect that some of the characters given for the male by Bradley (1922, Univ. California Publ., Ent., I, No. 9, p. 433) are of specific value only. In the female of *T. buyssoni*, the ocelli are placed in a flattened (not in an equilateral) triangle; the antenna consists of 12 segments, the flagellum being uniformly incrassate throughout, without apical club; the parapsidal furrows are absent; the anterior trochanter ends in an obtuse, narrow lobe, which, however, does not project beyond the lower margin of the femur; the anterior femur is swollen and flattened as in the male, but not angled at the base; the middle femur is flattened beneath; both the last tergite and sternite are obtusely pointed at apex, the sternite thickened along the margin and depressed on the disk. I find the larger posterior tibial spur trifid (not bifid as given by Bradley).

Trimeria buyssoni is the only species of *Trimeria* which I have been able to study. So far as one can judge from the rather incomplete published accounts, the genotype, *T. americana* (H. de Saussure), and the three other described species, *T. neotropica* (Mocsâry), *T. joergenseni* Schrottky, and *T. howardi* Bertoni, are congeneric with *T. buyssoni*. Of these five species only three appear to be distinct upon morphological characters, *viz.*, *T. americana*, *T. buyssoni*, and *T. neotropica*. It would seem that *T. joergenseni* is but a color variant of *T. buyssoni*, while there is nothing in the description of *T. howardi* (apart from differences in coloration) to allow of its separation from *T. neotropica*.

MERMIS PARASITISM IN *PACHYCONDYLA STRIATA*.

By T. D. Strelnikov
Leningrad, Russia

In my collection of ants from Alto Parana (Paraguay) I encountered a large specimen of *Pachycondyla striata* F. Sm. which was infected with a nematode worm (Mermis). In a recent paper by Professor W. M. Wheeler[1] the whole problem of Mermis

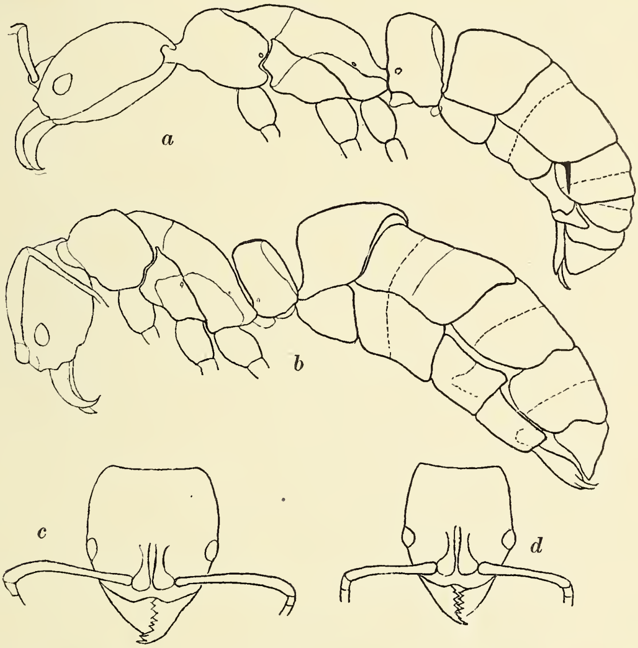

Fig. 1. a, *Pachycondyla striata*; normal; b, *Pachycondyla striata*; Mermithized; c, head of normal worker from above; d, head of Mermithergate.

parasitism and intercastes among ants is reviewed. He has given an account of all cases of mermithism, including several new cases among certain Neotropical Formicidæ. Professor Wheeler gives also an interpretation and a discussion of the whole problem of mermithized ants and a list of the relevant literature.

The *Pachycondyla striata* from Paraguay, which I have

[1]Wheeler, W. M. Mermis Parasitism and Intercastes among Ants. Journ. Exper. Zool. Vol. 50, No. 2, 1928.

studied in Professor Wheeler's laboratory at the Bussey Institution, represents a new case of mermithization, similar to that of *Pachycondyla fuscoatra*, described by Emery.

Pachycondyla striata was found in small colonies under dead leaves. It stings severely and when disturbed can bury itself quickly into the ground. I encountered the parasitized specimen of *Pachycondyla striata* running along a trail in the forest in the neighborhood of Puerto Bertoni, where the famous naturalist Dr. M. S. Bertoni lived. The movements of the ant were slow.

The differences presented by the morphology of the parasitized *Pachycondyla striata* in comparison with an unparasitized specimen may be seen from the accompanying figures.[2] The gaster of the mermithergate is very voluminous and swollen. In the normal ant the abdominal segments are fitted into one another so as to allow the abdomen to dilate as a whole. But in the parasitized individual some of the segments are more or less separated from one another, so that the abdomen is increased in length from 6.5 mm. in a normal to 8.5 mm. in the mermithergate individual and from 2.25 to 3 mm. in diameter. The petiole of the parasitized ant is narrower and lower, than in normal workers. Some modifications in the thorax were also observed. The pronotum of the mermithergate is shorter and the epinotum narrower than in normal *P. striata*.

The greatest difference is discernible in the head, which in the parasitized specimen is conspicuously smaller and less robust, i. e. narrower and shorter, and of a peculiar narrow, more rectangular shape behind the eyes. There are no traces of ocelli.

The mandibles of the infected specimen are narrower and smaller, the antennal scapes decidedly shorter and a little thinner. The funiculus is also slightly shorter.

The surface of the body is smoother and more shining than in normal *P. striata* workers, owing to the fewer hairs on all parts of the body. The color of the hairs is also different. In the parasitized specimen they are more grayish, but in normal *P. striata* they are golden-yellow.

In the intersexual form of *P. striata* we have parasitic castration and mingling of the normal secondary sexual characters.

[2]Made by camera lucida.

THE TARSAL CHEMICAL SENSE OF THE SCREW WORM FLY, *COCHLIOMYIA MACELLARIA* FAB.

By Cyril E. Abbott,
Elgin, Illinois.

In 1921 Minnich found that the tarsi of *Pyrameis atalanta* Linn. and of *Vanessa antiopa* Linn. are sensitive to certain soluble compounds. He (1922) further demonstrated that a variety of compounds, when applied to the tarsi, result in an extension of the proboscis. Under some conditions even distilled water gave this result. The threshold varies with the physiological state of the animal. In 1926 Minnich also published a paper demonstrating that *Phormia regina* Meigen, *P. terræ-novæ* R. D., and *Lucilia sericata* Meigen also have this tarsal sense. These flies distinguish between water, paraffin oil, and saccharose solution by means of the tarsi and the oral lobes of the probosces.

The chemical senses of the screw worm fly (*Cochliomyia macellaria* Fab.) have been much studied and discussed, but owing to the fact that this work has been concerned with purely practical results, it has not greatly clarified the problem. (See U. S. D. A. Bul. No. 1472). While working for the Bureau of Entomology during the summer of 1928, it occurred to me that in order to study properly the chemical senses of these insects, separation of contact and distance stimuli was necessary. The short time at my disposal was accordingly devoted to the demonstration and study of tarsal receptivity.

Newly emerged flies were constantly available, and these were generally used. As these young flies were very restless, it was often necessary to defer the tests to the day following emergence. In no case were flies over twenty-four hours of age used in the first series of tests. Each fly was put into a shell vial (2.5 x 10 cm.), the open end of which was then closed with a single layer of cheese cloth held in place by a rubber band. Each fly was tested by wetting the cloth with the test substance. Extension of the proboscis was recorded as a positive response; the converse was considered negative. Flies that extended the proboscis before stepping upon the cloth were marked positive to water vapor, and those not so responding were considered negative. This served as a check on the contact responses of the insects. The contact water tests served as a check on the responses to sugar solution.

Flies received no water until the first test. For flies tested the day after emergence this time interval was twenty-four hours; otherwise it was about four hours after emergence. Experience soon developed the fact that flies kept for a few hours without water, almost without exception extended the proboscis as soon as their tarsi encountered moisture. Such flies were said to be *water sensitized.* The only difficulty encountered was the general restlessness of the insects; this made it necessary to extend the period of water inanition, in many cases, to the following day. The only effect this had was to quiet the flies. There was no essential difference in their responses, from those kept for shorter periods without water.

The same flies were then given an abundance of water and tested again, usually about half an hour later. Such flies did not usually respond by proboscis extension. They are hence described as *water non-sensitized.* None of these flies were given food until tested with sugar solution. They were tested immediately after becoming *water non-sensitized,* that is, immediately after the tests just described. This interval probably never exceeded thirty minutes. Flies that were *water non-sensitized* were therefore *sugar sensitized.* They responded to sugar solution but not to pure water. All flies were carried through the three tests.

All the water used in the tests was distilled. The sugar solution consisted of 10 gms. of sucrose in 100 c. c. of water. Tests were also made with a solution of urea (5 gms. in 100 c. c. of water). No preliminary tests were made for vapor reactions with urea, but the flies were all *water non-sensitized.* A nearly equal number of male and female flies were used. Hypersensitive specimens were discarded.

The following is a summary of the response data with water and with sugar solution:

	Vapor		Liquid	
Water sensitized	Positive	Negative	Positive	Negative
Number (of flies)	7	190	173	24
Percent	3.5	96.5	97.9	12.1
Water non-sensitized				
Number	10	198	32	176
Percent	4.8	95.2	10.5	98.5
Sugar sentized				
Number	7	209	198	18
Percent	3.2	96.8	91.7	8.3

All flies tested while *water sensitized* were used in the other tests. The experiments with urea gave the following results:

	Positive	Negative
Number	5	44
Percent	3.2	89.1

The fact that the sexes were almost equal in number, and that they responded equally, indicates that there can be no great difference between them as regards this sense. The data given indicates that water vapor was not an important factor in initiating responses. The feeding reactions of the flies depended upon physiological states; those kept from four to twenty-four hours without water gave more reponses than those which had taken in water within thirty minutes. A comparison of the contact responses demonstrates that the flies easily distinguish between pure water and the sucrose solution.

The results of the experiments with urea were unexpected. Not only did the specimens fail to give a feeding response; they apparently made violent efforts to escape continued contact with the solution. Urea is very bitter to human end organs, and it may have a similar effect upon the tarsal organs of the flies. Flies are not attracted to a solution of pure urea.

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A NOTE ON THE GENUS PELECINUS.[1]

By Charles T. Brues.

The peculiar hymenopterous genus Pelecinus is represented in North America by *P. polyturator* Drury, which extends also into South America. Over the southern part of its range, this species varies greatly in color and a number of species have been described from tropical America which are perhaps only variations not worthy of specific rank.[2] Pelecinus is highly dimorphic and the sexes can be instantly recognized by the form of the abdomen. In the male, this part of the body is strongly clavate and less than twice as long as the remainder of the body, whereas in the female the abdomen is linear and fully five times as long as the head and thorax together. The female of this insect is a common North American insect, and has been bred from the larvæ of scarabæid beetles of the genus Phyllophaga (=*Lachnosterna*). The male on the other hand is very rarely seen and is always regarded by those familiar with the species as a very unusual find. Since the female is frequently seen in great numbers, there can be no question that the male is actually very scarce and that practically all the individuals of the species in the United States are females. It would seem therefore that these females must ordinarily reproduce parthenogenetically and that under such circumstances female progeny are produced; *i. e.*, that they represent a thelytokous race. On the other hand, among the neotropical color varieties males are well represented in the population for they are frequently obtained by collectors. This makes it probable that the economy of the tropical forms is widely different from that of the nearctic ones.

Ashmead[3] makes the statement that the female is not rare in some of our northern states during August and September

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 302.

[2]Cf. Roman, Ent. Tidskr., 1910, p. 196. I am inclined to believe, however, that there is more than one neotropical species since two males that I have seen show a great difference in the form of the first abdominal segment, exactly as figured by De Romand nearly a century ago. (Mag. Zool., 1842, pl. 86).

[3]Journ. New York Entom. Soc., vol. 10, p. 243, 1902.

(most of the specimens I have seen bear the date of August; a few July and September)where the female forms a conspicuous object when flying, since its flight is slow and difficult on account of its abnormally lengthened abdomen. He says further, "The male, on the contrary, is extremely rare and exceedingly rapid in flight. It is sharp-eyed, takes flight rapidly, and is rarely captured." I have never seen but one male alive, but it was captured without difficulty. One morning in mid-August 1900, I spied a male resting on the soil beneath an old apple tree on the grounds of the Marine Biological Laboratory at Woods Hole, Mass. It was in company with a considerable number of females and was still there when I returned after hastily securing an insect net from the near-by laboratory building. This male appeared to be in no way especially wary, and although he may have been freshly emerged, he was fully mature, with the body completely colored and hardened.[4]

Judging from the behavior of this individual and the frequency with which males are taken in Central and South America, it seems plausible to suppose that males of the northern race are not nearly so abundant and that this is a true spanandrous race. Probably, however, even in northern localities males at times occur in somewhat greater numbers.

The males are so notoriously uncommon and so prized by collectors that attempts have been made to attract them by enclosing a number of females in a gauze box exposed in a place where the species is abundant. I have been told by collectors in Chicago many years ago that this method is sometimes successful and that in certain localities a few males may be obtained in this way, just as males of certain moths may be trapped in great numbers by the same subterfuge. This may be due to the presence of males only in certain restricted places. At any rate the economy of this extremely aberrant and interesting group of Hymenoptera deserves further study, since it appears that in different parts of its geographical range, it very evidently repro-produces in a different manner, the northern race represented

[4]Professor Nathan Banks confirms this observation as he tells me that a male specimen which he took at Falls Church, Va. was likewise not a very active insect.

almost entirely by thelytokous females and the tropical forms by a comparatively equal proportion of males and females.

The systematic position of Pelecinus has always been a matter of disagreement among hymenopterists. Ordinarily it has been regarded as a highly modified member of the superfamily Serphoidea (Proctotrypoidea), but recently Handlirsch has considered it to form a superfamily annectant between the Terebrantia and Aculeata. Considering its highly specialized form and isolated position it is impossible to determine the relationships of Pelecinus with any great degree of satisfaction. Some recent studies which I have made upon the fauna of the Baltic amber lead me to believe that the recent Pelecinus has been derived from a type represented by the very primitive Stephanidæ through types existent in the early Tertiary that I am inclined to believe show a derivation of Pelecinus from a Stephanid-like ancestor.

Such being the case we have in Pelecinus a primitive type which has become modified in certain regions to a thelytokous method of reproduction, such as is seen in certain very much less primitive parasitic Hymenoptera of the superfamily Ichneumonoidea. In most of these, arrhenotoky prevails although a few cases of thelytoky have been observed and frequently normal arrhenotoky with the occasional production of a very few females in the brood. Evidently the appearance of thelytoky in Pelecinus is definitely related to climate and may be regarded as a recent acquisition.

In 1894[5] Patton described a second North American species from Tennessee to which he gave the name of *P. brunneipes*. This he distinguishes from *P. polyturator* by its smaller size, lighter legs, the presence of an oblong brown cloud in the first cubital cell behind the stigmal cloud, the presence of puncto-reticulate sculpture on the disc of the propodeum in place of the transversely arcuately rugose sculpture of *P. polyturator*. I have had in my collection for a number of years a very small female Pelecinus taken by Prof. W. M. Wheeler at Colebrook, Conn., in August 1910, which is probably the form described by Patton. It differs very markedly from all of the numerous females of *P.*

[5](Amer. Naturalist, vol. 28, p. 896).

polyturator with which I have compared it, but no further examples have come into my hands during the eighteen years that have elapsed since this one was obtained. There are however, in the collection of the Museum of Comparative Zoölogy four additional females, three from the Banks collection taken at Falls Church, Va., taken during August and September and one from Jones Creek, Lee Co., Virginia. From Patton's description, the Connecticut specimen differs slightly in having the white antennal annulus restricted almost entirely to the apex of the ninth segment, not extending over the tenth, and in having only a single cloud, mainly in the radial cell of the fore wing.

P. brunneipes can hardly be regarded as more than a distinct subspecies, but it is distinguishable very readily from the typical form. The following dichotomy indicates the structural differences between the females of the two.

Front coarsely reticulate medially, smooth at the sides, with some coarse punctures between the reticulate and smooth parts; parapsidal furrows coarsely crenulated or cross-striated; propodeum behind middle distinctly transversely rugose-reticulate, sometimes with large punctures intermixed; fore wing distinctly clouded only in the radial cell; length 50-60 mm.

P. polyturator Drury.

Front between the base of antennæ and the ocelli coarsely and quite regularly punctate, some of the punctures confluent; parapsidal furrows indicated by a line of fine, evenly spaced punctures; propodeum smooth, except for a few separate punctures medially behind the middle; fore wing sometimes (in the type) with a second apical cloud in the cubital area, below the cloud in the radial cell;[6] length 27-31 mm.

P. polyturator, subsp. *brunneipes* Patton.

The male of this form must be comparatively rare also as none has ever been recorded and there is no reason to suppose that it occurs any more abundantly than that of the larger North American form.

[6]A variety from Peru, *P. polyturator*, var. *apicalis* Roman has the apex of the fore wing broadly and distinctly blackened.

Although I have been pondering over the peculiar disparity in the sex ratio of Pelecinus for some years, it is only after having read Vandel's recent paper on geographical parthenogensis[7] that the significance of the matter seems clear. Vandel applies this term to a condition which he finds to exist in very diverse groups of invertebrates, where two races of a single species occur in different regions, the one reproducing bisexually and the other by a process of permanent parthenogenesis. Furthermore in the cases studied by Vandel, he found that the bisexual race is the one inhabiting the tropical part, or at least the warmer portion of the range of the species. There is also a further difference in the number of chromosomes whereby a condition of polyploidy is developed in the parthenogenetic form.

It is quite evident that the case of Pelecinus agrees exactly with Vandel's cases of geographical parthenogenesis. The tropical forms are bisexual, and quite generally smaller in size, while the northern one is highly spanandrous and the female is extremely large. The large size of the northern race is especially noteworthy as it is a very large insect, particularly the female which may quite probably be a tetraploid form, although this has not been determined cytologically.

Pelecinus is therefore most probably a further example of geographical parthenogenesis and extends the occurrence of the phenomenon to the parasitic Hymenoptera.

[7]La Parthonegenése géographique, Bull., Biol. France et Belgique, vol. 42, pp. 166-281; 1928.

A NEW GALL MITE ON *PRUNUS MARITIMA* WANG.[1]

By James Kendall.

The examination of a collection of the short stalked, red, pouch galls taken on *Prunus maritima* Wang. at Woods Hole showed that the mite producing it was not a variety of *Eriophyes padi* Nal. as it has previously been believed. It differs from *Eriophyes padi* Nal., the producer of a pouch gall on the leaves of *Prunus padus* L., in that it is larger, has a pair of accessory setæ, and has a greater number of striæ. Schoene (1907) cites the difference of *Eriophyes pruni* Schoene, the mite producing a pouch gall on *Prunus americana* L., from *Eriophyes padi* Nal., which it was supposed to have been, by the possession of a pair of accessory setæ. Unfortunately, Schoene has not published a description of the mite which he refers to his manuscript of 1907. The mite which occurs on *Prunus maritima* may be a closely related form of the mite which Schoene refers to under the name of *Eriophyes pruni* Schoene. Until extensive collections of the genus *Eriophyes* occuring in America are made and preserved with some degree of permanence, it is necessary to consider many forms as distinct species which may later be considered subspecies and varieties of a certain designated type species. Such a process must occur slowly, even as it has in Europe under the guidance of Dr. Alfred Nalepa. The description of the mite producing the gall on *Prunus maritima* Wang. will be given under the name of *Eriophyes maritima* and considered as a new species. (fig. 1.)

Eriohpyes maritima n. sp.

Body cylindrical; thoracic shield with median longitudinal ridges on the dorsum and does not project over the rostrum, which is relatively very short and curves slightly downward. Tubercles of dorsal setæ near posterior border of shield and farther apart than the length of the setæ which incline toward each

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 306.

other across the median line of the shield. Legs long and slender; tarsus and tibia of equal length; feathered claw four-rayed and in the second pair of legs exceeded in length by the claw bristle. Sternum bifurcate with thoracic setæ II very near its outcurving ridges; thoracic setæ I, the shortest of the thoracic setæ, is well forward and anterior to the plane of the anterior end of the sternum; thoracic setæ III is the longest of the thoracic setæ and arises from large tubercles at the base of the coxæ of the second pair of legs. Abdominal striæ 65-75 in number with fine tuberculation often limited to the ventrum; last 5 striæ near

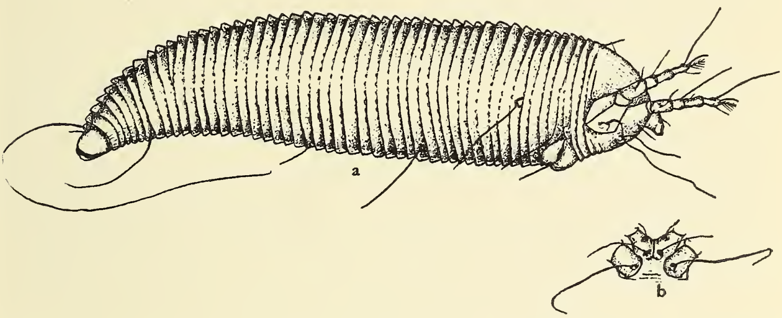

Fig. 1. *Eriophyes maritima* n. sp. on *Prunus maritima*: a, lateral view; b, ventral view of thorax.

the telson without tubercles but with ventral longitudinal striations. Lateral setæ posterior to the plane of the epigynium and the same length as ventral setæ I; ventral setæ II, the shortest and most median of the ventral setæ, as long as the dorsal setæ; ventral setæ III the longest and stoutest of the ventral setæ; the genital setæ about twice as long as the second pair of thoracic setæ; caudal setæ almost half the length of the body; accessory setæ acicular and not half as long as ventral setæ II. Female, 280x 70μ. Described from specimens killed and mounted in aceto-carmine; slides also prepared with celloidin method given by Ahmed Hassan (1928), from material collected at Woods Hole, July 2, 1928.

Measurements of the bristles and setæ of *Eriophyes maritima*: Feathered claw 9μ, claw bristle 1 9μ, 2 10μ, outer setæ of leg 1 30μ, femoral setæ 10μ, patellar setæ 10μ, thoracic setæ 1 10μ, 21 30μ, 111 65μ, lateral setae 30μ, dorsal setæ 16μ, ventral setæ 1 35μ, 11 16μ, 111 40μ, caudal setæ 130μ, accessory setæ 7μ.

The gall which Eriophyes produces on *Prunus maritima* Wang. is probably the one which Chadwick (1907) lists in his catalogue as No. 97 for that plant host and considers it to be the same as his No. 100 which occurs on the leaves of *Prunus serotina* Ehrh. However, fresh material and sections of the galls show them to be quite distinctly different from each other. The gall on *Prunus maritima* is dull red, has a shorter stalk, has a rough surface with coarse trichomes, and has a corrugated inner wall with trichomes present only in the oriface which opens to the under side of the leaf. The gall on the leaves of *Prunus serotinæ* Ehrh. (*Padus virginiana* L. Mill.) is green or rose colored, smooth surfaced, has a longer stalk, and has on the inner walls cellular, trichome-like outgrowths, besides the trichomes which fill the oriface. The mites in these latter galls lack the accessory setæ and may be a subspecies of *Eriophyes padi* Nal., or a variety as Prof. Parrott (quoted by Chadwick 1907) believed them to be.

NEW ORIBATOID MITES

By Arthur Paul Jacot.

Shantung Christian University.

In working over various collections and a revision of the Phthiracaridæ of the northeastern states, the following forms were found to be undescribed:

I. From the Territory of Hawaii:

Indotritia subgen. nov. (**Euphthiracarus**)

Related to genera Tritia, Euphthiracarus, Acrotritia, Oribotritia, but with bristles of aspis very short, the posterior ones closer to each other than to pseudostigmata and between them, median bristles near edge of aspis and close to pseudostigmata, lateral carina usually well developed; abdomen usually rounded (barely pointed) behind; anal plates with long median blades, usually with bristle at their base; lateral plates with at least two pairs of anterior bristles and three pairs of posterior bristles.

Type:—*Tritia krakatauensis* Sellnick (Treubia, vol. 5 (1924), pp. 372-373, figs. 1-3).

E. (Indotritia) bryani sp. n.

Aspis from side with postero-median depression, lateral carina not strongly developed; pseudostigmatic organ rather short, blade-like; abdomen similar to that of type, bristles short; venter rather broad, lateral plates with two pairs of anterior bristles and three pairs of posterior bristles, anal plates with basal bristles only.

Type locality:—"Wilkes Id.," Wake Island, under stones; Aug. 2, 1923; coll. by E. H. Bryan, (Tanager Expedition), about 24 adults, no. BBM07T1 and BBM07T2. *Cotypes* in Bernice Bishop Museum, Honolulu and Museum of Comparative Zoölogy respectively.

E. (Indotritia) hawaiiensis sp. n.

Aspis with median carina, lateral carina distinct; pseudostigmatic organ very short and fine; abdomen similar to that of *T. javensis* Sellnick (1925), bristles rather long and stout; lateral plates with two pairs of anterior bristles, anal plates with two pairs of bristles.

Type locality:—Kaala Mts., Oahu; April 1892; coll. by R. C. L. Perkins, 5 adults, no. BBM18P. *Cotypes* in Bernice Bishop Museum.

Galumna swezeyi sp. n.

Large (.75 x .95 mm.) lamellæ thick; rostral bristles close to edge of lamellæ, long, faintly barbed on outer edge; lamellar bristles very much included, long, tips almost meeting, strongly barbed; interlamellar bristles long, stout; pseudostigmatic organs short, with oval to obovate head; pteromorphal groove partially filled by an area porosa; areæ porosæ mesonoticæ large, round-oval, far down on sides; median pore large; paramesial bristles midway between apertures. Color amber yellow.

Type locality:—Kuliouou, Oahu; March 5, 1920; coll. by O H. Swezey, 2 specimens, nos. SPES11S1 and SPES11S2. *Cotypes* at Sugar Planters' Experiment Station, Honolulu and Museum of Comparative Zoölogy.

II. From the States of Connecticut and New York.

Phthiracarus olivaceus sp. n.

Size fairly large (abdomen .42 x .63 mm.); aspis anteriorly depressed, posteriorly flattened, median bristles between pseudostigmata, posterior bristles inserted beneath abdomen rim; pseudostigmatic organ rod-like, distal end resembling flower stigma, only slightly dilated; abdomen somewhat long-oval, broadest behind center, posteriorly depressed, bristles heavy, of same caliber throughout, six pairs in median row; ventral bristles at suture, the posterior pair remote from each other; anal plates nearly as wide as genital, anterior lapets well developed, bristles: two marginal, three "median"; genital plates dove-tailing at posterior end, bristles; one anterior marginal, four median; color olivaceous, texture sanded.

Type locality:—orchard, one mile west of East Village, Monroe, Conn.; lower face of old rail, soft moist spot; Aug. 22, 1927; coll. by the writer, 33 specimens, no. 2527h2. *Cotypes*:—M. C. Z.

Phthiracarus setosellus sp. n.

Size somewhat small (.34 x .54 mm.); aspis anteriorly depressed, posteriorly flattened, posterior bristles near median; pseudostigmatic organ short, scalpel—or lancet-like; abdomen rather elongate, oval, widest at center, bristles long, tapering, fine, five pairs in median row; ventral bristles at suture, the posterior pair remote from each other; anal plates as wide as as posterior end of genital plates, median bristles more lateral than in preceding; genital plate bristles: two marginal, five median, the posterior-most marginal; color pale tan; texture sanded.

Type locality:—Glen Cove, Long Is., N. Y.; from rotten wood and under bark slabs; May 8, 1920; coll. by writer, 5 specimens, no. 209h. *Cotypes*:—M. C. Z.

III. From Switzerland.

Achipteria oudemansi sp. n.

Size rather large; .34 x .64 mm., thus extremely slender; lamellæ with inner distal angle more anterior than outer, as seen from above elongate ovate i. e. anterior half wider than posterior half; base of lamellar bristles close to end of lamellæ; notogaster extremely pinched together between lamellæ forming an acute angle and extending far in between them; interlamellar bristles opposite end of notogaster and inserted on the lamellæ; pseudostigmatic organ long, slenderly clavate, extending far beyond sides of pteromorphæ which are drawn out into long, slender horns, their ends turned inward almost touching the lamellae; anterior end of camerostome pointed or carinate; anterior ventral angle of pteromorphæ drawn out into a sharp corner; anal covers the diameter of one of them distant from posterior edge of ventral plate.

Type locality:—Les Rasses, St. Croix, Vaud: moss, near a wall; Aug. 10, 1927; coll. by Mr. Auguste D. Jacot, 6 specimens, no. 270301c. *Cotypes* in the writer's collection.

A NEW CECIDOMYIID OF THE GENUS LESTODIPLOSIS.

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

The following species was received from Mr. R. L. Taylor, who, in making a biological study of the White-pine weevil (*Pissodea strobi* Peck.), has secured many interesting species of insects that are either parasitic, predaceous, commensal or otherwise. The larvæ of the genus Lestodiplosis according to Kieffer are zoöphagous, subsisting upon the larvæ of Cecidomyiids, Mycetophilids, and Xylophagids. Dr. E. P. Felt says[1]:—"This record of zoöphagous habits is confirmed by the rearing of American species, since members of this genus were obtained from a wide variety of galls and the larvæ evidently subsisted upon Itonidids, other small insects and acarids."

Lestodiplosis iridipennis sp. n.

Head black, antennæ white, joints of uniform length, the enlarged portions narrowly banded with black. Thorax yellowish, when viewed from the front showing three broad brown stripes extending to the base of the wings, scutellum yellow, metanotum black, abdomen yellow with yellow hairs. Legs white, tibiæ with the base, middle and tip banded with black, tarsi with the base and tip of the first and second joints black. The base of the third joint is also narrowly black. Wings with yellow and blackish hairs, the latter arranged in spots, these hairs are highly iridescent when viewed at certain angles in a bright light, giving the wing a golden yellow color, ornamented by six large, bright, purple spots, regularly placed, the two anterior ones between the costa and radius, two in the middle of the wing, and the two posterior ones extending on both sides of the cubitus, the outer end of the cubitus is also slightly purplish. Length 1.5 mm.

One male, July 10, 1928, from material taken at Oneonta, N. Y. Type in the Museum of Comparative Zoölogy.

This beautiful little midge is so pronounced that I trust the above description will suffice. It would run to *L. florida* in the table by Felt, but the antennæ do not agree. In the description of *L. florida* the color of the thorax and wings are very different.

[1]New York State Museum Bull., Nos. 231-232, p. 129, 1921.

THE ARTHROPOD FAUNA OF CONIFEROUS LEADERS WEEVILED BY *PISSODES STROBI* (PECK).[1]

BY RAYMOND L. TAYLOR.

An interesting feature of a study of the bionomics of the white pine weevil, *Pissodes strobi* (Peck), is the varied fauna found associated with it under the same general ecological conditions. Many of these forms bear the very definite relationship of parasite and host or predator and prey, but there remains a number of coexistent species which show no obvious connection with the weevil. This paper deals with the latter group.

In the course of dissecting a large number of the weeviled terminal shoots of the white pine, *Pinus strobus*, Scotch pine, *P. sylvestris*, and Norway spruce, *Picea excelsa*, but principally while breeding out parasitic forms, an incidental series of 90 spiders, mites and insects was obtained. The majority of the miscellany treated herein represent the captures on or near a scrim screen in the window of a room in which 2602 leaders weeviled the previous summer were confined. The primary purpose of this breeding room was to obtain a large number of the insect parasites of Pissodes with a minimum of labor and breeding apparatus. Most of the fauna from this room were taken under conditions which, perhaps, do not establish conclusively that they were from the shoots, but it may be said that the breeding room was empty, except for the shoots, and all doors and cracks were sealed with gummed paper strips. It was, in general, made tight to prevent the escape of the desired parasites. It would seem, at least where species were numerous, that origin in the leaders is indicated. Fauna obtained from smaller cages, with no possibility of other origin, are noted as from localities other than Massachusetts.

This list is presented for what value and interest it may be worth. All specific determinations were made by specialists in the various groups. The following key will show by whom the determination was made, the abbreviation being enclosed in brackets in each case after the specific name.

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 301.

A—J. M. Aldrich	F—C. A. Frost
Bl—M. W. Blackman	H—Carl Heinrich
Bu—August Busck	J—C. W. Johnson
C—E. A. Chapin	R—S. A. Rohwer
Em—J. H. Emerton	S—Grace Sandhouse
Ew—H. E. Ewing	

Grateful acknowledgement is hereby made to these authorities for their kindness, and to Mr. H. J. MacAloney and Dr. T. C. Barnes for permission to incorporate a part of their unpublished lists of incidental fauna from the same type of material, twelve and two species respectively. Species bred out by these investigators will be so noted. All localities, if not otherwise stated, are Boston, Mass. and environs.

It should be made clear that the following several classes are definitely *excluded* from this list:

1. All parasitic Hymenoptera, whether parasites of *Pissodes strobi* or otherwise.

2. Several predacious Clerids, one fly definitely known to be connected with the white pine weevil, one fly erroneously connected with the weevil in the literature, and one lepidopteron which is facultatively predacious upon Pissodes. These two classes are reserved for another and more extended paper.

3. All insects known to work in these leaders but not obtained, *e. g.*, the pine tip moth, *Rhycionia frustrana*, the pine-bark aphid, *Adelges pinicorticis*, *A. pinifoliæ*, *Pissodes affinis*, *P. approximatus*, *Hylobius pales*, *et al.* The white pine weevil, itself, was not obtained from the breeding room or the cages, although rarely, living adults may emerge after hibernation in the pupal cell.

It is realized that this miscellany is not a complete list of the arthropods associated with weeviled leaders, but it is believed that it comprises a fair representation of those forms which more or less regularly live or hibernate in such shoots.

Class Arachnida

In the opinion of Mr. J. H. Emerton, all of the following spiders, except *Agelena nævia*, were very probably from no source other than the leaders. There can be no question in the case of *Theridion murarium*, as it has often been dissected out of the leaders in the fall. Mr. Emerton states that no place of hibernation for this species has been reported previously. The indications are that this spider invades empty weevil pupal cells in the fall for shelter only.

Order Araneae

Family *Dictynidæ*

Dictyna muraria Em. [Em.] Late March, April. A few half-grown.

Family *Theridiidæ*

Theridion frondeum Htz. [Em.] April. 2 young.

T. murarium Em. [Em.] April. Abundant, all half-grown.

Family *Linyphiidæ*

Tmeticus bostoniensis Em. [Em.] April. 1 female adult.

Family *Argiopidæ* (*Epeiridæ*)

Epeira displicata Htz. [Em.] April. Common, all young.

E. patigiata Em. [Em.] May. Several, all young.

Family *Thomisidæ*

Philodromus sp. [Em.] April. 1 young.

P. sp. [Em.] April. 2 young.

Family *Clubionidæ*

Clubiona abboti L. Koch. [Em.] April. 1 female adult.

Family *Agelenidæ*

Agelena nævia Walck. [Em.] April. 1 very young.

Family *Salticidæ*

Mœvia vittata Htz. [Em.] May. 1 very young.

Tutelina (*Icius*) *elegans* Htz. [Em.] May. 1 very young.

Wala mitrata Htz. [Em.] April. 1 very young.

W. palmarum Htz. [Em.] April. 1 very young.

Order Acarina

Family *Tarsonemidæ*

Pediculoides ventricosus Newport. In frass under bark, spring and fall. Rare to abundant. Predacious on variety of larvæ in shoot; of no particular effect on *Pissodes strobi*, but highly destructive to insect cultures reared in the laboratory.

Family *Tyroglyphidæ* [Ew.]

Migratory, non-parasitic nymphs, or hypopi, of this family very common in frass and on a wide variety of insects. Particularly abundant in material from Ohio and New Hampshire. June, July.

CLASS INSECTA

Order Corrodentia

Family *Psocidæ*

Psocus sp. [J.] July. 19.

Order Hemiptera

Family *Miridæ*

Deræcoris pæcilus McAtee. [J.] May. 2.

Phytocoris eximius Reut. [J.] June. 1. Also Sizerville, Pa. July. 1.

Order Homoptera

Family *Chermidæ*

Psylla sp. [J.] May. 2.

Order Coleoptera

Mr. C. A. Frost has stated that it is remarkable that so many of the species listed below are "scavengers or inclined that way." He adds that he believes it very likely that (of the earlier forms) *Attagenus*, which was abundant, *Laricobius*, a rare form, possibly *Cryptophagus*, and *Glischrochilus*, regularly hibernate in white pine shoots. The occurrence of *Ptinus fur*, however, he considers unusual and yet it occurred in significant numbers. The striking abundance of *Galerucella luteola*, the elm leaf beetle, seems worthy of note.

Family *Carabidæ*

Stenolophus conjunctus (Say). [F.] Early May. 1.

Family *Histeridæ*

Carcinops quatuordecimstriata Steph. [F.] May. 1.

Family *Cleridæ*

Thanasimus dubius (Fab.). [F.] Sept. 1.

Hydnocera unifasciata Say. [C.] June, July. 12.

Phyllobænus dislocatus Say. [C.] June, July. 18.

Three species omitted.

Family *Dermestidæ*

Attagenus pellio Linn. [F.] May. 26.

Trogoderma ornata Say. [C.] June. 1.

Anthrenus scrophulariæ (Linn.). [F. & C.] The carpet beetle May, June. 3.

A. verbasci (Linn.) [C.] July. 1.

Family *Ostomidæ*

Tenebroides corticalis (Melsh.). [F.] Late May. 1.

Family *Nitidulidæ*

Glischrochilus fasciatus (Oliv.). [F.] April. 1.

Family *Derodontidæ*

Laribobius erichsoni Rosenh. [F.] April. 1.

Family *Cryptophagidæ*

Cryptophilus integer (Heer.) [F.] Readfield, Me. Sept. 1.

Cryptophagus acutangulus Gyll. [F.] May. 4. Also Durham, N. H., Roscommon, Mich.

C. sp. [F.] Late May. 1.

Atomaria sp. [F.] Concord, N. H. Early June. 1.

Family *Coccinellidæ*

Scymnus punctatus Melsh. [F.] Late May. 1.

Family *Alleculidæ*

Hymenorus sp. [C.] July. 1.

Family *Tenebrionidæ*

Tenebrio obscurus Fab. [C.] July. 1.

Family *Melandryidæ*

Canifa pallipes (Melsh.) [F.] Late May. 3.

Family *Ptinidæ*

Ptinus fur Linn. [F. & C.] April to June. 18.

Family *Anobiidæ*

Sitodrepa panicea (Linn.). [C.] The drug-store beetle. July. 1.

Cœlostethus notatus (Say). [F.] April, May. 3.

Family *Scarabeidæ*

Trox scaber (Linn.). [C.] July. 1.

Phyllophaga fusca (Froelich). [F.] May. 1.

Family *Cerambycidæ*

Pogonocherus tomentosus Hald. [F.] Readfield, Me. Sept. 1.

Family *Chrysomelidæ*

Galerucella luteola Mull. (*xanthomelæna* Schrank). [F.] The elm-leaf beetle. May, early June. 165.

Family *Curculionidæ*

Magdalis perforata Horn. [F.] Mont Alto, Pa. June. 1.

Family *Scolytidæ*

Pityophthorus cariniceps Lec. [Bl.] May. 1.

P. puberulus Lec. [Swaine.] Bred by Barnes. N. Y.

Order Lepidoptera

Family *Tineidæ*

Tinea sp. [Bu] June. 1. Not a pine feeder.

Family *Tischeridæ*

Tischeria sp. [Bu.] June. 1. Not a pine feeder.

Family *Lyonetiidæ*

Bucculatrix sp. [Bu.] June. 1. Not a pine species.

Family *Gracelariidæ*

Lithocolletis ostensackenella Fitch. [Bu.] June. 1. Feeds on *Robinia*.

Family *Heliozelidæ*

Agonopteryx (*Depressaria*) *atrodorsella* Clem. [J.] April. Common.

Family *Gelechiidæ*

Eucordylea atrupictella Dietz. [Bu.] Bred by MacAloney, Petersham, Mass.

Paralechia pinifoliella Kearf. [Bu.] June. 1. The pine-leaf miner.

Recurvaria piceaella Kearf. [Bu.] June. 1.

Family *Tortricidæ*

Laspeyresia youngana Kearf. [H.] June. 7.

Taniva albolineana Kearf. (var. of *Peronea hastiana* Linn.?) [H.] June. 1.

Family *Pyralidæ*

Canarsia ulmiarrosorella Clem. [H.] June. 3. Not a pine insect; feeds on elm.

Dioryctria abietella Fab. [A.] Bred by MacAloney, Petersham, Mass.

One species omitted.

Order Diptera

Family *Trichoceridæ*

Trichocera brumalis Fitch. [J.] April. 1.

Family *Chironomidæ*

Forcipomyia specularis Coq. [A.] Bred by MacAloney, Petersham, Mass.

Family *Cecidomyiidæ*

Lestodiplosis iridipennis Johnson. [J.] Oneonta, N.Y. June. 2.

Family *Sciaridæ*

Sciara sp. [J.] May. Abundant. Also Oneonta, N. Y., Ansonia, Pa., Sizerville, Pa., Milroy, Pa., Durham, N. H. and Roscommon, Mich.

Family *Scutopsidæ*

Reichertella femoralis (Mg.). [J.] May, June. Common. Also Oneonta, N. Y., McConnellsburg, Pa., Sizerville, Pa., Milroy, Pa., Fayetteville, Pa., Concord, N. H.

Family *Scenopinidæ*

Scenopinus fenestralis Linn. [J. & A.] June, July. 4.

S. glabrifrons Mg. [J.] Late June. 1.

Family *Dolichopodidæ*

Medeterus sp. [J.] June. 1.

Family *Empididæ*

Tachydromia sp. Bred by MacAloney, Petersham, Mass.

Family *Phoridæ*

Megaselida (*Aphiochæta*) *rufipes* Mg. [J.] May. 3.

Family *Tachinidæ*

Chætotachina simulans Mg. [J.] June. 1. Mr. C. W. Johnson believes this form to be parasitic upon sawflies, of which a number invade the pupal cells of Pissodes to hibernate.

One species omitted.

Family *Calliphoridæ*

Calliphora erythrocephala Mg. [J.] May. 1.

Family *Muscidæ*

Muscina stabulans Fall. [A.] The common stable fly. Bred by MacAloney, Petersham, Mass.

Family *Borboridæ*

Leptocera sp. [A.] Bred by MacAloney, Petersham, Mass.

Family *Sapromyzidæ*

Sapromyza rotundicornis Lw. [A.] Durham, N. H. June. 2.

Family *Lonchaeidæ*

One species omitted.

Family *Chloropidæ*

Gaurax apicalis Mall. [Malloch.] Bred by MacAloney, Petersham, Mass.

G. festiva Lw. [J.] Oneonta, N. Y. July. 2.

G. sp. [J.] May. 1.

Hippelates sp. Bred by MacAloney, Petersham, Mass.

Madiza glabra [A.] Bred by MacAloney, Petersham, Mass.

Botanobia (*Oscinella*) *coxendi* Fitch. [A.] Bred by MacAloney, Petersham, Mass.

B. frit Linn. [J.] Late May. 9. Also Concord, N. H., Mont Alto, Pa., Northwestern Ct., and Oneonta, N. Y.

Family *Drosophilidæ*

Chymomyza amœna Lw. [A.] Bred by MacAloney, Petersham, Mass.

Drosophila funebris Fab. [J.] May. 6.

Scaptomyza graminum Fall. [A.] Ann Arbor, Mich. June, July. 27.

Family *Milichiidæ*

Desmometopa latipes Mg. [A.] July. 1.

Family *Ochthiphilidæ*

Leucopis simplex Lw. [J.] Common. Also China, Me., McConnellsburg, Pa.

Order Hymenoptera

Family *Tenthredinidæ*

Dr. Rohwer has written in reference to the following sawflies: "Not any of these species feed on pines. They feed in the larval stage on herbaceous shrubs, and were using the burrows of Pissodes only as places to hibernate."

Ametastegia glabrata (Fall.). [R.] Late May. 1 male.

Emphytus mellipes Nort. [R.] May, early June. 6 males, 4 females.

Emphytina aperta (Nort.). [R.] Readfield, Me. June. 1 male; Concord, N. H. Early June 1 male.

E. tener (Fall.). [R.] May. 2 males, 3 females; Fayetteville, Pa. Late May, 1 female; Ansonia, Pa. May. 1 female.

Hemitaxonus dubitatus (Nort.). [R.] Late May. 1 male.

Strongylogaster soriculatipes Cress. [R.] June. 1 female.

Pontania sp. [R.] June. 1 female.

The parasitic families *Braconidæ, Ichneumonidæ, Ceraphronidæ, Diapriidæ, Cynipidæ, Chalcididæ, Eurytomidæ, Eupelmidæ, Pteromalidæ* and *Eulophidæ,* of which a number of species were obtained, are omitted.

Family *Vespidæ*

Ancistrocerus tigris (Suass.). [J.] June. 1.

Family *Sphecidæ*

Trypoxylon frigidum Sm. [R.] Bred by Barnes. N. Y.

Stigmus fraternus Say (?) [S.] June. 1.

Pemphredon (*Diphlebus*) sp. [S.] June 5. Also Sidney and Readfield, Me. July.

Passalœcus annulatus Say (?) [S.] June. 1.

P. sp. [S.] June. 1.

Xylocelia sp. [S.] June. 1.

Family *Hylaeidæ*

Hylaeus sp. Bred by MacAloney, Petersham, Mass.

NOTES ON SOME BUTTERFLIES FROM NEW ENGLAND.

By Austin H. Clark,
Smithsonian Institution, Washington, D. C.

The following notes on butterflies taken in New England are worthy of record.

Eurymus eurytheme form **eriphyle** (Edwards)

In 1925 (Psyche, vol. 32, No. 6, December 1925, p. 297)I recorded as an unusually pale male of *Eurymus philodice* a specimen captured by Hugh U. Clark at Essex, Mass., on August 30, 1925.

On reëxamining this specimen I detected an almost imperceptible flush of orange on the lower half of the fore wings. The costal border of the fore wings is brighter yellow than the rest of the wings, and the inner border has a conspicuous rounded angle near the body.

There can be no doubt but that this is in reality an example of the form *eriphyle* of *Eurymus eurytheme*, the occurrence of which in Massachusetts I did not at the time suspect. The bright orange form of that species was noted at the same place on the same day, and a few days previously five of these were seen at Ipswich, not far distant.

Eurymus eurytheme form **ariadne** (Edwards)

Mr. Scudder recorded (Butterflies of New England, vol. 2, 1889, p. 1114, second aberration) a male of *Eurymus philodice* taken November 10 at Bangor, Maine, by Mr. Carl Braun in which all the wings, especially on the disc of the upper surface, were "shot with orange; the orange, though deep in color, is not of a solid character, but is more or less intermingled with yellow scales, giving a somewhat pink appearance."

This would appear to have been an example of *Eurymus eurytheme* form *ariadne*. About Washington this form is most numerous at the end of the season, and has been noticed as late as November 11.

Eurymus eurytheme form **keewaydin** (Edwards)

Of the three males from Ipswich, Mass., taken on August 25, 1925 (Psyche, vol. 32, No. 6, December 1925, p. 297), one approaches closely the light form *keewaydin* to which, I believe, it should be referred. A second is intermediate, and the third, which is the largest, is of the form *amphidusa.* All three in life had slight violet reflections.

About Washington the form *keewaydin* is most common in late summer.

Dryas aphrodite cypris (Edwards)

Seven males and two females referable to this form were taken at Essex, Mass., all after the middle of July, 1925. They are at once distinguishable from the common form of *aphrodite* occurring in the region by the longer and narrower fore wings of which the outer border is distinctly concave, and by the less rounded and shorter hind wings. The ground color of the upper surface of the wings is light and almost uniform, and the black markings are reduced.

The two females have the wings more nearly of the normal type than the males. In both the black bar between veins M1 and M2 is extended inward so as to form a conspicuous black patch.

Careful comparison with a series of *cypris* from Colorado removes all doubt regarding the identity of these specimens.

Probably they do not represent an isolated colony of this western form, but instead should be interpreted as examples of a well characterized variant (a light long-winged "dry" form) which in portions of the west becomes the sole representative of the species.

Yet the occurrence in the same year in the same region of *Eurymus eurytheme* in the northern "dry" (*eriphyle*), intermediate (*keewaydin*) and "wet" (*amphidusa*) forms should be borne in mind.

Dryas aphrodite carpenterii (Edwards)

At Essex, Mass., late in the season there appears a small, dark and richly colored form of *Dryas cybele* with curiously short wings which appears to be identical with Edwards' *Argynnis carpenterii.*

Note.—The specimens herein recorded as the forms *eriphyle, keewaydin* and *amphidusa* of *Eurymus eurytheme* have been sent to the Museum of the Boston Society of Natural History; specimens of *Dryas aphrodite cypris* and of *Dryas cybele carpenterii* taken at Essex on July 18, 1925, are in the National Museum at Washington.

THE EFFECT OF THE EXTREME TEMPERATURE OF DEC. 7, 8, AND 9, 1927 ON HIBERNATING *CRIOCERIS ASPARAGI* L. AND *HIPPODAMIA CONVERGENS* GUER. AT AMES, IOWA

BY RANDALL LATTA
Ames, Iowa

During the early winter of 1927 at Ames, Iowa, the temperature dropped suddenly on Dec. 6 from 26°F to7° the following day, to —25° on the 8th and then rose again to —8° on the 9th. A small amount of snow had previously fallen, but was mostly in drifts, leaving many places exposed.

Field observations following this period proved that *Hippodamia convergens* Guer., a common coccinellid and *Crioceris asparagi* L. the asparagus beetle, were not able to withstand this unusual temperature.

Hippodamia convergens is probably the most common coccinellid in the vicinity of Ames, Iowa. Large numbers of them, as well as lesser quantities of other species of ladybirds, gathered in late summer at a turnip patch on a truck farm at the outskirts of Ames, to feed on the aphids there. As fall advanced the beetles hibernated in the sod fencerow at the edge of the turnip field.

In the latter part of December the above mentioned fencerow was examined and a 100% mortality found. In a space 6 feet long and one foot wide immediately bordering the turnip patch 26 dead *H. convergens* were counted. An open crevice of a fencepost held 50 dead ladybirds of this species, and between 50 and 75 dead specimens were removed from beneath a stone at the same place. At the same time living specimens of *H. parenthesis*, *H.* 13-*punctata* and *Coccinella* 9-*notata* were found active among the dead *H. convergens*.

Other observations made later supported the above findings. At a highland prairie northwest of Gilbert, Iowa, nearly 40 dead *H. convergens* were uncovered beneath stones, and at the time living *H.* 13-*punctata* and *H. parenthesis* were collected.

In the spring of 1928, *Hippodamia* 13-*punctata* and *H. pa-*

renthesis were very common while *H. convergens* were scarce enough to be almost rare.

At the same truck farm, a large asparagus bed was heavily invested with *Crioceris asparagi*. These beetles hibernated early in such shelter as they could find: in the sod of the fencerows, hollow asparagus stalks thruout the bed, hollow weed stalks, in the burrows of the grape cane borer, smartweed borer, and even in company with a strawberry leaf roller larva in a folded strawberry leaf.

After Dec. 10th an exhaustive survey of the asparagus bed revealed an almost total mortality, only six beetles being revived when warmed out of several hundred collected. The six were hibernating in a hollow asparagus stalk.

In the sod fencerow the beetles had hidden in the layers of decayed organic material found at the surface of the ground in most blue grass sod, but were never found in the ground. The first 12 or 14 inches of sod next to the asparagus sheltered the majority of the beetles that had thus wintered. As high as 83 specimens were counted in an area one foot square.

The asparagus beetles had not been observed to bore into a stalk, nor had any evidences of frass been seen in the stalks examined. Beetles had entered, usually, by the path of some previous insect, or at a broken internode.

A number of stalks in lots of 50 were examined to determine the number of beetles that had used such shelter, and in four lots the infestation ran 32%, 32%, 22%, and 52% with as high as 46 specimens in a single stalk.

Two species of *Anthicidœ*, *Anthicus cervinus* Laf. and *A. amœnus* Casey, were often collected in company with the asparagus beetles and always showed activity upon being disturbed.

Sanderson (Journal of Economic Entomology, Vol. I, 1908, pp. 245-262) plots on a map of the United States a series of isotherms showing the average annual-minimum temperatures and the relation between the northward limitation of certain forms and these isotherms. The average annual-minimum for central Iowa is —10°. The —25° of the past winter is therefore an exceptional drop for this locality.

The average annual minimum isotherm of —10° bisects Iowa, crosses northern Illinois, cuts thru Michigan and includes the region of Ontario influenced by the lakes, cuts thru New York state and the center of New England. Allowing for seasonal deviations of warm winters, etc., the beetle has hovered along this invisible barrier during its westward spread.

SOME BEES FROM UTAH

By T. D. A. Cockerell,
University of Colorado, Boulder, Colo.

Comparatively little is known of the bees of Utah, so I heard with great satisfaction that Professor Vasco M. Tanner and his associates at Brigham Young University were vigorously collecting and studying the Hymenoptera of their state. They will undoubtedly have a rich field for interesting discoveries. At the present time I record a small series of bees, many of them new to Utah, sent to me by Professor Tanner.

Nomada civilis Cress. ♀ 662 (Clarence Cottam)

Nomada (*Gnathias*) *bella* Cress. ♀ 1637 (C. J. D. Brown)

Triepeolus wyomingensis Ckll, 2♂, Sheep Creek, Duchesne Co.

These show that the black mark on first abdominal segment varies from a well defined transverse band, rounded at ends, to an irregular mark, broad in middle, but linear and partly broken laterally.

Triepeolus tanneri n. sp.

♂ Length about 10.5 mm.; robust, black, including mandibles, antennæ, tegulæ (except dark brown margin) and legs (except tarsi; dull red at apex), spurs black; ornaments cream-color; eyes light green, purplish only to a slight degree at extreme base; face narrow; a patch of glittering white hair lateral of each antenna; clypeus dull, minutely and densely granular-punctate all over; mesothorax strongly, more or less confluently punctured, glittering between the punctures; a pair of not very distinct dagger-shaped pubescent marks anteriorly, the base on anterior margin of mesothorax, approached by, but not touching pubescence of sides; scutellum strongly bigibbous; mesothorax dull, granular and rough, bare except a little hair at its upper end; wings very brown; abdomen with six even apical bands, and an anterior one, interrupted in middle, on first segment (the apical one on first almost interrupted);

black area on first segment a very broad (anteroposteriorly) but not very long transverse band, clean cut, with broadly rounded ends; band on second segment somewhat enlarged at sides, but with no anterior extension; venter black, not banded. Farr West, Utah (C. J. D. Brown). In my MS. table it runs to *T. lineatulus* Ckll., which differs at once by the transverse mark on pleura, the anterior extensions of band on second segment, the much longer black band on disc of first segment, etc. It runs out in all other tables.

Epeolus dacotensis Stevens. ♀ Sheep Creek, Duchesne Co., June 1926. Previously known from North Dakota.

Anthophora occidentalis Cress., ♂ Sheep Creek (Tanner, Cottam)

Anthophora urbana Cress., ♂ Springville (C. Lynn Hayward)

Melissodes alopex n. sp.

♂ Runs in my table (Tr. Am. Ent. Soc., 1906) to *M. menuacha* Cress., which it resembles in size and general appearance. It differs thus: pubescence in general much redder, fox-red on thorax and very bright on tibiæ and tarsi; third antennal joint shorter (its length about 990 microns); eyes darker green; wings strongly blackish, outer nervures black; second cubital cell very broad, not appreciably narrowing above; hind margins of abdominal segments not at all hyaline; second segment densely hairy at base, and with a median fulvous band; third to fifth with the exposed parts densely covered with fulvous hair, except broad apical margin of third, and narrow brownish margin of fourth; apex black haired.

Duchesne, Utah, July 1926 (Tanner) There is also a strong resemblance to *M. sabinensis* Ckll., from Arizona, but that has a broader, much more closely felted abdomen, and a much narrower face.

Melissodes agilis Cress. ♂ Zion National Park (Tanner)

Melissodes agilis aurigenia Cress., ♂ Zion National Park (Tanner)

Megachile sapellonis Ckll. ♀ Aspen grove near Timpanogas (Tanner) Described from New Mexico.

Megachile perihirta Ckll. ♂ Sheep Creek, June, (Tanner)

Megachile manifesta Cress. ♀ St. George, Aug. (Tanner)

Anthidium tenuifloræ Ckll. ♂ Triplett Farm, Burnt Fork, June (Hayward); Summit Danials (*sic*) Canyon, 8000 ft., July (Hayward)

Alcidamea hypocrita Ckll. ♀ Wellsville Canyon, June (Brown)

Osmia lignaria propinqua Cress., ♀ Provo, April (Hayward); Wellsville Canyon, June (Hayward)

Osmia nassa Ckll. ♀ Summit Danials Canyon, 8000 ft., July (Hayward). In this specimen the thorax is dorsally black. Described from California.

Osmia melanotricha Lovell & Ckll. ♀ Triplett Farm, Burnt Fork, June (Hayward) Described from Maine.

Ceratina submaritima Ckll. ♀ Wellsville Canyon, June (Tanner) Known from the Pacific coast; I did not expect it so far inland.

Spinoliella scitula Cress., ♀ Fort Bridges, June (Hayward)

Agapostemon virescens Fabricius, ♀ Wellsville Canyon, June (Tanner)

Halictus lerouxii Lepeletier, ♀. No. 23. A small neat form, such as I have found at Florissant, Colo. Compared with Illinois material it looks distinct, but is surely the same species.

Halictus (*Seladonia*) *meliloti* Ckll. ♀ Provo, May (Hayward)

A TWO-EYED SPIDER FROM UTAH.

By Ralph V. Chamberlin,
University of Utah, Salt Lake City, Utah.

The highly interesting family Caponiidæ includes two African species, representing the genera Caponia and Diploglyna, and about a score of American species representing five genera. The American species hitherto known occur in the West Indies, northern South America and Central America, and in the desert region about the Gulf of California from where the writer has described species of three genera,—Orthonops, Tarsonops and Nopsides.[1] The genus Orthonops was established for the single species *O. overtus* Chamberlin the type of which was taken on San Luis Island, Gulf of California; but in April, 1928, Mr. Willis J. Gertsch, as a member of a field party from the University of Utah, secured a female of a second species of this genus in the San Rafael Desert region of Emery Co., Utah. This species, which is described below, is the only member of the family to have been found north of Mexico. Like all other American members of the family, excepting *Nopsides ceralbona* Chamberlin, this form has but two eyes, a feature not found in spiders of any other family. Along with other distinguishing peculiarities, the members of this family have all four spiracles leading into tracheal tubes, no book-lungs being present.

Orthonops gertschi, new species.

Female.—Carapace uniform light orange color, sparsely clothed with black hairs of moderate length which are all weakly curved. The sternum similar in color or slightly paler and bearing similar but more numerous hairs. Cheliceræ, labium and endites colored and clothed like sternum. Palpi yellow, the hairs, particularly on the tarsus more numerous, appressed. Legs clear yellow, clothed with dark hairs like those of palpi and carapace. Abdomen gray throughout, somewhat darker above,

[1]The Spider Fauna of the Shores and Islands of the Gulf of California, Proc. Cal. Acad. Sci., XII (4), No. 28, p. 597 et seq., 1924.

subdensely clothed with dark, appressed hairs similar to those of other parts of the body but mostly shorter and finer. The carapace depressed, the head region not set off by distinct furrows and no stria thoracica evident, subovate in outline; pars cephalica narrowed forward, with anterior corners widely rounded. Eyes on a somewhat darkened area; removed from anterior border of head, as viewed from above, by only slightly more than the length of the eye-row, though without measurement the distance appears greater; eyes circular, separated by less than their diameter, the light, pupillary areas separated in dorsal view by about their diameter. Labium rather broad, apically rounded. Endites rather long, bent over the labium and nearly meeting in the middle line in front of it. Cheliceræ with claws slender; upper margin of furrow with a low membrane over most of the length, the lower margin with a shorter but higher, distally rounded, membranous appendage. Sternum weakly convex, in outline subelliptic but more strongly narrowed caudad than cephalad, the caudal end acute. Abdomen narrowly elliptic or subfusiform, pointed at both ends. First and second legs decidedly more robust than the third and fourth, but the fourth longer than the first. All coxæ moderately long, the first and fourth longer than second and third. Paired claws of legs with six long teeth in single series. Unpaired claw on all legs well developed, smooth and untoothed. The appendage at base of tarsi I and II elongate, narrowly oblong in outline but distally pointed and somewhat curved. In leg I the tarsus is clavately thickened distad; its distal division, exclusive of claws, about half as long as the proximal division.

Total length, 4.75 mm. Length of cephalothorax, 1.9 mm.; width, 1.37 mm. Length of leg I (inclusive of coxa), 5.74 mm.; tib. + pat., 1.9 mm. Length of leg IV, 6.86 mm.; tib. + pat. IV, 2.1 mm.

Locality.—Utah: Emery Co., San Rafael Desert at Straight Wash., April, 1928. Holotype, a female, in author's collection.

Book Notices.

Destructive and Useful Insects. By C. L. Metcalf and W. P. Flint. McGraw Hill Book Co. New York. $7.50.

This book which includes 918 pages, with 561 illustrations, is an account of American insects as they affect the welfare of man. More than two-thirds of the text deals with the injurious and destructive activities of insects that affect agriculture, together with a consideration of general and special methods of combating them. This is the most valuable part of the book as it includes very full accounts of practically all the pests of importance which affect vegetable crops and fruits. With this is a chapter on household insects, one on insects that attack and annoy man and another on insects injurious to domestic animals. A chapter on the value of insects to man contains much interesting material which seldom receives space in entomological text-books. There is also a brief treatment of the morphology and classification of insects. The illustrations are well selected, but are nearly all from other publications.

The authors are certainly to be congratulated in having gathered together a large mass of material into an extremely useful book, to which economic entomologist and others of their less practically inclined brethren will have frequent occasion to refer.

C. T. Brues.

Elementary Lessons on Insects. By James G. Needham. C. C. Thomas, Springfield Ill. and Baltimore Md. $2.00.

This small volume of somewhat over 200 pages gives an account of the structure and development of insects together with a consideration of some of their more important economic relations. It is suitable for secondary schools, or summer classes as a text-book and should be valuable as a *vade mecùm* for teachers who require a certain amount of entomological knowledge for the teaching of "nature study."

Ten of the more important orders of insects are considered with general reference to their structure, development and habits.

Interpolated through this part of the book are numerous laboratory and field exercises, which cover a wide variety of subjects and material, much wider than it would be possible for the average class or teacher to complete, even during the summer time. It should be easy, however, to select a part of the exercises for which material and time might be available.

C. T. Brues.

PSYCHE

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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

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