

# PSYCHE.

## THE HABITS OF THE ACULEATE HYMENOPTERA.—III.

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*Family V. MELLINIDÆ.* This family (if we can call it a family) is represented in our fauna by one genus with three species, and as these are exceedingly rare, no observations on any of them have been made. Westwood, however, has observed the European *Mellinus arvensis* burrowing in sand-banks, and Shuckard states the species preys upon Diptera. Kirby and Spence also say it selects the smaller flies, including the troublesome *Stomoxys calcitrans*.

*Family VI. MIMESIDÆ.* In this family we have 17 described species, distributed in two genera; the habits of none of them seem to be known.

According to Shuckard, the species belonging to the genus *Psen* Latr. nidificate in sand; whereas, those of *Mimesa* Shuck., according to Westwood, appear to be wood-burrowers and provision their cells with the larvae of different species of Homopterous insects.

*Family VII. PHILANTHIDÆ.* This family is well represented in our fauna, by no less than seventy-five species, distributed in four genera.

Westwood, whom I have drawn upon for many of the facts recorded in this paper, states that the species belonging to the genus *Cerceris* Latr. show considerable diversity in habits. The economy of *Cerceris ornata*, according

to Walckenaer, forms its nest in foot paths, and other situations exposed to the sun, to the depth of five inches, but in a tortuous direction, provisioning them with different species of Halictus, four being requisite for the food supply of one larva.

In the Trans. ent. soc. Lond. i, p. 203, Westwood gives an interesting account of the habits of *Cerceris arenarius* Linn. which forms a burrow in the sand and provisions it with a species of Cuculionid (*Strophosomus*) which it carries in flight by means of its four fore legs, its hind legs being extended. Other short-snouted weevils are also employed, such as *Pachygaster picipes*, *rancuss*, etc. According to Latreille, *Cerceris aurita* employs *Lixus ascanii* and other weevils. Westwood also mentions a cocoon of one of these species covered with debris of a multitude of a species of Chrysis, which he considered had probably served for food of the larva of one of these insects; while Packard, in his Guide, states that "Dufour unearthed in a single field thirty nests of *C. bupresticida* which were filled with ten species of Buprestis, comprising four hundred individuals, and none of any other genus; also that *C. tuberculata* provisions its nest with *Leucosomus ophthalmicus*, and *C. tricineta* with Clythra."

I can find nothing published on any American species; but Mr. H. G. Hubbard tells me that while a student at the Cambridge museum, some years ago, he observed a species provisioning its cells with the acorn weevil *Balaninus nasicus* Say; that specimens were given to Dr. Hagen and will be found in the Museum collection. From Mr. Hubbard's verbal description I think this insect may be *Cerceris venator* Cr.

*Cerceris fumipennis* Say provisions its cells with *Chrysobothris deutipes*, according to observations made by Mr. Hubbard.

The genus *Philanthus* Fabr. preys upon bees. Latreille who first discovered the habits of a species in this genus (Hist. nat. fourmis, p. 307) found that *Philanthus triangulum* Fabr. dug burrows in hot sandy situations and provisions its nest with honey-bees; a single bee being sufficient food supply for rearing a single wasp. The genus is poorly represented in Europe; but in this country we have many described species. Although so well represented, not a single note seems to have been published concerning the habits of any species.

In the south I have observed *Philanthus punctatus* Say preying upon *Halictus disparalis* Cr. and other small Halicti.

**Family VIII. NYSSONIDAE.** Although this family is represented in our fauna by 8 genera and 56 species, not a word has been published concerning the habits of a single species.

The genus *Gorytes* Latr. seems to confine its attacks to Homopterous insects belonging to the family Cercepidae. Westwood says:—

In June, 1837, I observed the female of *Gorytes mystaceus* engaged in protruding her legs and sting into a patch of the frothy secretion caused by the larva of *Aphrophora spumaria*, without, however, being able to dislodge the occupant. Subsequently I saw it similarly occupied with a drop of water, evidently mistaken for the froth, but unsuccessfully; but I shortly afterwards observed it with a larva of this insect, which it carried beneath its body by the help of its middle legs. Mr. Shuckard has also captured it, as well as his *G. Fargei* (= *G. campestris* St. Farg.?) with a similar prey.

The genus *Nysson* Latr. is said to nest in sand, but its prey has not been observed.

**Family IX. BEMBECIDAE.** This family comprises some of the largest and most showy of our fossorial wasps, no less than twenty-four species, distributed in nine genera, being known to occur in the United States.

The genus *Sphecius* Dahlb. comprise the giants of the family, which as a boy, were known to me under the name of Queen Hornets, and I really believed them to be Queens of the yellow-jackets. Although it has been known for years that our largest species, *Sphecius speciosus* Drury, formed its burrows in the ground and provisioned them with Cicadas, storing them with *Cicada dorsata*, *C. tibicens* and *C. marginata*, it was not until last year, in the publication of Dr. C. V. Riley's admirable article entitled "The larger digger-wasp" in Insect life, vol. iv, p.

248, that we had any information in detail of its habits, burrow, and development.

Dr. Riley is justly noted for the thoroughness of all of his entomological work, but in this paper, we have a model of just how the biology of our bees and wasps should be worked out; and I hope others will imitate it in working up the habits and development of other of our bees and wasps.

In this article Dr. Riley has given very thoroughly the entire life history of this interesting wasp, illustrating the same with most beautiful figures, the wasp with its prey, a diagram of its burrows, the position of egg attached to the Cicada, the larva, pupa, larva forming its cocoon, and the cocoon itself. I do not quote from it, as it is readily accessible and should be read by all to be thoroughly appreciated.

The habits of no other of our Bembecids seem to have been worked out in detail. In Florida I have observed *Monedula carolina* preying upon the large horse-fly *Tabanus atratus*, so troublesome to horses and cattle in the South. A singular peculiarity of this insect is its ability to fly backwards in front of a moving horse while watching the opportunity to suddenly bounce upon and seize one of these flies.

Mr. D. W. Coquillett tells me that while in California he has frequently observed *Bembex fasciata* Fabr. storing its nests with *Eristalis tenax*, while *Bembex obsoleta* Say employs flies belonging to the genera *Musca*, *Lucilia*, *Sarcophaga* and *Psilocephala*.

Here it will be well to quote from John Bartram's paper "On the yellow wasp of Pennsylvania" published in 1763 (Phil. trans., vol. 53 (1763), pp. 37-39), as I believe he has reference to a Bembecid. He says:—

I saw several of these wasps flying about a heap of sandy loam: they settled on it and very nibly scratched away the sand with their fore feet, to find their nests whilst they held a large fly under their wings with one of feet; they crept with it into the hole that lead to the nest and staid there about three minutes, when they came out. With their hind feet, they threw the sand so dexterously over the hole, as not to be discovered; then taking flight, soon returned with more flies, settled down, uncovered the hole, and entered with their prey.

This extraordinary operation raised my curiosity to try and find the entrance, but the sand fell in so fast that I was prevented, until by repeated essays I was so lucky as to find one. It was six inches in the ground, and at the farther end lay a large magot, nearly an inch long, thick as a small goose quill, with several flies near it, and the remains of many more. These flies are provided for the magot to feed on before it changes into the nymph state: then it eats no more until it attains to a perfect wasp.

It will be seen on reading the account of the habits of the European *B. rostrata* that this statement of John Bartram's, made one hundred and twenty-eight years ago, is now confirmed.

The European *Bembex rostrata* has been very thoroughly worked out by Mr. C. Wesenberg, in a paper in the Danish language, entitled "*Bembex rostrata*; its life and instincts," published in the

Copenhagen Entomologiske meddelelser, vol. 3, 1891.

As a familiarity with the Danish language is not one of my accomplishments, I am indebted to Mr. Martin Linell for a translation of some of the more important portions; and as Mr. Wesenberg has discovered many new and important facts in regard to the life history of this species, in many respects totally at variance with the habits of all other fossorial wasps whose habits have been investigated, I feel sure a *resumé* of them here will be appreciated by my readers.

It makes its cell two or three inches deep in solid sand covering it up with loose sand and generally also with a little flat stone to prevent parasites from gaining access to the larva. The cell measures one cubid inch, the entrance tunnel being one and a half centimeters long and arcuate. A cell contains four or five fresh flies (*Lucilia*, *Eristalis*, etc.) and torn off wings, sucked out thoraces, etc., and in the middle of these a big flat larva.

All other digger-wasps furnish the food for their young once for all, either first laying their egg, then putting in food, or first filling up the cell with food, then laying their egg on it, and covering the whole without again visiting their cell or seeing their larva. Such, however, is not the case with *Bembex rostrata*, for just as soon as the larva has hatched, the female makes visits to it several times a day bringing each time a fresh fly for its larva.

*Bembex*, according to Wesenberg, lacks the power of paralyzing its prey and all the flies are dead and show deep marks on the thorax just above the tegulae, made by strong jaws of the wasp.

In two cases, he found the eggs laid on a single fly *Pollenia*. When the larva is hatched the mother brings more and more

flies, the flies brought being larger and larger as the larva grows. With a larva not quite grown he found 4 *Eristalis*, 6 *Syrphus*, 2 *Musca*, and 3 *Anthomyia* flies.

The fully grown larva was of a greyish white color  $2\frac{1}{2}$  centimeters long, with the segments behind the head gradually expanded to the last segment.

Fabre took a young larva, fed it on flies, and before pupating it had devoured 82 flies.

He also says that 50 *Bembecids* will nest on a spot as big as a room, during a period of three months, the period for the development of each larva being two weeks. This will allow only five or six young ones for the season. But does each female have more than one nest? If so, how can it remember them? Mr. Wesenberg then tells how the larva forms its cocoon, quoting from Fabre, and follows with some remarks about the circle of small holes about the middle overlooked by Fabre.

As Dr. Riley has called special attention to similar holes in the cocoon made by *Sphecus speciosus* without satisfactorily explaining the reason for them, I give below what Wesenberg says about the formation of the cocoon and the reason for the existence of these holes.

The larva spins its cocoon thus: It first pushes all the remnants of food into a corner of its cell, spins fine white silk threads to all the walls, makes a net of pure silk supported by these threads, closed and tapering at one end but kept open at the other end by threads to the walls of the cell. Then the larva protrudes its head and scrapes sand from the wall; when it has a lump large enough it brings it by the mouth into its net and distributes the sand-grains uniformly over the inside with silk as cement. The outer side is then prepared with still greater care. Sand-grain after sand-grain is carried out and glued on, until the white silk cocoon is transformed into a dark brown sand cocoon. The sand lump is now used up, but still the cocoon is lacking a cover. A new lump of sand is now scraped together, taken inside

and the larva spins the cover of fine silk, dresses it with sand and then spins over the whole inside of its cocoon with a layer of fine silk so as not to scratch its fine thin skin. A circle indicates where the cover is fastened on. The cover loosens at this circle when the *Bembex* is ready to crawl out. This cocoon is water-tight. The larva changes skin after closing up its cocoon, becomes smaller and smaller and turns yellow, the head bends down under the thorax and it then hibernates.

Fabre has overlooked that the cocoon has about its middle a circle of 8 or 10 small holes and correspondingly on the inside as many small silk pads as covers. Underneath these pads are fine pits with elegantly polished sides, the bottom of these pits being perforated by a very minute hole that from the outside looks like a black puncture. Directly under the bottom is the dark brown sand cocoon.

What role have these communications played during the larval state?

Mr. Wesenberg's explanation is that when the larva has closed its cell it goes into a pseudo-pupa stage, and that within its body there still remains some particles of undigested food, which require air and oxygen for digestion, and that these holes are made purposely by the larva for admitting air, and just before the final pupal stage it closes them up, before spinning the silken pupal covering.

*Family X. LARRIDAE.* This is another family of digger-wasps, but with the species much more numerous although not so showy or highly colored as those in the preceding family. Several genera and between 60 and 70 species are known in our fauna.

The genus *Tachytes* Panzer comprise most of the larger forms. The

European *Tachytes pompiliformis* Pz., according to Shuckard, provisions its cells with small Lepidopterous larvae which is contrary to what has been observed of the species in America.

Mr. Wm. H. Patton, in Ent. news, vol. 3, p. 90, states that *Tachytes mandibularis* Ptn. is common at Hartford, Ct., "forming hillocks three or four inches in height and the same in breadth of base, upon the sidewalks and lawns about September first. It stores up *Xiphidium* for its brood."

Mr. D. W. Coquillett tells me in California he has observed *Tachytes rufofasciatus* Cr. storing its cells with young grasshoppers *Melanoplus cyanipes*; while *Tachytes harpax* preys upon *Xiphidium brevipenne*.

Dr. Riley, in Rep. U. S. ent. comm., vol. i, p. 317, states that *Larra* (*Larroda*) *semirufa* Cr. is reported to capture young *Melanoplus spretus*; while according to his ms. notes *Larra terminata* preys upon *Chortophaga viridifasciata*.

In the south, I have seen *Larra argentata* provision its cells with a small immature cricket; which it completely paralyzes before storing away in its clay cell. From a single cell, I have taken as many as six of the small crickets.

Mr. Patton (l. c. supra) says that *Lyroda subita* Say "is peculiar for its non-fossorial tarsi; and its method of carrying *Nemobius*, which it catches to feed its young is interesting. It holds the cricket by clasping the base of the antennae between its mandibles

and clypeus, the minute teeth here preventing the antennae from slipping—this explains the use of the teeth on clypeus.”

The species in the genus *Astata* Latr. prey upon Homopterous insects belonging to the Pentatomidae. The European *Astata boops* Schr. preys upon the nymphs of *Picromerus bidens* Linn., *Palomena viridissima* Poda and *P. dissimilis* Fabr., while in California Mr. D. W. Coquillett has taken *Astata nubecula* Cr. in October, preying upon *Thyanta rugulosa* Say and storing them in a burrow formed in a limestone formation.

*Family XI. AMPULICIDAE.* In this small family only a single species, *Rhinopsis canaliculata* Say, is found in the United States. It is exceedingly rare and nothing is known of its habits, but it has probably similar habits to its oriental cousin *Ampulex compressum* Fabr., which preys upon cockroaches.

*Family XII. SPHECIDAE.* The species, in this family, vary greatly in size and habits. It is represented in our fauna by about 80 species distributed in 9 genera, and some curious mistakes have been made about them both as regards the unity of habits in the species and their mode of living.

The genus *Sphex* Linn. preys upon young Acridiidae and Locustidae. Dr. Packard has observed *Sphex ichneumonea* L. in Massachusetts in the last week of July and during August and early in September, digging their holes in a gravelly walk.

The holes were four to six inches deep. In beginning its hole the wasp dragged away with its teeth a stone one half as large as itself to a distance of eight inches from the hole, while it pushed away others with its head. In beginning its burrow it used its large and powerful jaws almost entirely, digging to the depth of an inch in five minutes, completing its hole in about half an hour. After having inserted its head into the hole, where it loosened the earth with its jaws and fore legs, it would retreat backwards and push the dirt still farther back from the mouth of the cell with its hind legs. Just as soon as it reached the required depth the wasp flew a few feet to the adjoining bark and falling upon an *Orchelimum vulgare* or *O. gracile* stung and paralyzed it instantly, bore it to its nest and was out of sight in a moment, and while in the bottom of its hole must have deposited its egg in its victim. Reappearing it began to draw the sand back into the hole scratching it in quite briskly by means of its spiny fore tarsi, while standing on its two hind pairs of legs. It thus threw in half an inch of dirt upon the grasshopper and then flew off.

This is probably the case with all the species in this genus, only I think they must provision their nests with more than one locust.

Mr. J. Angus, according to Dr. Packard, has reared *Isodontia tibialis* St. Fargeau from a cavity previously tunnelled by *Xylocopa virginica*. This shows the species of this genus have different habits from *Sphex*, and is still further supported by an observation of Mr. D. W. Coquillett's, who tells me *Isodontia elegans* Pattn. in California preys upon *Oecanthus niveus* DeGeer.

The genera *Chlorion* Latr. and *Chalybion* Dahlb. are very closely allied in structure and color. Dr. Riley, in the Rep. U. S. ent. comm., vol. i, p. 328, says: "A steel-blue species, *Chlorion coeruleum*, though ordinarily using spiders, also employs locusts." This species, as far as my observations in Florida go, instead of "ordinarily using spiders" to provision its nest, invariably uses crickets, *Gryllus* and allies. This is also supported by Mr. Coquillett's observations on it in the West, who tells me he has taken it preying upon *Gryllus luctuosus*; also by Mr. Wm. H. Edwards's statement quoted by Riley (l. c. supra, p. 319), who took it in Coalburgh, W. Va., running about with a "hopper."

We have here, therefore, a case of mistaken identity, as it is *Chalybion coeruleum* Linn. and not the above species that preys upon spiders. Another curious error about this species has also crept into our literature, and is repeated again and again by our most prominent entomologists, which is that this also sometimes stores its cells with Lepidopterous larvae. This error probably occurred by some one finding in some of its cells Lepidopterous larvae, and without taking time to thoroughly investigate the matter, jumped to the conclusion they were placed there by the *Chalybion*, when in reality they were placed there by quite a different insect — an Odynerid or Eumenid.

There can be no doubt of this as I have in three cases succeeded in rearing the Odynerid.

*Pelopaeus cementarius* Drury, widely distributed all over North America, with three or four distinct varieties, and known as the "Mud-dauber" also preys only upon spiders. In another paper I hope to give a full account of its life history and parasites.

The genus *Ammophila* Latr. preys upon Lepidopterous larvae, or at least all true *Ammophilae*. In our fauna, I think we have two distinct genera confused.

*Ammophila sabulosa* Linn. of Europe, according to Latreille, provisions its cells with caterpillars and this agrees with the habits of the North American *Ammophilae*. Westwood, however, states that Shuckard observed this same species "dragging a very large inflated spider up the nearly perpendicular side of a sand-bank at least 20 feet high and whilst burrowing makes a loud whirring buzz." Shuckard here evidently mistook a species of *Psammophila* for this insect, which at a distance very closely resembles one of these insects.

Walsh discovered his *Ammophila pictipennis* in southern Illinois provisioning its nests with cut-worms and I have seen it doing the same thing in the South. In the Proc. ent. soc. Wash., vol. ii, 1891, p. 256, Mr. Theo. Pergande has published at length some interesting observations of his made on *Ammophila gryphus* Smith, which preys upon the larva of *Heterocampa subalbicans*; while in Ent. news, vol. iii, p. 85, Dr. S. W. Williston has published similar observations on a

species found in Kansas and other western states—*Ammophila yarrowi* Cr.

A single caterpillar usually suffices for the food supply of a single wasp-larva but this species brought caterpillar after caterpillar "till four or five of them have been stored up for the sustenance of her future offspring." Dr. Williston says:—

The things that struck us as most remarkable was the most unerring judgment in the selection of a pebble of precisely the right size to fit the entrance and the use of the small pebble in smoothing down and packing the soil over the opening, together with the instinct that taught them to remove every evidence that the earth had been disturbed.

In Florida I have seen *Ammophila cementaria* Smith preying upon a half grown Sphinx larva, which after paralyzing it seized by its large jaws just back of the head; and as the larva was too heavy for it to fly with, it straddled it and then dragged it off to its cell, moving forwards.

*Family XIII. POMPILIDÆ.* This family is well represented in our fauna by 10 genera and 127 described species, the majority of which seem to prey entirely upon spiders.

In the American naturalist for 1887, Dr. G. Lincecum has given us a most interesting account of probably our largest species, *Pepsis formosus* Say, known in the South as "The tarantula killer." It preys upon *Mygale hentzii* Girard and Dr. Lincecum, in speaking of the effects of the sting upon the spider, says:—

The effect of the introduction of its venom is as sudden as the snap of the electric spark. The wasp then drags it, going backwards, to some suitable place, excavates a hole five inches deep in the earth, places its great spider in it, deposits an egg under one of its legs, near the body, and then covers the hole very securely.

Just as is found to be the case among the true bees, some of the genera being parasitic or inquilinous on those of some of the others, so in this family we have at least one that is parasitic—the genus *Ceropales* Latreille, which lives in the cells of the others. St. Fargeau, as quoted by Westwood, seems to have been the first to observe this curious habit, "having often observed the females of this genus enter backwards into the nests of some of the real fossorial species, which he considered a certain proof that their object was to deposit their own eggs therein."

This parasitism has been confirmed in America by Walsh and Riley, who have bred *Ceropales rufiventris* from the cells of *Agenia bombycina* Cr. and other Ageniæ.

The genus *Agenia* Schiödt also preys upon spiders. Walsh and Riley in Amer. ent., vol. i, p. 131 have figured and described the thimble-shaped cells of four of our species—*Agenia bombycina* Cr., *A. corticalis* Walsh, *A. architecta* Say and *A. mellipes* Say—built under old bark of standing trees or under logs and stones.

From these cells, besides the *Ceropales* already mentioned, Walsh bred a Chalcid-fly *Pteromalus* sp. and *Osprynochotus junceus* Cr.



