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## Life History and Habits of *Polistes metricus* Say

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LIFE HISTORY AND HABITS OF *POLISTES METRICUS*,  
SAY.

FRANK C. PELLETT.

The summer of 1915 was not a favorable season in which to study life histories of such insects as the Gold Banded Paper-Maker. The weather was too cool and there was so much rain that results were anything but satisfactory. It is very probable that in a season of normal temperature the time required in the various stages of development would be somewhat shorter than was the case in 1915. However, since I have spent considerable time in observing these insects during the past summer, I am hopeful that these notes may be of interest. Two years before, a similar observation was begun, only to be interrupted shortly by the destruction of the nest.

The nest of this wasp is composed of a single comb, or series of cells opening downward. Unlike the species of *vespa* commonly known as hornets and yellow jackets, no outer covering is provided. While the nests are often placed under the cornice of a house roof, they seem to be more often placed near the ground under a box, or in an old can or other similar situation. Discarded beehives and winter cases offer attractive situations on my grounds and I have found several of the nests during the past summer.

The first nest was found on June 6th. At that time about half of the cells were built and a count showed that eleven contained larvæ and fifteen contained eggs. Two or three partly finished cells were empty. This nest was placed underneath the cover of an empty beehive. A better situation for observation could hardly have been found, since it was possible to take up the cover and hold it in any desired position, and return it to the former place, without disturbing normal conditions.

Figure 43, A, shows the nest as it appeared at that time with the mother *polistes* resting above. To get the proper perspective the pictures should be held above the head and be seen from below instead of from above.

At first polistes was much disturbed by my presence and seemed very nervous and moved above restlessly when I was near. However, the nest was visited so frequently and so many hours spent in observing her movements that she soon manifested little interest in my movements. As soon as she

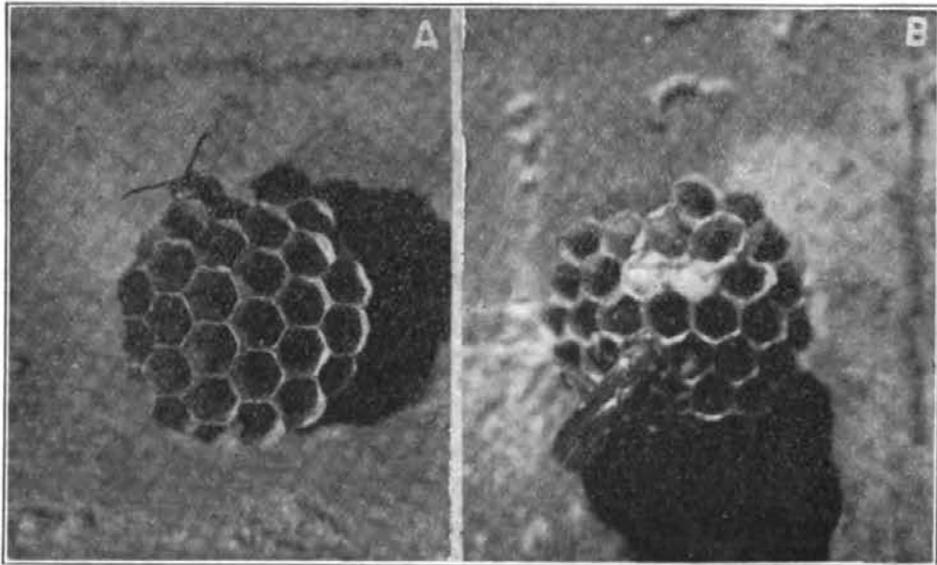


FIG. 43. A. Nest as it appeared when found. B. Polistes feeding her young.

became accustomed to my presence the cover was turned over, leaving the open end of the cells up to make observation easier. If the wasp flew away the cover always had to be replaced in its former position before she could find the nest again, although she would continue her normal activities with her house up-side-down.

The eggs were not placed in the center of the bottom of the cell where the queen bee deposits her eggs, but were attached to the sides of the cells a little above the bottom. When the eggs hatched they remained attached to the cell in the same position. The mother spent much time in feeding the young, giving them such attention very frequently on warm days, and also spent a great deal of time with her own toilet. After every feeding she would carefully clean first one leg and then another and brush every particle of dust off her body and head.

Soon after the nest was found the weather turned cool and it rained. With the temperature at about fifty degrees the mother settled herself quietly above the comb and made no move to feed her young or to continue her building. Even

when visited and the nest turned topsy turvy, she hardly moved from her resting place. Although it remained cool for two days, the larvæ were not fed as far as could be seen. The weather warmed somewhat on the afternoon of the third day, but the wasp was not apparently conscious of it. The fourth day she became very active again, and fed the young almost constantly. At times she would bring little balls of food which apparently were caterpillars, which she had caught and kneaded into pulp between her mandibles. At other times she would seem to feed the very young larvæ when she apparently had nothing to give them. That she did feed them was evidenced by the movements of their lips after she withdrew from the cell. Apparently the very young larvæ are at times fed with regurgitated food. Usually the balls of food which she brought home were about the size of number eight shot. After kneading such a bit carefully, turning it round and round between her jaws, she would divide it into two or three parts and give it to the larger larvæ. Sometimes they would suck these bits for several minutes, when the mother would take them again and eat them herself or feed them to other larvæ. At other times, the youngsters would swallow them entirely after sucking them for some time.

One day I caught a mosquito, and rolling it between my finger and thumb, imitated as best I could, the kneading which the wasp gave the food. Then placing it on a grass stem it was given to a larva. The little larva opened its mouth much like a young bird waiting to be fed, took the mosquito and tried for some time to eat it. A red mite was caught and given to another larva in similar manner. The mite being very small was swallowed at once, but the other larva was still wrestling with the mosquito when the mother returned and took it away. After kneading it for a time, she ate it herself. Other mosquitoes were caught and offered in the same way, but she seized them, bit them viciously and dropped them at once. She became much agitated and flitted her wings in a most nervous manner. Such a bit was then fed to a larva without attracting the attention of the mother until it had tried for some time to dispose of it. Again she took it and kneaded it for a time and this time fed it to another larva, which swallowed it. Thus I took lessons in feeding the young larvæ, which were destined to stand me in good stead later in the season.

Some days elapsed before I saw the wasp in the act of enlarging her nest. I had seen her tear down parts of the cells when she was agitated and could hear the cutting of the paper with her sharp mandibles. After kneading the bits of paper for a moment, she had fed them to larvæ which ate them with apparent enjoyment. I had also seen her give a touch now and then as though in the act of adding something and had about decided that she did such work at odd moments, with but a touch here and there. However, on the 25th of June after nearly three weeks of watching, I saw her hard at work. It must be remembered that the weather was cool and wet and seldom favorable to activity of this kind.

She gathered her raw material near at hand and it was easy to follow her from her nest to a weather beaten post a few feet distant, where she secured her wood. After alighting on the post she would cut away enough of the exposed wood to make a good mouthful. She would then fly directly to the nest where she would stand for a moment kneading the pulp between her jaws and with her forefeet turning it round and round. She would then spend some time looking over the comb to find the most favorable place to work. When she had satisfied herself as to the place to begin, she would bite the soft pulp against the top of the partly constructed cell. It seemed very soft and waxy and spread easily. She pushed her forefeet against the opposite sides of the thin wall, backing slowly around the cell and drawing out the new tissue very thinly. Sometimes she would pass entirely around the cell and sometimes only part way. At times she would add as much as a sixteenth of an inch to the structure with a single mouthful and but two or three minutes were necessary to get fresh load of raw material. After each trip she would rest for a moment and make her toilet. Then she would peek into a few cells and be off again for another load.

Between times, she made a very elaborate toilet, sometimes standing on her hind legs and rubbing the other four together. At other times she would stand on her forelegs and extend the others behind her. Rarely she stood on her right middle leg in about her normal condition and stroked herself with the others as well as rubbing them together. Standing thus on one leg she presented a striking appearance.

Although much time was spent with the wasps nearly every day, it was a long time before the mother was observed in the act of laying. When the weather was nice she laid an egg nearly every day, as was observed by careful note of all empty cells. In cool weather she would sometimes miss a day, or even two or three. She laid on the 11th and 12th of June, then again on the 14th and 15th. Only one more egg was laid until the 20th. Apparently the wasp was very sensitive to weather conditions.

Finally by noting the conditions at the various times of my visits it was determined that the eggs were laid in the morning between eight and eleven o'clock. Accordingly on the last day of June, even though I had an engagement in a distant city, I determined to see the egg laid before leaving. I took up my watch shortly after eight o'clock and waited rather impatiently. The mother was rather sluggish and there was little action to keep up interest for nearly two hours, before she began preparing for her day's work. She would remain entirely motionless for many minutes at a time, then she would look into a few cells, and again become quiet. Finally about ten-thirty a. m., she flew away and was gone but a few minutes. On her return she began looking about in search of an empty cell. Finding one by pushing her head deeply into it, she doubled herself very shortly, and reversed her position, placing her abdomen into the same cell. She then remained very quiet with her head toward the center of the comb for several minutes. At last she moved out and again put her head in to see that the newly laid egg was in its proper place. Afterward she again became quiet for some time. Although I came near missing the train as a result of the long wait, I felt that the time had been well spent, and thereafter had no further difficulty in observing the egg laying as frequently as I wished.

A number of eggs were marked to ascertain the period required for hatching. Most of them hatched in just eighteen days. When the weather warmed a bit some hatched in sixteen days. Since the weather was cool and the temperature so much below normal probably this is longer than the normal period. A number of those observed spinning their cocoons spent twenty-three days in the pupal state. A few individuals required twenty-five days to complete the transformation.

Two years before, some under observation completed this stage in only fifteen days according to my notes, which indicates that weather greatly influences the length of the various periods of development.

When the larvæ had completed their growth, the spinning of the cocoons was an interesting observation. It was on the 24th of June that the first two completed this performance. Although the operation was not timed, probably not more than an hour was required to spin the cocoon. The silk was very filmy and so fine that a single strand could hardly be seen with the naked eye. During the spinning the larvæ moved their heads back and forth, round and round, constantly adding to the web. At first it was very thin and the inmate of the cell could plainly be seen at work through the thin network. It gradually thickened, until the spinner was entirely hidden from view, although the movement continued for some time after the covering became opaque.

Thinking to see something of the transformation a small hole was cut in the top of one of the cocoons. The day following the cell was found to have been emptied and a new egg placed therein. Apparently this change is not for the eyes of man to see.

As the days passed, the experiment of feeding the larvæ was continued. Mosquitoes being plentiful in the weeds near at hand, they were caught daily and fed to the larvæ. At times the mother would take them away and eat them herself. At other times she would feed them to the youngsters as already described. More often she would resent the interference with her family affairs and toss the dead mosquito contemptuously away. At times when she became nervous or angry she would cut the tops of some of her paper cells. Snip, snip she would cut away using her mandibles like a pair of scissors. Although on such occasions she was watched closely, she was not again seen to feed the paper to her offspring as in the one instance already described. When she was offered small caterpillars in place of the mosquitoes, she would accept them readily, roll them up into a ball and knead it vigorously and then feed the larvæ.

On warm days polistes was very active. Between her building and the feeding of the larvæ she was busy, indeed. After

each trip afield, whether for food or wood pulp, she would tarry for a minute or two to clean herself carefully from any clinging dust and be off again. As the season advanced the number of larvæ increased and made a corresponding demand upon their mother for food. By the middle of July several had spun their cocoons, but more eggs were being laid in the newly built cells and other eggs were hatching.

On the morning of the 16th of July the nest was visited as usual. There had been a heavy rain lasting through most of the night before. The nest was dislodged and had fallen to the ground and the mother wasp was nowhere to be seen. The nest was carefully replaced and fastened to the board with glue and pins. After waiting all day for the return of the mother it became apparent that she was lost. I could ill afford to lose the wasp family at this stage of the observation, for eggs, larvæ and pupæ were marked to ascertain the period of development. Near at hand was another similar nest, but the mother was not a lively individual, and the nest was composed of but a few cells. The nest containing the motherless family was fastened close beside her own to ascertain whether she would adopt the unfortunates.

The foster mother did not take kindly to such an arrangement and moved rapidly over the strange comb, flitting her wings violently, and showing marked evidence of displeasure. Since she had seldom been visited I felt that possibly my presence was responsible for her agitation, and accordingly she was left alone until the following morning in order to give her an opportunity to become accustomed to the unusual condition. On my return the next day she had her head in a cell and backed out with an egg in her mandibles which she proceeded to eat. An examination showed that she had disposed of some of the larvæ in similar manner. Since I could ill afford to have the observation terminated in such a cannibalistic manner, the nest was taken to the study to see what could be done toward raising the youngsters by hand.

I soon realized that I had undertaken a rather novel experiment. There were eggs which would hatch every day or two for three weeks, young larvæ just hatched and others in every stage of growth. There were also a considerable number of sealed cells, but as yet none of the pupæ had emerged. I began to frequent the cabbage patch in search of small

caterpillars or cut worms. The unfortunate worm when found would be placed on a board and cut into bits with a sharp knife. The bits were fed to the larvæ with a grass stem. It was found easily possible to feed the larvæ, but the younger ones did not thrive.

On the 18th of July the first wasp emerged. It was a female and a perfect image of her missing mother. I now felt my hopes rise high, for would not the newly matured polistes mother her unfortunate sisters. The nest was placed on the porch of the study in order to give her an opportunity to fly to the fields in search of food, as soon as she was old

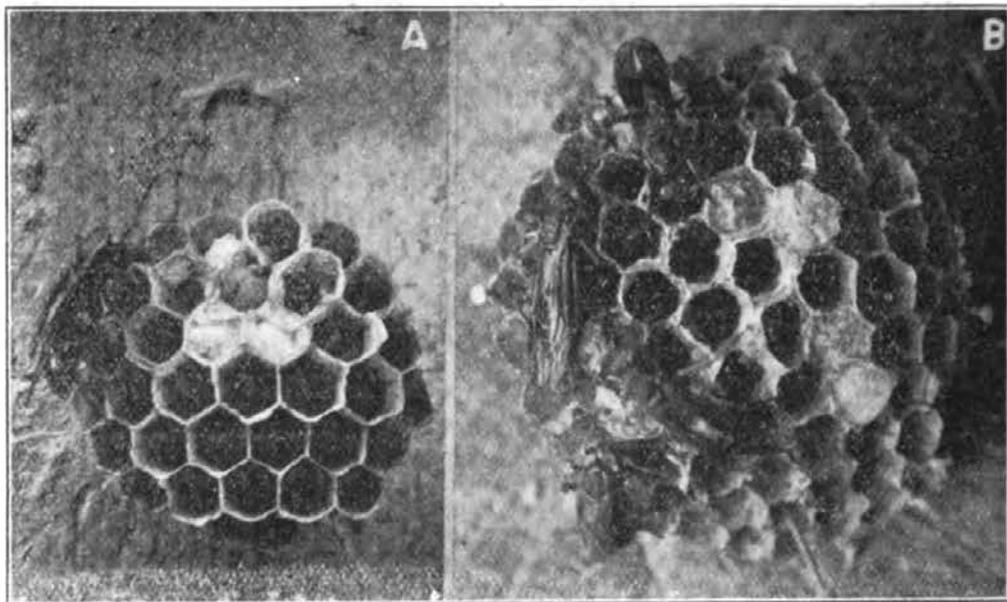


FIG 44. A. Larva spinning its cocoon. B. The completed nest.

enough to assume such a responsibility. The same day a second female emerged, and I felt that soon I would be relieved of my arduous task. It is not easy for a mere man to mother his own offspring at a tender age, and when it comes to feeding newly hatched wasps, he is hardly prepared to do justice to the needs of the infants.

Within a few hours after the emergence of the young wasps, a caterpillar was cut up for the young larvæ as usual. Instead of feeding it to them directly, it was given to one of the elder sisters to whom I was looking for expert assistance. To my great joy she took it and holding it between her forelegs, kneaded it exactly as I had seen her mother do

many times. After the food had received suitable preparation she fed one or two of the larvæ. This action within a few hours after her own emergence convinced me that my troubles were over. However, I was doomed to disappointment, for this proved an unusual case. As others matured and the nest became populous with adult females I was greatly disappointed to find that they not only would not forage for the family but only now and then would they take the trouble to feed the infants when worms were brought to them. The mature wasps remained but a few days until they disappeared.

By the fifth of August about a dozen had emerged and only one remained at the nest. A larva which had hatched on the 29th of June died that day. Although I had kept it alive for twenty days after its mother disappeared it was apparently no larger than when she herself had last fed it. While my careful ministrations had been sufficient to enable the larger larvæ to complete their growth the food which I was able to supply did not meet the needs of the younger ones. Either it was not suitable in quality, was not properly prepared or else it was not supplied in sufficient quantity or at proper times. At any rate I did not succeed in rearing any of the larvæ that were less than half grown when the mother disappeared.

About this time I found another nest of the same kind under the eaves of the study and having given up hope of further success by hand, the nest containing the motherless family was pinned beside it to see whether there would be any better success in getting the orphans adopted than in the previous instance. The weather was still cool and wet. The summer of 1915 was a record breaker in this respect. A week later the abandoned nest still remained beside the other, but the mother of that family had apparently gone also. Two other nests were examined at that time only to find them deserted.

On the same day, August 12th, I found another nest of polistes which previously had been overlooked. It was larger and more populous than any of the others. All the others except the unfortunate one which had received so much attention had been small and all the mothers had disappeared early. Since no males had been seen up to this time I was

much pleased to find a family in normal condition. An examination showed that there were still eggs and young larvæ in the new nest, beside pupæ and seven adult females. I was so curious about the new discovery that four stings were the net result of the first day's observation. On September 4, there was only one egg still unhatched but no males had appeared. It was not until September 10, that the first male emerged. He was recognized instantly by his lighter color and bright yellow face. The seven segments of the abdomen and the absence of a sting established the sex beyond question. For several days about as many males emerged as females, but soon the males predominated. By the 21st of September more males remained at the nest than females. Since as many wasps were deserting the nest as were emerging from the pupal state, there was no permanent increase in the population.

The last larva died on October 3d. It was nearly grown but apparently had not increased in size for many days. Apparently it was fed just enough to keep it alive but not enough to enable it to complete its development. It was about the size of one that was hatched on August 10th. Although the date of the hatching of this particular larva had not been noted, indications were that it was about the same age. If so it lived for about fifty days without being able to complete its development. At that time there were a few sealed cells from which pupæ were still to emerge and one lone female remained at the nest. The season had been so abnormal that it was impossible to make satisfactory observations on which to base an estimate of the normal period required to complete the life cycle. It so happened that something happened to every larva marked to ascertain the time of the larval period and it was evident that the variation was so great on account of variable weather conditions that the period required by a single one would have been of little value. While I am hopeful of getting more satisfactory information concerning the periods of development another season I have no expectation of again attempting to rear a family of wasps by hand.

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