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THE NEST OF *ODYNERUS TEMPIFERUS* VAR. *MACIO*
BEQUAERT, WITH NOTES ON THE HABITS OF THE
WASPS¹

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ALTHOUGH much has been written on the habits of various solitary wasps, nearly all the available information has to do with the construction and storing of the cells and the capture of the prey. Little has been recorded concerning the habits of the insects immediately after reaching the adult stage.

The rearing of a series of individuals of both sexes of *Odynerus tempiferus* var. *macio* Bequaert² from a nest brought to us by David I. Bushnell, Jr., gave us an opportunity for making notes upon the habits of this wasp based upon individuals the entire history of which, as adults at least, was known. As the nest was too fragile to send to Dr. Bequaert for study after the emergence of the wasps, a description of it is included herein.

Locality.—At the mouth of Tobacco Creek, between Essex and Caroline Counties, Va., 25 miles from Fredericksburg. The nest was collected by David I. Bushnell, Jr., on October 15, 1935.

Nest.—The nest was constructed about a fork in a slender alder (*Alnus rugosa*) twig that is 4 mm in diameter just beneath the nest.

¹The studies recorded herein of the reactions of these wasps to light were made in cooperation with Dr. E. D. McAllister, Division of Radiation and Organisms, Smithsonian Institution.

²Proc. U. S. Nat. Mus., vol. 84, pp. 79-88, 1936.

The weight of the nest (3.5 ounces with the surface dry) bowed the twig so as to bring it within 4 or 5 feet of the ground.

The nest consists of a large, somewhat irregular mass, with large, low, broadly rounded humps. It is constructed chiefly of coarsely sandy clay. On the surface are embedded a few large quartz grains up to 2.5 mm in diameter. In one place there is a rounded patch or overlay about 10 mm in diameter of finer and lighter-colored clay. The length in the direction of the supporting twig is 60 mm; the greatest diameter, at right angles to the length, is 60 mm; and the least diameter is 55 mm.

There are 21 included cells. These are kidney-shaped, with the concave side toward the twig, 12 to 15 mm long and 7 to 9 mm high in the middle. They are somewhat broader than high. In transverse section the floor, always toward the twig, is seen to be straight, the sides and top strongly and evenly arched. The partitions between the cells are 3 to 5 mm thick in the thinnest place.

The first cell is placed in the fork with the long axis at right angles to the plane of the diverging branchlets and the sides almost touching them. The concave side, or floor, is toward the fork and 10 mm distant from it. The second and third cells are on either side of the fork, on the outer side of the diverging branchlets. The other cells are arranged concentrically about the fork as a center, all evenly spaced from one another, the long axes running in any direction.

The nest was brought to us in the middle of October and was kept indoors during the winter. It probably was not exposed to a temperature of less than 65° F. during that time. It was placed in a cloth-covered glass jar with about an inch of saturated newspaper in the bottom, and the surface was thoroughly soaked under the tap once or twice a week.

This soaking of the surface had the effect of washing out the colloidal material, so that by the time the wasps were ready to emerge the surface had become very friable, fine sand falling from it at the slightest touch or jar. The effect of this would be greatly to facilitate the emergence of the insects.

A thorough search was made for the remains of the insects with which the cells had been stored, but no trace of any was found.

The cocoon, formed of a rather sparse layer of silk supporting a continuous sheet of gummy substance, is thin and delicate.

Emergences.—Two males, March 4; two males, March 5; the emergence of the males occurred before 9 a. m., except in one case in which the emergence was not completed until shortly after that time.

One female, March 15; one female, March 17; on March 18 the nest, which had become very dry, was thoroughly wetted about 10 a. m., and within 15 minutes a female emerged; one female, March 19; one

female, March 23, at 9:15 a. m. and another on the same date at 10 a. m.

Total, 4 males and 6 females.

The male that emerged shortly after 9 a. m. was assisted by the wetting of the nest. Not long after emergence he retreated within the cell and remained looking out. The female that emerged after the wetting of the nest retired into a cell about 1 p. m. and spent the rest of the day there.

The emergence holes of the males are 4 mm in diameter and those of the females are 6 mm in diameter.

Parasite.—One of the cells that was opened before the emergences began contained a dead larva and a dead adult tachinid, with its pupal skin. The tachinid was very moldy. It was determined by David G. Hall as one of the *Miltogrammini*.

Contents of other cells.—Dead larvae, 4; dead male, 1; dead female, 1; crippled female, 1; male ready for emergence (March 3), 1; living larva (February), 1; empty, except for mold, 1.

Habits.—Immediately after emerging most of the wasps were nervous and suspicious, and if a hand was brought within 4 or 5 inches of them they faced it and took a defensive attitude. But none of them were in the least aggressive, and the female that emerged on March 23 paid no attention to a finger within half an inch. The suspicious attitude on the part of the others was soon lost, and they showed no concern when objects in their jar were rearranged with the hand or when a finger came within an inch or less of them. However, they were not disturbed on sunny days when they were flying about.

In sunlight they are very active, but if it becomes cloudy they cease flying at once, crawl about for a while, and come to rest, no matter how warm it may be.

The flight of the females is direct and clumsy. The flight of the males is more agile than of the females, with frequent quick turns and much hovering, accompanied by an oscillation from side to side covering a distance of about an inch and a half. The females occasionally hovered, remaining stationary in the air with the body at an angle of about 45°.

When resting the wings are held parallel close down upon the back, and usually the fore legs are drawn up from the supporting surface, sometimes with the tips of the tarsi crossed. The antennae diverge at an angle of 90° and are slightly ascending. In the females the antennae are straight, but in the males the distal fourth is recurved so that the tip points backward at an angle of about 45° with the body axis. When completely at rest the head is tilted forward and the antennae are depressed so that they almost or quite touch the supporting surface.

Two tall corks placed in the jar were greatly appreciated, and at least one or two of the wasps could always be seen resting upon them. The first female to emerge had a very characteristic defensive attitude. She stood with the body making an angle of about 45° with the direction of the annoying finger, head to the left, the body tilted to the right side and the abdomen turned slightly to the left. The legs of the first pair were drawn up close against the body, and the tarsi twitched constantly, about once a second, sometimes simultaneously and sometimes alternately, or changing from one to the other. This female was irritable and bad tempered. If any of the others approached her when she was resting she would make a lunge at them, without moving her feet, and menace them with her jaws. For resting she always chose a place near the bottom of the jar on the dark side of one of the corks. She was never able to climb up the glass side of the jar. Her never-failing bad temper, combined with her small size and other features, made her always readily identifiable.

The second female to emerge, which was considerably larger than the first—in fact the largest female of all—was of a very placid disposition. At first she was mildly startled at the appearance of a finger close to her, but only to the extent of facing it and watching it closely. She never assumed a defensive attitude, and never, except when resting, drew up the fore legs. She was able to climb up the glass without difficulty and at once chose the cloth covering of the jar as a resting place (as one of the four males had done), on the first day spending a large part of her time trying to bite through it. Two of the females that emerged later often joined her on the cloth.

All the females but the first were good tempered and, though not particularly sociable, never menaced one another.

At the time the first female emerged the only surviving male seemed entirely inert, spending all his time resting on the dark side of a large cork. But with the introduction of two females into the jar he immediately became very lively.

Having been in the jar for many days he knew it well and flew about without hitting the glass sides or falling into the water dish. The females frequently bumped into the glass and often, rebounding from the glass, fell into the water back downward. One of them always extricated herself without difficulty, but on the first day of their imprisonment the others had to be lifted from the water several times. But in less than two days they too learned the limitations of the jar and how to avoid the hazards of the water dish.

The wasps were fed on honey and water, which they ate readily. They would not eat sugar and water. Only one displayed any interest in cherry flowers.

On March 26 a female was placed in a large jar with a heap of mud at one side of the bottom on which was a small pool of standing water, a sprig of flowering cherry, and a forked privet twig. The day was cloudy, and after moving about the jar in a desultory way for about an hour the wasp came to rest behind the bottle of water holding the twigs. The next day was rainy, and the wasp spent the day at the top of the privet twig resting with the tip of the abdomen touching the twig and the body making an acute angle with it, and the forelegs drawn up close to the body.

On the day following the wasp came to the mud at 9 a. m., rested on it for about half an hour, then crawled up the privet twig to the cloth. When sunlight entered the jar the wasp became very active, but spent most of its time on the sunny side of the jar, showing no interest in the mud. It died the next day.

The four remaining females were transferred to the large jar on March 30. None of them showed any interest in the mud.

The first female to emerge died on March 31; she retained her bad disposition to the end, from time to time hovering near and pouncing upon the others.

The last surviving male died on March 26.

The three remaining females were transferred to petri dishes on March 31 for the purpose of subjecting them to experiments with light. All three were found dead on April 3.

After being placed in a petri dish 150 mm in diameter and 20 mm high with white blotting paper covering the bottom, each of three females at the first opportunity (two days later) made a complete examination of the container, running rapidly and irregularly about and investigating every portion of the bottom, top, and sides.

In one petri dish there was on the blotting paper a small blackish spot with a light border about 2 mm in diameter situated 50 mm from the edge. This was promptly discovered by the wasp, which suddenly stopped and whipped down the antennae so that the tips almost or quite touched it, remaining motionless for a second or two. It then started off again but soon returned to the spot, remaining for a short time motionless as before. Every few seconds, after running irregularly about over the blotting paper, it would rush directly to the spot, depress its antennae, and remain motionless. The intervals between the examinations of the spot gradually became longer, but not until it had approached the spot from every direction did it cease making occasional dashes to it.

After the wasp had thoroughly and completely studied the location and nature of the spot, it developed an interest in a small area at the edge of the dish where the blotting paper was turned upward and frayed. Previously it had paused here a few times in passing; but now it turned its entire attention to this region, occasionally leav-

ing for an irregular circuit of the petri dish, but soon returning. It turned its head down so that the front of the head was parallel with the plane of the paper and tore at the fibers with the serrate anterior edge of the mandibles, frequently turning on its side to work to better advantage.

It paid no attention whatever to small spots caused by shadows.

Reactions to light.—A very brief study of the response of the wasp to illumination by light of different wave length was made on the first and second of April. This study was terminated all too suddenly by the death of the three insects—not as a result of the light treatments given. The results are very interesting but cannot be taken as conclusive because of the meager data obtained. They are briefly recounted merely as suggestive of new lines of study.

A quartz monochromator and mercury arc was used to supply radiation of definite wave length. This instrument gave a strip of light about 1 inch wide across the petri dish in which the insect was confined. The intensities of each wave length used were adjusted to equality, this value being 0.0005 watts to the square centimeter (1/200 total sunlight intensity), which for the yellow light was about 50 foot-candles. The white light was obtained from a 60-watt bulb and a daylight filter, the filter being used to approximate sunlight quality.

The notes taken on the reaction of these insects to the various illuminations are given in table 1.

For equal incident energy of the different wave lengths it is seen that the shorter wave lengths, violet and ultraviolet, consistently give a greater stimulus to activity. Yellow and green light give only a weak stimulus.

The shortest wave lengths used, 3,130 Å, gave the greatest stimulus—to the one insect subjected to it. The response to white light was quite striking in comparison with that for the colored light. In this case almost an equal response was observed for about one one-hundredth the intensity of the colored light.

TABLE 1.—*Reactions of wasps* (*Odynerus tempiferus var. macio Bequaert*)
to light

April 1, a. m.

Wave length	Intensity	Insect no. 2	Insect no. 3	Insect no. 4
Å				
5,780.....	100 foot-candles (0.0005 watt/ cm ²).	No response in 1 minute.	No response in 1 minute.	
5,461.....	.....do.....	.....do.....	.....do.....	
4,358.....	.....do.....	.....do.....	Definite response (1 minute).	Response.
4,047.....	.....do.....	Definite response.....	.....do.....	Definite response.
3,650.....	.....do.....	Response.....	Response.....	Response.

TABLE 1.—*Reactions of wasps (Odynerus tempiferus var. macio Bequaert) to light—Continued*

April 1, p. m.

Wave length	Intensity	Insect no. 2	Insect no. 3	Insect no. 4
Å				
5,780.....	100 foot-candles (0.0005 watt/cm ²).	Response 45 seconds after exposure.	Response 25 seconds after exposure.	Response 15 seconds after exposure; quit after 45 seconds.
4,047.....	do.....	Immediate response.	Immediate response.	Immediate response.
5,780.....	do.....	do.....	Abdominal breath- ing only.	
4,047.....	do.....			Response after 50 seconds exposure.
3,130.....	do.....	Response in 5 sec- onds; after several minutes became very active; tried to fly; stayed in illuminated strip.		
5,461.....	do.....			Breathing only; no activity in 7 min- utes.
4,047.....	do.....	Breathing after 50 seconds; active walking only after 6 minutes; tried to fly after 12 min- utes.		

April 2, p. m.

White light (day- light filter).	5 foot-candles.....			2:45 p. m.; started walking immedi- ately; studied sur- roundings in nor- mal manner.
Do.....	50 foot-candles.....			Moved from 5 to 50 foot-candles; same normal activity; tried to "dig out" of chamber.
Do.....	500 foot-candles..	3:29 p. m.; very defi- nitely stayed in strip of light; after 8 minutes began exploring dark part of chamber.		
Do.....	8 foot-candles.....			3:44 p. m.; after 40 seconds started ac- tivity; still familiar with its chamber, explored dark re- gions.
Do.....	Less than ½ foot- candle.		3:53 p. m. started exploring after 2 minutes; continued for 1 minute, then rested in light for several minutes.	
Do.....	Less than ½ foot- candle.	About the same re- sponse as no. 3.		