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THE LIFE HISTORY OF *ULULA HYALINA*
LATREILLE.¹

J. F. McCLENDON.

WHILE collecting insects in Galveston, Texas, during June, 1900, I found specimens of *Ulula hyalina* Latreille, and at the suggestion of Dr. Wheeler kept them alive for the purpose of obtaining their eggs and following their larval and pupal development. The insects would fly against the sides of the large glass jar in which they were kept, and finally killed themselves; but two females deposited their eggs before they died. After many of the eggs and young larvæ were destroyed by various accidents, I finally succeeded in raising two larvæ. One of these I preserved when full-grown, the other after it had pupated. Later I obtained several imagoes from different localities and one full-grown larva from Austin, Texas. After reading the few notes that have been published on the life history of this interesting insect, I concluded that a more thorough treatment of the subject would not be out of place.

The first notes on the life history of the Ascalaphidæ, the family to which our insect belongs, were published in 1826

¹ *Contributions from the Zoölogical Laboratory of the University of Texas*, No. 27.

by Guilding, who is perhaps best known to zoologists as the discoverer of *Peripatus*. These notes were on the life history of *Ulula macleayanus* Guilding,¹ which is synonymous with *Ulula hyalina*, or a variety of it, occurring in the island of St. Vincent, West Indies, where Guilding obtained his specimens. His description is meager and, to some extent, erroneous; but the arrangement of the repagula has not been observed subsequently, to my knowledge. Hagen published a paper² in 1873,

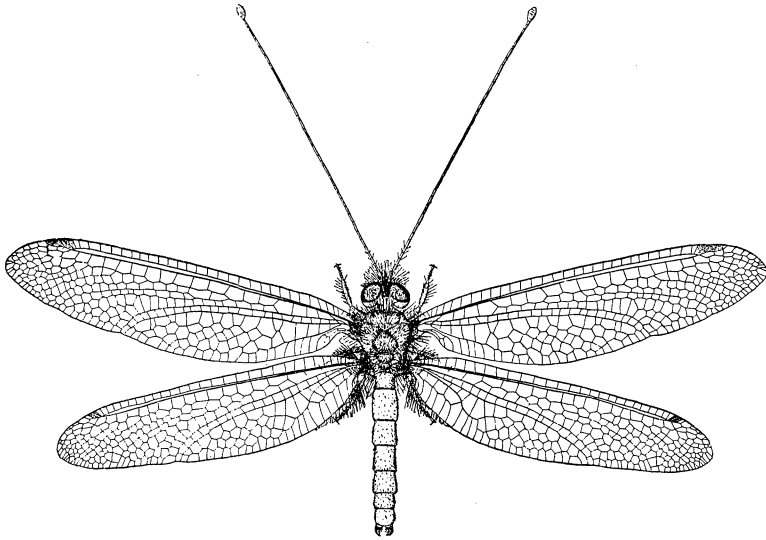


FIG. 1.—*Ulula hyalina* Latr. Male.

which contained short descriptions of sixteen species of Ascalaphidæ. He repeated Guilding's descriptions and also described the larva of *Ulula senex* Burm., ignoring the fact that it was synonymous with *Ulula hyalina* and, consequently, also with *U. macleayanus*. Westwood wrote a review in 1888 of the previous papers on the life history of the Ascalaphidæ³ and added a short life history of a Ceylonese species, perhaps *Ascalaphus insimulans* Walk., accompanied by figures, but

¹ The Genus *Ascalaphus*, *Transactions Linnæan Society*, vol. xv, p. 509.

² Die Larven von *Ascalaphus*, *Stettiner entomologische Zeitung*, Jahrg. xxxiv (1873), p. 33.

³ Notes on the Life History of Various Species of the Neuropterous Genus *Ascalaphus*, *Transactions Entomological Society*, London, 1888, pp. 1-12, Pls. I, II.

failed, as did Guilding and Hagen, to work out the mouth parts thoroughly. A good description of the ant-lion's mouth parts, which are very similar to those of the ascalaphid larva, may be found in a paper by Redtenbacher¹ as early as 1884. Hagen and Westwood do not appear to have been familiar with this paper.

Ulula hyalina is distributed over the southern half of the United States, Mexico, and the West Indies, but is comparatively rare in many of the places where it is found. The insect (Fig. 1) when at rest remains motionless on some small branch or stalk, head down, with wings and antennæ closely applied to the branch, and abdomen erected and often bent so as to resemble a short brown twig or dried branch. On being approached, the insect moves to the opposite side of the branch, and, on being further disturbed, flies to another branch and alights with head up, then quickly turns and assumes its characteristic attitude. I found specimens on stalks of green sedge near the beach at Galveston, Texas. The insect contrasted strongly with the green stalk, but there were, near the tops of the stalks, brown seeds which resembled the insect and made it hard to find.

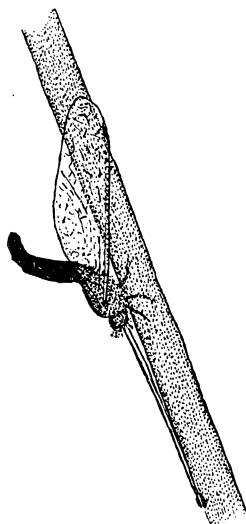


FIG. 2.—*Ulula hyalina*. Male, life size, resting on a stalk of green sedge.

Guilding says the eggs (Fig. 3) are placed in double series of 64 to 75, near the end of a branch, and are fenced off by little rods, which he called "repagula" (Fig. 3), placed on end and arranged in circles around the branch below the eggs, thus preventing the approach of insects and the wandering abroad of young larvæ until they can climb over the repagula and have likewise acquired strength enough to resist ants and other insect enemies. I observed one of my specimens from Galveston deposit its eggs and repagula; but it was too weak

¹ Uebersicht der Myrmeleoniden-Larven, *Denkschriften der Kaiserlichen Akademie der Wissenschaften*, Bd. xlviii, Taf. VII. Wien, 1884.

from confinement to remain on the stalk on which it rested and fell to the ground, so that I could not tell how it would have arranged the eggs under normal circumstances. These repagula I find to be in all probability abortive eggs, since dissection shows that some of the tubules of the ovary produce eggs, and others repagula.

The eggs hatch after nine to ten days. The young larva remains quiet a day or two, after which it seeks the ground.

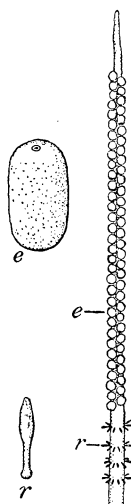


FIG. 3. — *Ulula hyalina*.
Egg and repagulum;
and a figure showing
the arrangement of the
eggs and repagula on a
stalk, according to
Guilting's description:
e, egg; *r*, repagulum.

The larva, while growing in size, always retains the form shown in Fig. 4, except that after hatching and after each moult the head is proportionally larger. It hides in some slight depression or under the edge of a stone, with its body covered with sand and its mandibles widely extended so as to touch the fringe of hairs on each side of the head. Its brown color simulates the surroundings. Its body is hidden by the covering of sand, and the head is somewhat concealed by its peculiar covering of hairs (Figs. 4, 5, 12), so that small insects may crawl, unawares, too near the extended mandibles. In this case the larva thrusts out its head and snaps the mandibles together, pinioning the victim on the curved points. It then proceeds to suck out the juices of its prey like an ant-lion. In the latter this is accomplished, according to Redtenbacher, by the expansion of the pharynx, the juices passing through the

duct formed by the mandible and maxilla fitting together (Fig. 6). The wound is kept open by the maxilla working like a piston in the groove of the mandible. The palpi at the same time move back and forth slightly. The labium and ligula are folded back into the mouth and adhere together so as to close the orifice in front. I have observed that the *Ulula* larva soon kills its victim, and at intervals opens its mandibles slightly, until one of them comes out, and then sticks it into a new place. This is continued until the skin is sucked dry,

when the larva throws it aside and assumes its characteristic attitude and awaits another victim. On being disturbed the larva crawls away and seeks some other retreat. It often changes its hiding place at night, probably on account of scarcity of food. It always walks forward, contrary to the habit of ant-lions. The larval life lasts about sixty-two days, during which time the larva moults twice. It moults a third time inside of the cocoon, when it changes to the pupa.

As the habits of the *Ulula* larva are somewhat peculiar, it becomes of interest to compare them with the habits of the not very remotely related ant-lions (Myrmeleonidæ). According to Redtenbacher, the Myrmeleonidæ (Formicaleo, Acanthaclisis, and perhaps Palpares) lie quietly during the day like *Ulula hyalina*, except that the body, instead of being simply covered with sand, is buried slightly beneath the surface. They can walk backward as well as forward. At night they wander about in search of prey. Myrmecælurus can walk forward as well as backward, but digs a pit like the ordinary ant-lion. These latter, however, never walk forward. The digging of a pit by the ant-lion may be but a step removed from the habit of Palpares in burying its body. The ant-lion also has the instinct of wandering at night in search of a more favorable situation when food is scarce.

When the *Ulula* larva is full-grown it seeks some hidden place at night in which to pupate. Having found such a place, it spins a web, covering it with sand and such other small objects as may be at hand. It then gets inside the web and begins spinning a cocoon. The next day it remains quiet, and at night continues the work. I had an opportunity of observing several stages of the process, as my specimen spun its cocoon against the side of a glass jar partly filled with sand. The side next

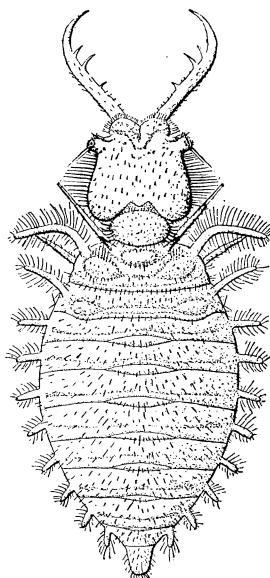
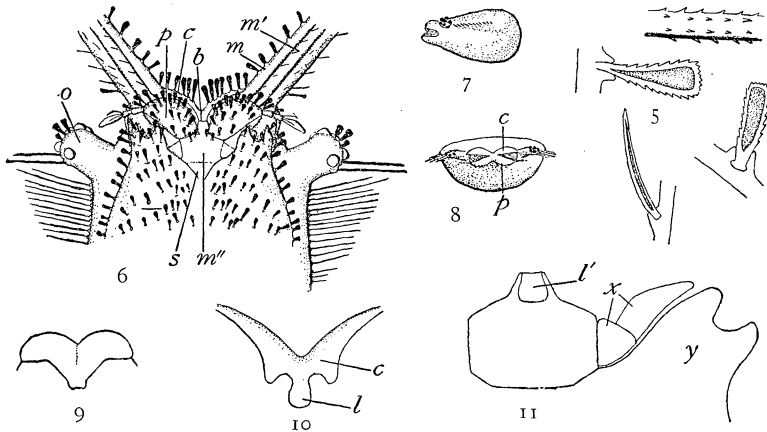


FIG. 4.—*Ulula hyalina*. Full-grown larva.

to the glass could be seen through until after the third night, so that it must have required more than three days to construct the cocoon.

The mandibles (Fig. 15, *m*) of the pupa are toothed on their inner edges for the purpose of enabling it to bite a hole in the cocoon when the metamorphosis has been completed. I did not have an opportunity to observe the escape of the imago.



FIGS. 5-11.—*Utula hyalina*. Larva. Fig. 5, three small setae seen in optical section and a portion of a long one, surface view; Fig. 6, the head of a larval skin of the first moult, seen from below; Fig. 7, head with mandibles pulled out and setae scraped off, seen from the side; Fig. 8, the same, from the front; Fig. 9, clypeus seen from above; Fig. 10, distal portion of the clypeus, seen from below; Fig. 11, inner surface of the mentum and adjacent integument. *c*, clypeus; *l*, labrum; *m*, mandible; *m'*, maxilla; *s*, submentum?; *m''*, mentum; *β*, labial palpus; *δ*, point of contact of mentum and clypeus; *l'*, ligula; *x*, lobe of the mentum; *y*, lobe of the gena; *o*, ocular peduncle.

Below I have added descriptions of the egg, repagulum, larva, pupa, and cocoon.

Egg and Repagulum.

Egg (Fig. 3, *e*).—Length $1\frac{3}{4}$ mm. Ovoid, about twice as long as broad, cream-colored. An elevated ring, the micropyle, on upper pole.

Repagulum (Fig. 3, *r*).—Length $1\frac{1}{2}$ mm. Slender, spindle-shaped, knobbed at base. Basal knob red; shaft brown.

The repagula are abortive eggs. Some tubules of the ovary bear eggs, others repagula.

According to Guiding the eggs are placed in a double alternating series of 64 to 75, near the extremity of the branch, and the repagula (barriers) are placed in circles around the branch, below the eggs (Fig. 3).

Larva (Fig. 4).

Length 13 mm. Head cordate, broad behind, tapering anteriorly, swollen beneath, thicker behind than in front, fuscous varied with black, covered with hair except on mid-ventral line, deeply emarginated on posterior border above, leaving an angular projection in center of emargination. Anterior border fringed with serrated hairs; lateral borders each with a very deep fringe. Ocular peduncles (Fig. 12, *o*) prominent, cylindroid, slightly flattened dorso-ventrally, each bearing seven simple eyes and thickly beset at the end with serrated hairs, two of which are very large and inclined backward. Eyes black, six on upper surface of ocular peduncle, five forming an incomplete circle around the sixth, one on under surface of ocular peduncle near the posterior outer margin.

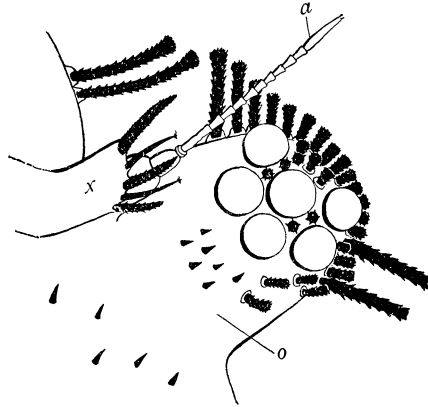


FIG. 12.—*Ulula hyalina*. Ocular peduncle of larva: *o*, ocular peduncle; *a*, antenna; *x*, lobe over antenna.

Antenna (Fig. 12, *a*) $1\frac{1}{2}$ times as long as ocular peduncle, basal segment very large and broad at base, second segment much smaller, third still smaller and proportionately much shorter, and followed by a piece not definitely segmented and still more slender; the succeeding nine segments are of nearly equal size, the terminal segment is as long as the three preceding and ends in a tuft of small hairs;

there is a lobe above the base of the antenna ending in a fringe of five hairs,—three stout serrated ones alternating with two slender smooth ones which terminate in stellate enlargements. Clypeus (Fig. 9) narrow behind, continued in front as a pair of semicircular lobes over bases of mandibles, middle of anterior border continued downward and reaching the mentum. Labrum (Fig. 10, *l*) small, infolded into the mouth. Mandible long, swollen at base, straight for three-fourths its length, then curving inward; curved portion free from hairs, inner edge set with three teeth, middle one largest, posterior one smallest, space between anterior and middle one smaller than that between middle and posterior one, mandible grooved on ventral side. Maxilla swollen at base, lying in groove of mandible, with which it forms a duct leading to the mouth, serrated on inner edge near tip. Mentum (Fig. 6, *m''*) nearly square, anterior border produced in the middle so as to

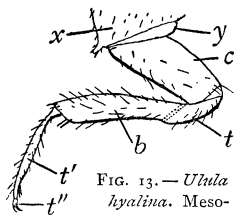


FIG. 13.—*Ulula hyalina*. Mesothoracic leg of larva: *x*, mesothorax; *y*, articular membrane; *c*, coxa; *t*, trochanter; *b*, femur; *t'*, tibia; *t''*, tarsus.

There is a lobe above the base of the antenna ending in a fringe of five hairs,—three stout serrated ones alternating with two slender smooth ones which terminate in stellate enlargements. Clypeus (Fig. 9) narrow behind, continued in front as a pair of semicircular lobes over bases of mandibles, middle of anterior border continued downward and reaching the mentum. Labrum (Fig. 10, *l*) small, infolded into the mouth. Mandible long, swollen at base, straight for three-fourths its length, then curving inward; curved portion free from hairs, inner edge set with three teeth, middle one largest, posterior one smallest, space between anterior and middle one smaller than that between middle and posterior one, mandible grooved on ventral side. Maxilla swollen at base, lying in groove of mandible, with which it forms a duct leading to the mouth, serrated on inner edge near tip. Mentum (Fig. 6, *m''*) nearly square, anterior border produced in the middle so as to

reach the clypeus, lateral margins produced into a pair of triangular lobes (Fig. 11, *x*) inclined forward and devoid of hairs, each divided by a suture into two triangles; ligula infolded into mouth, adhering to the labrum; basal segment of labial palpus very large, flattened, fourth segment as long as second and third combined. On each side of the mentum arises a lobe of the gena (Fig. 11, *y*) which projects over the base of the mandible, deeply emarginated on anterior border. The hairs (Fig. 5) on the head, as well as on the body, are of peculiar structure: the base of a hair is constricted so as to close the cavity within, and the integument is raised around the constricted portion; the hairs are of two kinds, smooth and serrated; some of the serrated hairs are enlarged at the tip.

Thorax flat, much broader behind than in front, luteo-fuscous mottled with fuscous, thickly beset with hairs, all of which are fuscous or black;

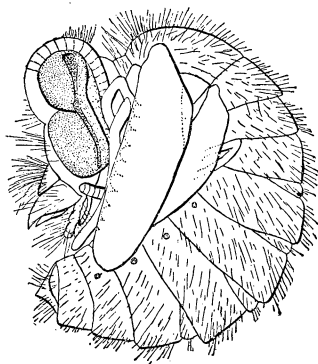


FIG. 14. — *Ulula hyalina*. Pupa.

prothorax freely articulated with mesothorax, much narrower than head, much broader than long; metathorax broader than head, bearing above three ellipsoid swellings, each of which has the margin depressed below the general level; one lies near the anterior border, the other two near the lateral borders and are connected by a deep groove; two pairs of lateral lobes, anterior pair short, conical, inclined forward, terminating in a few black setæ which are packed together so as to appear like the end of the lobe, second pair very long, inclined forward at base, then bent slightly backward, fringed with large, serrated hairs; there is a pair of spiracles below near the bases of posterior pair of lobes; metathorax broader than mesothorax, a pair of ellipsoid swellings above, similar to those on mesothorax, a pair of lateral lobes, shorter than pair on mesothorax, inclined forward, fringed with large hairs; a pair of spiracles below, near bases of lateral lobes; legs luteo-fuscous with fuscous hair, anterior pair small, each succeeding pair larger, coxa very long (see Fig. 13),¹ trochanter small and almost rigidly attached to the femur, tibia slender, tarsus of a single small joint, unguis black, much curved.

Abdomen broad and thin, dorso-ventrally compressed, pointed behind, lateral margins very convex, luteo-fuscous mottled with fuscous, covered with hairs which vary from fuscous to black, flattened and wrinkled below,

¹ Redtenbacher (*loc. cit.*, Fig. 116) gives a different interpretation to the joints of the leg of the ant-lion. He calls coxa what I believe to be a much-developed articular membrane (Fig. 13, *y*), and what I have called the trochanter he regards as part of the femur. The articulation between the trochanter and femur is not well developed and allows very little movement, but it cannot be overlooked. I may add that my interpretation is based on comparison with the imago.

somewhat convex above, divided into nine segments; tergites, except last two, separated along middle, so as to disclose the articular membranes,— each tergite, except the last two, with a cross groove nearly reaching the lateral borders; each segment bears a pair of lateral lobes fringed with fuscous hairs; each segment also bears a pair of spiracles below, near the bases of the lateral lobes; last segment conical, truncated. There is a circle of black curved spines around anus.

Pupa (Fig. 14).

Length 12 mm., diameter in cocoon 6 mm., breadth of abdomen 4 mm. The pupa resembles the imago in general, but is much smaller and comparatively shorter.

Head short, and compressed against thorax; eyes fuscous, with a deep vertical fold at right angles to the sulcus; antennæ comparatively short,

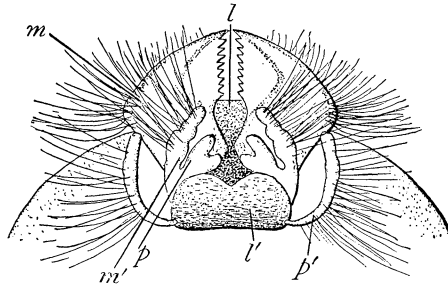


FIG. 15.—*Ulula hyalina*. Mouth of pupa from below: *l*, labrum; *m*, mandible; *p*, maxilla; *m'*, maxillary palpus; *l'*, labium; *p'*, labial palpus.

curved backward over the head, not knobbed, white; face light yellow, clypeus not distinct from labrum; mandibles (Fig. 15) stout, armed each with nine to ten teeth; inner edge of mandible rufo-fuscous, teeth black; gular region white; maxilla bilobate, maxillary palpus of three segments; labium slightly bilobate; labial palpus slender, smaller at base than at tip; mouth parts and vertex clothed with fine white hair.

Thorax short, cream-colored varied with ferruginous; prothorax compressed against back of head; wing sacs small, white; legs slender, white.

Abdomen short, curved under so that the anus reaches the mouth, cream-colored, varied with ferruginous, covered with fine white hair, a narrow mid-dorsal groove; each segment except the last two with a pair of spiracles.

Cocoon spherical, diameter 7 mm., made of silk.

UNIVERSITY OF TEXAS, AUSTIN,
November 20, 1901.