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CLEMENSIA ALBATA, AN ALGAL FEEDING ARCTIID[1]

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ABSTRACT. The larva of *Clemensia albata* Packard (Arctiidae) feeds on an alga, *Protococcus viridis* Agardh, which grows on tree trunks. Observed maximum fecundity per adult female was 58 eggs. Minimum egg to adult time was 81 days, of which 47 were as larva. Feeding-resting cycles were dependent on humidity. Larvae were somewhat gregarious. The larva and pupa are described and illustrated.

Dyar (1904) and Huard (1929) reported lichens as the food plant for *Clemensia albata* Packard (Arctiidae: Lithosiinae). Huard's report may have been based on Dyar's findings, although he specified "les lichens des écorces." Dyar was able to rear one larva to second instar; however, there may have been enough free living algae present to account for this limited success. Larvae reared in the Catskill Mountains fed upon a green alga. According to Packard (1895), the larvae would not eat willow, poplar or lichens.

Forbes (1960) reported a South American lithosiine as feeding on a blue-green alga. No reference was given and Forbes may have received the information in correspondence, although Bourquin (1939) reported a lithosiine, *Eudesmia argentinensis* (Rothschild), as having "musgos y algos" as food plants although it was not clear that an alga was the actual host. Bourquin indicated that the food plant was growing on rocks in a humid environment, but he illustrated a larva browsing on a foliose bryophyte, probably a lichen. The plant was identified in the plates as *Hepatica* (= *Marchantia*), a liverwort. The aquatic larvae of some *Paragyractis* Lange (Pyralidae: Nymphulinae) live on algae-covered rocks in rapid streams. They spin webs on the rocks and the flattened larvae have blood gills near the spiracles (Munroe, 1972). Lange (1956) reported *Paragyractis jaliscalis* (Schaus) as feeding on algae and diatoms from rock surfaces on stream bottoms.

The ova of *C. albata* are creamy-white, spherical, with the base scarcely flattened, and are laid singly or in clumps of four or five. Dyar (1904) reported the egg diameter as 0.8 mm. Each egg is covered with a loose assemblage of scales from the tip of the female's abdomen. A particularly large, fresh female laid 58 eggs over the course of a week. Considering the large size of the egg, this is an impressive number for such a small moth.

Using specimens from the Adirondack Mountains, I started eight

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larvae on a lichen, *Hypogimnium* sp., and one larva developed to second instar, although it was never actually observed feeding (bits of bark were also present). On a second attempt, using Catskill material, first instar larvae were offered bits of bark, lichens, and a green alga, *Protococcus viridis* Agardh (Chlorophyta: Protococcaceae). The first instar larvae immediately congregated on the alga and refused to feed on the lichens even when the alga was removed.

Protococcus viridis grows on moist bark of trees, on old wood in subaerial habitats, and on floating logs (Prescott, 1962). In the Catskills, *P. viridis* had the best growths on the smooth trunks of *Acer rubra* L., *Betula lutea* Michx., and *B. lenta* L., especially those trees growing alongside the creek where the relative humidity was high. The algal host was difficult to gather in sufficient quantities for 58 larvae and all but 20 were released. The alga was gathered by stripping sections of birch bark. The best time to replenish the food was in the early morning, when the previous night's condensation had stimulated algal growth.

The larvae reared in the Catskill Mountains, Greene Co., New York, were offered *Hypogimnium* sp. and *Parmelia* sp., both lichens, but would not feed on these despite the fact that algae is the host half of the symbiotic relationship. Hale (1961) lists the following green algae as lichen symbionts: *Trebouxia, Myrmecia, Chlorosarcina, Coccomyxa, Chlorella, Trochiscia, Palmella, Protococcus, Leptosira, Phycopeltis,* and *Trentopohlia;* black or brown lichens contain blue-green algae (Cyanophyta), primarily *Nostoc, Gloeocapsa, Stigonema,* and *Rivularia.* In the case of *Parmelia* lichens, *Protococcus* is the algal symbiont.

The larvae of *C. albata* were found to feed at any hour, irrespective of light and dark periods, but dependent on relative humidity. Under dry conditions, the algal host is reduced to a thin, closely adhering layer of single cells on the bark. During humid weather, the alga multiplies and in a short time many layers of cells develop. Larvae are actively searching or feeding during humid periods. In the laboratory, the larvae would search for food after a few drops of water were added, even if no alga was provided. During periods of drought, the larvae crawl under bark and become inactive, although this inactive state is passive and can be terminated if disturbed. Unlike many lithosiines, *C. albata* immatures displayed no interspecific aggression. When it was dry, the larvae would congregate in parallel rows of five or six individuals even though there was adequate space and cover for solitary retreats. Pupae left in the petri plate with the larvae were not eaten. *Hypoprepia fucosa* Hübner and *H. miniata* Kirby have larvae which are cannibals on larvae and pupae. *Holo-*

melina aurantiaca Hübner will devour pupae of its own or of another species' as will numerous other arctiines.

The larval mandible, in many lithosiines, has a basal mandibular process; this is particularly prominent in *C. albata* (Fig. 7). Gardner (1943) referred to this process as a mola and thought it was a specialization for lichen feeding as the molae grind upon each other and might thereby serve to break up the indigestible outer coat of the fungal tissues. Whether the presence of a molar process is diagnostic for the subfamily remains to be seen. Gardner observed it in three genera and five species of Indian lithosiines.

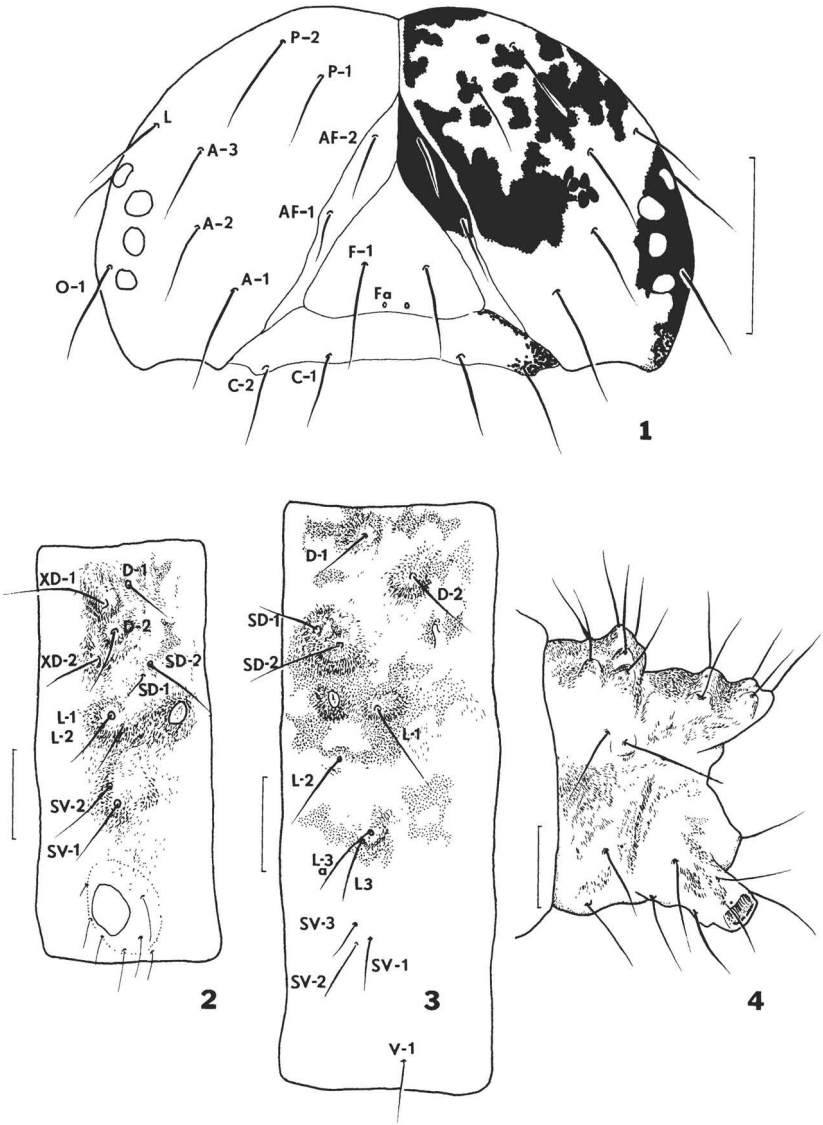
Clemensia albata larvae have a disruptive pattern making them difficult to detect when they are feeding on the exposed surface of algae-covered bark. The black markings are produced by fine cuticular setulae which occur in definite patches. Subcuticular pigmented areas produce a pattern of brown blotches and a green body color provides the background. The caterpillars are sluggish and depend on their cryptic markings to avoid predators, in contrast to many arctiines which are fast crawlers and will quickly drop or roll into a ball when disturbed.

Pupation takes place under bark or in a furrow on the bark. A flimsy cocoon is constructed with bits of bark, algae, and a few strands of silk. Based on adult collection records, the species probably overwinters as a second or third instar larva. October and early spring records for the southern United States (Forbes, 1960; Kimball, 1965) indicate a potential for multivoltinism which the present study confirms.

Ova laid 8 July 1978 hatched eight days later. The first pupa was formed on 2 September, and the first adult emerged 28 September. The female moth (P1), larvae, pupae, and reared adults (F1) are associated by code number tlm 78-58. The description is based on ultimate instar larvae. Setal terminology follows Hinton (1946).

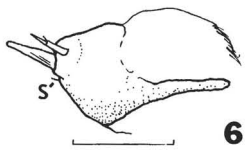
Description of *Clemensia albata*

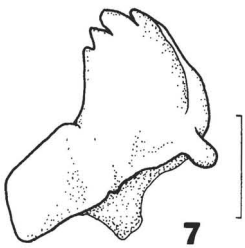
Larva. Head 0.81 mm wide. Total length (fully expanded, preserved) 11–17.5 mm ($N = 12$, $\bar{x} = 15.35$). Abdominal prolegs present on third through sixth segments; crochets homoideous. Integument clothed with setulae (approximately 65/0.1 mm^2) visible at 100×. Primary setae borne on chalazae, 1 seta per chalaza except subventral setae share a common chalaza. Metathorax, Ab-3 and Ab-7 with setulae longer than normal, giving appearance of dark patches. Subcuticular pigmented areas also present. Spiracle Ab-8 0.10 mm high. **Coloration:** Ground color dark, mossy green, integument mottled with black and brown, the black areas caused by setulae and the brown patches resulting from subcuticular pigmentation. Metathorax, Ab-3 and Ab-7 with subdorsal dark areas produced by setulae. Ab-1, Ab-2, and Ab-8 with lateral dark areas also produced by setulae. Overall appearance very cryptic. **Head** (Fig. 1): Epicranial suture 0.81 times height of frons. Second adfrontal seta (Af-2) posterior to apex of frons, located midway to origin of adfrontal sutures. Vertex, ocellar region, area adjacent to adfrontals, and upper half of area between adfrontal and frontal sutures dark brown. Anterior portion

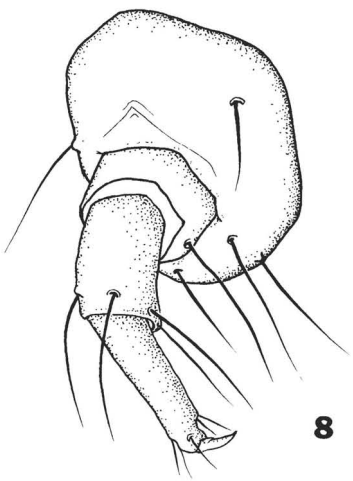


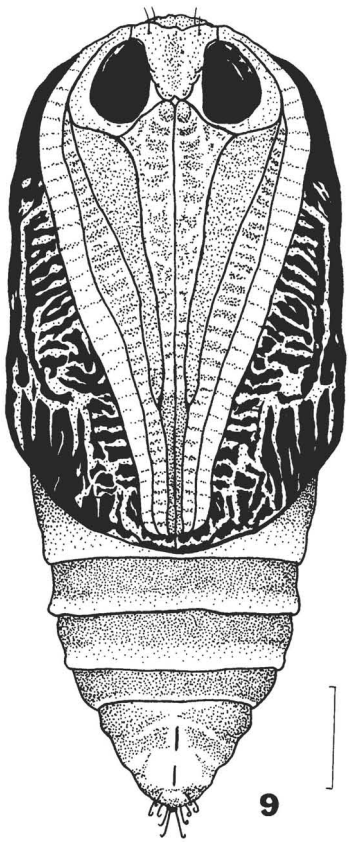
FIGS. 1–4. *Clemensia albata*. **1,** setal map and pattern of head; **2,** setal map of prothorax; **3,** setal map of 1st abdominal segment; **4,** setal map of 10th abdominal segment. Scale lines = 0.5 mm.

of head, frons, and clypeus, light, unpigmented. Posterior two-thirds of head capsule including apex of frons clothed with setulae visible under high power (100×). Ocellar interspaces between Oc1 & Oc2 and Oc2 & Oc3 subequal; Oc3 to Oc4 .5× diameter of Oc4. Oc4 to Oc6 2.6× diameter of Oc4; Oc4 to Oc5 2.75× diameter of Oc4. **Mouthparts:** Hypopharyngeal complex (Fig. 6): spinneret with distal lip surpassing second









FIGS. 5–9. *Clemensia albata*. **5,** photograph of living larva; **6,** hypopharynx; **7,** mandible; **8,** thoracic leg; **9,** ♀ pupa containing pharate adult. Scale lines for Figs. 6–7 = 0.25 mm, for Fig. 9 = 1.0 mm.

segment of labial palpus, bare; stipular setae (S) short, half length of second segment of labial palpus. Distal and proximolateral region of hypopharynx without spines. Prementum weakly sclerotized, fading into distal region. **Mandible** (Fig. 7): Inner ridges not apparent; well developed molar process present at base. **Thoracic segments:** Prothorax (Fig. 2): cervical shield absent, setae borne on chalazae; integument clothed with setulae, dark patches occur where these setulae are longer; subcuticular pig-

mented patches present posterior to D1 and posterodorsal to SD2. D1 anterior to D2 and on its own chalaza; D2 posterior to and equidistant from XD1 and XD2; SD2 the most posterior of the primary setae and much larger than SD1 which is located anteroventrad of SD2; L1 & L2 on a single chalaza; SV1 & SV2 on a single chalaza. 6 coxal setae present (Fig. 2). Spiracles pale. Meso- and metathorax: similar to prothorax, setae borne on chalazae; D1 & D2 share same chalaza as do D2 & XD2; SD2 weakly developed and SD1 strongly developed on meso- and metathorax; SD2 and SD1 farther apart than on prothorax, SD2 closer to D2 than to SD1. **Abdominal segments** (Figs. 3–4): Ab-1 (Fig. 3) with setae borne on chalazae. Markings produced by hairs and subcuticular pigmentation as with thoracic segments. SD1 & SD2 adjacent, but on separate chalazae; L1 & L2 distant, L1 nearly on horizontal and L2 nearly on vertical plane with spiracle; L3 chalaza bisetose; SV1, 2, & 3 and V1 all present. Segments protuberant dorsally. Crochets a uniordinal, homoideous mesoseries; 13–20 per third abdominal proleg (N = 12, $\bar{x}$ = 17.38), 10–22 per fourth ($\bar{x}$ = 17.04), 16–22 per fifth ($\bar{x}$ = 17.87), and 13–19 per sixth ($\bar{x}$ = 17.04).

Material examined: 12 specimens, Stony Clove Creek, elev. 412 m, lat. 42°08′00″, long. 74°15′10″, Greene Co., New York, larvae preserved 2 September 1978, from ova of female collected, determined and reared by T. L. McCabe.

Pupa. Female pupa (containing pharate adult): Two pairs of setae, one pair on each anterolateral corner of the frons as drawn. Compound eyes of imago visible through pupal case as drawn; glazed eye only partly covers actual eye, sculptured eye lies almost wholly over actual eye. Maxillae, second pair of legs, and antennae all project nearly to wing tip; first pair of legs extends two-thirds distance of maxilla; third pair of legs concealed. Wings with furrows as drawn. Lateral and dorsal surfaces of abdomen sparsely covered with microscopic, many branched setae (visible at 100×). Cremaster with two types of setae: 8 small, subapical setae with curled apices and 2 large, apical setae with reflexed apices. **Male pupa:** Same as the female except the gap between the anal and genital slit is greater, that of the male being twice the length of the anal slit whereas the gap in the female is subequal in length to the anal slit.

Material examined: 3 specimens, Stony Clove Creek, elev. 412 m, lat. 42°08′00″, long. 74°15′10″, Greene Co., New York, pupae preserved 5 October 1978.

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