

THE LIFE HISTORY OF AN ORIENTAL SPECIES OF
COCHLIDIIDÆ INTRODUCED INTO MASSACHUSETTS
(CNIDOCAMPA FLAVESCENS WALKER).

[Lepidoptera, Cochlidiidæ.]

BY HARRISON G. DYAR.

(Plate XIV.)

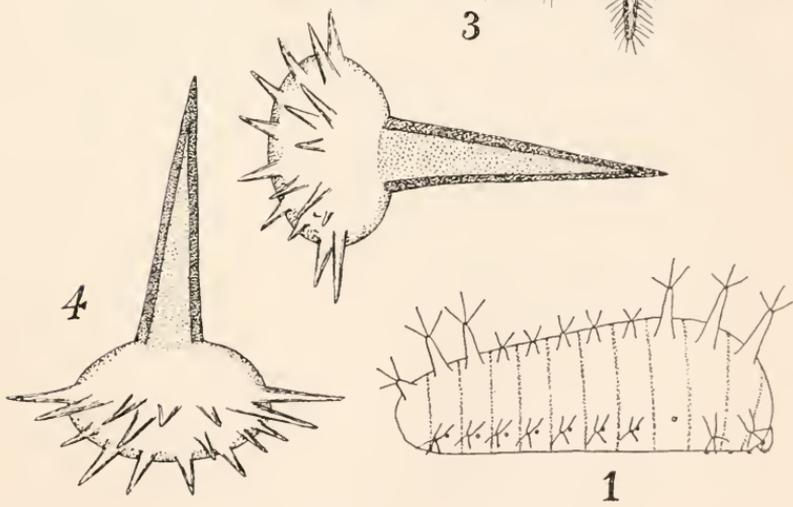
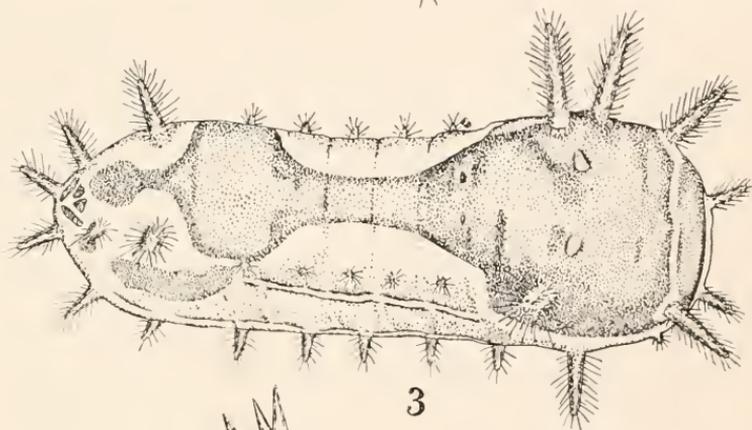
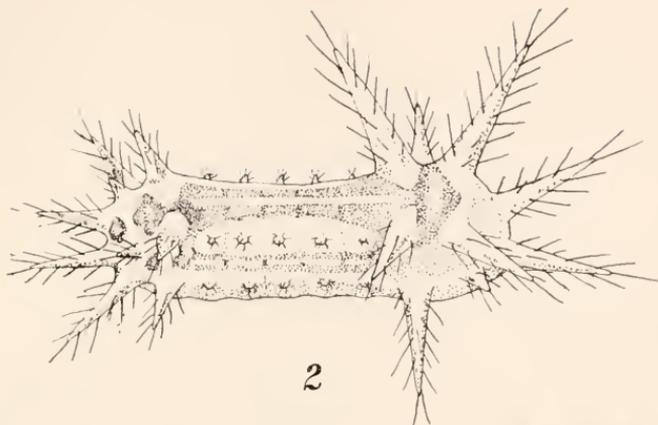
CNIDOCAMPA FLAVESCENS Walker.

BIBLIOGRAPHY.

- Monema flavescens* Walker, Cat. Lep. Het. Brit. Mus., v, 1112, 1855.
Monema flavescens Butler, Ill. Typ. Lep. Het. Brit. Mus., II, 14, pl. 25,
 f. 5, 1878.
Monema flavescens Pryer, Trans. Asiat. Soc. Japan, XII, 41, 1884.
Monema flavescens Fixsen, Romanoff Memoirs, III, 342, 1887.
Monema flavescens Leech, Proc. Zool. Soc. London, 610, 1888.
Miresa flavescens Graeser, Berlin. ent. Zeit., XXXII, 121, 1888.
Miresa flavescens Staudinger, Romanoff Memoirs, VI, 300, 1892.
Monema flavescens de Joannis, Bull. Ent. Soc. France, 147, 1896.
Monema (Miresa) flavescens Gribodo, Bull. Ent. Soc. France, 179,
 1896.
Monema flavescens du Buysson, Ann. Ent. Soc. France, LXVII, 80, 1898.
Monema flavescens Leech, Trans. Ent. Soc. London, 103, 1899.
Monema flavescens du Buysson, Bull. Ent. Soc. France, 29, 1901.
 ———— Kraepelin, Mitth. a. d. Naturhist. Mus. Hamburg, XVIII,
 196, 1901.
Monema flavescens nigricans de Joannis, Bull. Ent. Soc. France, 251,
 1901.
Cnidocampa flavescens Dyar, Proc. U. S. Nat. Mus., XXVIII, 952, 1905.
Cnidocampa flavescens Fernald, Bull. 114, Hatch Exp. Station, Mass.
 Agr. Coll., 1907.
Cnidocampa flavescens Fernald & Summers, Ent. News, XVIII, 321, 1907.
Cnidocampa flavescens Dickerson, Ent. News, XVIII, 373, 1907.
 ———— Joutel, Journ. N. Y. Ent. Soc., XV, 175, 1907.

SPECIAL STRUCTURAL CHARACTERS.

Dorsal and lateral spaces broad, subventral space narrow, contracted. Ridges very slight, the subdorsal ridge indicated by the change in direction in the slope of the body, which is rounded gradually; lateral and subventral ridges more distinct, approximate. Outline from above somewhat dumb-bell shaped, the central area being a little constricted and the ends from which the long horns arise enlarged. The effect is heightened by the coloration, the purple band being enlarged over the extremities. Warts produced into fleshy prominences, unequally



LARVA OF CNIDOCAMPA FLAVESCENS WALK.

elongated; in stage I bearing a few slender setæ; after the first molt, the subdorsal and lateral rows covered with numerous urticating spines, the subventral row rudimentary, represented by two weak setæ. Of the subdorsal row, the "horns" on joints 3 to 5 and 11 to 13 are long, those on joints 6 and 10 rudimentary, the ones on joints 7 to 9 much shorter than the long ones and equal to each other. Of the lateral row, the horn of joint 5 is absent, of 3 much shortened, while those of 4 to 11 are longer than the others. Depressed areas very feebly developed as slight irregular pits, partially free from skin-spines; the dorsal row (1) paired, the subdorsal (2) smaller, scarcely distinguishable; of the lateral rows, the lateral (4) is large, reniform, oblique, forming a distinct shallow pit, the lower intersegmental lateral (6) very small and close to (4). In the contracted subventral space the two large rows (7 and 8) are minute, but in a common elliptical depression.

At the last molt the length of the horns is considerably reduced, while the coloration becomes fully developed. The small, detachable skin-spines, or caltropes, occur in patches on the lateral horns of joints 6 to 12 and on the subdorsal horn of joint 13. No detachable spine patches are present.

The larva falls in "Type 2" (Dyar & Morton, Journ. N. Y. Ent. Soc., III, 146, 1895), but forms a separate section. The "end-spines" being lacking, throws it with the generalized forms of *Euclea* and with *Adoneta*, but the subdorsal horn of joint 8 is not differentiated as in all these. In the horn-structure it more nearly approaches *Sibine*, in which, however, the horn-formula is different, for the subdorsals of joints 6 to 10 are there uniformly suppressed, whereas in the present type those of 6 and 10 only are suppressed, those of 7 to 9 being fairly well developed. There is also a peculiar irregularity of development of the long horns at the extremities.

AFFINITIES, HABITS, ETC.

The genus *Cnidocampa*, with its one species, *flavescens*, is a somewhat isolated form of peculiar development. It appears most nearly related to *Miresa*. In the adult of this genus the antennæ of the male are pectinated on the basal third, while the larvæ (of the two species known to me, *albipuncta* Herrich-Schaeffer and *argentifera* Walker) possess long end-horns, short side-horns, the central subdorsals (joints 6 to 10) suppressed, end-spines apparently undeveloped. *Cnidocampa* has lost the pectinations on the antennæ of the adult, and is thus a modified form of *Miresa*. The larva, however, is less specialized than *Miresa*, having the subdorsal horns of joints

7 to 9 distinct, although essentially of the same type. The coloration of the *Cnidocampa* larva is less specialized than that of *Mirca*, its purple and green suggesting our *Sibine*, though the pattern of dumb-bell shape is unlike anything found in America. It is, however, apparently not an unusual device in Asia, the figure of the larva of *Orthocraspeda trima* Moore showing a similar pattern. There is, however, no close relation between *Orthocraspeda* and *Cnidocampa* structurally, either as larva or adult.

The young larva of *Cnidocampa* is without defined coloration, the pattern being gradually developed during ontogeny, without any sudden changes. This indicates a primitive condition, and undoubtedly the coloration is of an ancient type, as shown by its appearance in *Orthocraspeda*, a phylogenetically much older form. It is of a warning nature, the bright and conspicuous markings being accompanied with well-developed urticating spines upon the fleshy horns.

The larvæ spin hard cocoons upon the twigs of the trees upon which they have been feeding, usually in the forks of the smaller twigs. These cocoons overwinter, and the adults issue in the spring. The time of emergence varies with the latitude. Fernald found them to emerge in Massachusetts in the latter part of June and first of July; Fixsen records their emergence in Korea from the 18th to 26th of July. Some specimens overwintered at Washington, brought as larvæ from Massachusetts and placed upon trees in the open, emerged June 1, while others from north China, also overwintered at Washington, emerged the last of May. The species is generally single-brooded, but it may be double-brooded in the more southern part of its range. The early emerging specimens at Washington produced larvæ which matured, spun, and issued the same season, producing adults again in August. The range of the species, as given by Leech, is Amurland, Japan, Korea, central and north China. The species is easily exported, as the hard overwintering cocoons not infrequently occur upon fruit or ornamental trees and their peculiar appearance does not suggest that they are the work of an insect. Fryer remarks on their resemblance to birds' eggs, while Dickerson thinks that they look like leaf-buds. Either simile appears to me rather far-fetched. The general mottled coloration rather resembles that of bark, especially upon knotted twigs with patches of lichen, though there does not seem to be any very special adaptation for concealment, the exceedingly hard nature of the cocoon itself rendering such a thing superfluous.

The cocoons have been found introduced upon fruit trees in Hamburg, Germany (Kraepelin), San Francisco, California (Dept. Agriculture), and New York (Joutel); but in Massachusetts they were introduced in sufficient numbers so that the species reproduced and became established in a small district in Dorchester in the suburbs of Boston. The place is entirely built up to houses, but there are many open spaces with trees and shrubbery, as well as trees along the streets. A park of considerable extent (Franklin Park) is in the close vicinity. Conditions are therefore favorable for the continued existence of this interesting species in America; but unfortunately Dr. H. T. Fernald, in an excess of economic zeal, which we consider premature, destroyed large numbers of the cocoons, for fear that the insect might become a pest. What effect this action has had upon the continuance of the species we do not know. It is to be hoped that the moth has not been exterminated. Some thirty of the cocoons were allowed to emerge in the open in Washington and many eggs and young larvæ were subsequently observed. All, however, died in the third or fourth stage, probably because the location was too dry and open. The climate can scarcely have been too warm, considering the distribution of the species in Asia. I have several times observed young Cochlidian larvæ to die when placed upon trees in the open that I had thought favorable to them, but which proved to be dry and sunny. The moths, in ovipositing, doubtless avoid such situations. The eggs laid at Washington, while deposited by moths issuing at large, were necessarily laid in the vicinity of the place where I had placed the cocoons, and it was evidently an unsuitable one.

The eggs are laid singly upon the undersides of the leaves, and the larvæ live in the same situations, not moving greatly, yet passing from leaf to leaf occasionally. They eat at first the parenchyma of the leaf from beneath in little patches, later the whole leaf from the tip, all as in the manner usual in the family. Eight stages occurred in my specimens. The larvæ do not feed in the first stage. The adults rest with the tip of the abdomen against the support, the legs extended, in the manner of our *Natada nasoni* Grote and other Cochlidians. Their period of flight is short, as no nourishment is taken in the adult state.

The species appears to be common in its home. Graeser found the cocoons "sehr gemein" at Blagoweschtschensk, Amurland, where he found cocoons on all deciduous trees, especially on birches, in all the gardens and in the forest;

while du Buysson reports: "une année, M. l'abbé de Joannis en re ut trois mille cocoons, récoltés par des gamins." One reason for the apparent abundance is the conspicuousness of the cocoons, and it may be that the three thousand cocoons that the abbé's sharp-eyed boys collected represented practically all the specimens of this species in the place, which would not be a large number. The principal parasite appears to be *Chrysis shanghaiensis* Smith, which parasitized one-tenth of the cocoons above referred to. This species seems not to have been imported into America with its host.

The peculiar cocoons are one of the most noticeable features of the life history. Placed conspicuously upon the branches of the tree, their grotesque coloration at once attracts attention. In spinning the cocoon the larva, after selecting a suitable position, spins a few supporting threads; but the anterior ventral surface of the larva itself furnishes the main support for the first film. The larva bends backward and spins back and forth across its thoracic feet, gradually creeping upon the film as it forms. When the outside film is complete the larva strengthens it, continually turning about. The thread is dark brown; but during construction the larva voids an opaque white fluid from its anus which gives the white ground color. The peculiar brown markings are caused by bands of thick silk through which the white fluid has not penetrated before the whole solidified.

CRITICISM OF PREVIOUS DESCRIPTIONS.

Graeser's description of the larva is very brief, and mentions only the coloration, so that one can not tell therefrom whether the larva belongs to the spined or smooth types. This is especially important in this case, since the structure of the antennæ of the male adult is deceptive.

My description was made from inflated larvæ in which the color is largely lost. I failed to note the caltropes spines, which were largely removed in the specimens.

Dr. Fernald's description is rather long, but made from larvæ taken from the cocoons, whose shape and colors both were abnormal.

Fernald and Summers give full descriptions of the egg and larval stages, with reproductions of photographs of several of the stages. The locations of the horns are not accurately described, to which the photographs add little, as many of them are badly out of focus. The figures of the large larvæ, especially those of the sixth stage, are good and give a very characteristic representation of this curious insect. The authors failed to notice the caltropes spines.

DESCRIPTION OF THE SEVERAL STAGES IN DETAIL.

Egg.—Elliptical, flattened, yet moderately thick, shining, colorless, transparent like a drop of water, the skin minutely hexagonally reticulate. Size 1.8 mm. \times 1.2 mm. Laid singly on the back of a leaf.

Stage I.—Elliptical, the dorsum flattened, concave, the sides sloping, of normal *Euclca*-shape. Horns conical, the subdorsal row present on joints 4, 5, 11, and 12 large, the others subequal. Colorless; whitish, shining, the middle portion yellowish; skin smooth; setæ on the horns black. Subdorsal horns of joints 3-5, 11-13 three-haired, those of joints 6-10 two-haired; horns of the lateral row on joints 3, 4, and 12, three-haired, those of joints 6-11 two-haired. The short horns are even and regular, none adnate to others, the one on joint 8 not larger than the adjoining ones. Length, 1.3 mm. Duration of the stage, one day.

Stage II.—Entirely translucent whitish, with a green tint from the food. Subdorsal horns on joints 3-5, 11-13 large stout, subequal, those on 5 and 11 the longest; of the lateral horns those on joints 4 and 12 are longer than the others; all the horns stout, rounded, many-spined, the spines black-tipped. Length, 1.3 to 2.5 mm. Duration of the stage, four days.

Stage III.—Elliptical, rounded, the dorsum arched, venter flat, no angles between the back and sides; subdorsal horns of joints 3-5 equal, long, longer than the width of the body, well spined; horn of joint 6 minute; those of 7-10 small, about spherical, spined; of 11 and 12 stout, conical, about half as long as those of joint 3, spined; of 13 about like 3, long, the pair divaricate posteriorly. Lateral horns of joint 3 short, conical; of 4 long, slender, nearly as long as the subdorsal of 3; of 6 very small; of 7-10 small; of 11 slender but about as long as the subdorsal on the same joint; of 12 as long as the subdorsal of 3. No spine patches nor caltropes. Translucent olivaceous green, the spines on the horns black; a narrow white subdorsal line on joints 6-10; a broad faint yellow band in the subdorsal ridge, waved in its upper edge by the horns and faintly white-edged; a broken whitish line in the middle of the lateral space; a faint opaque band along the lateral ridge. The larva appears more flexible and elongate than most *Cochlidians*. Length, 2.5 to 4.3 mm. Duration of the stage, three days.

Stage IV.—Subdorsal horns of joints 3-5 equal, long, those of joints 4-5 divaricate in a square; of 6 and 10 minute; of 7-9 small; of 11 half as long as that on 5; of 12, half as long as that of 11; of 13, as long as that of 3, slender. Lateral horns of joint 3 small; of 4 and 12 long, as long as the subdorsal of 3; of 6 minute; of 7-9 moderate; of 10 smaller; no horn on joint 5, the spiracle placed higher than on the other segments. Translucent greenish; dorsal line absent,

replaced by a slight dark shade; the yellow band in the subdorsal ridge irregular, most distinct in joints 7-9, replaced by a bridge between the subdorsal horns of joint 4 and forming rings about the bases of the subdorsal horns of joints 11 and 12. Lateral white line present centrally in the lateral ridge, yellow, tending to ring the horns and joining the subdorsal line at the ends. Horns well spined, the spines black. Skin smooth, shining, sparsely granular. Depressed spaces indicated by intersegmental hollows only, not defined. Length, 4.3 to 7 mm.; another specimen, 4.9 to 6.6 mm. Duration of the stage, four days.

Stage V.—Subdorsal horns of joints 3-5 equal, long, erect; of joint 6 minute; of 7-9 small; of 10 still smaller; of 11 moderate; of 12 small; of 13 long, but shorter than those of 3-5. Lateral horn of joint 3 small; of 4 long; of 5 absent; of 6 very small; of 7-9 small; of 10 very small; of 11 moderate; of 12 long. Translucent yellowish: an opaque band in the subdorsal ridge of joints 7-9 with a bridge at joint 4, making the dorsal space sole-shaped, containing a central white line in a purple shade; a broad yellow line along the lateral ridge; a waved white line in the lateral space. The horns appear dark from the dense black spines. Of the depressed spaces, the addorsal-intersegmental (1) show centrally as dark dots below the skin, widening the purple dorsal line; on the sides obscure pale dots (4) segmentally, posteriorly, and two in line (5 and 6) above the bases of the lateral horns. Length, 7 to 10 mm.; of another specimen, 6.6 to 10.5 mm. Duration of the stage, four to six days.

Stage VI.—Elongate, the sides parallel, a little concave centrally, joints 3-5 enlarged, 11-13 less so; dorsum evenly rounded, no ridge at the subdorsal angle; subventral space contracted. Subdorsal horns of joint 3 moderate; of 4-5 long; of 6-10 minute, those of 6 and 10 smallest; of 11 moderate; of 12 short; of 13 about like the subdorsal of 3. Lateral horns of joint 3 small; of 4 longer than the subdorsal of 3; of 6-9 small, of 9 the smallest; of 10 moderate; of 11 long like that of 4, longest of any of the posterior horns. Translucent olivaceous, the horns yellowish, black-spined, with yellow cores; an opaque yellow bridge on joint 3, crossing the subdorsal horns to the lateral horns, thence to the lateral horn of joint 4, joining the yellow lateral band, then narrow from the lateral horn of joint 12 to the subdorsal horn; a yellow bridge on joint 4 between the subdorsal horns; a spot in the base of the subdorsal horn of joint 5, joining its core; subdorsal band on joints 6-10, tapering to a point in 6 and 10; a core-spot in the horn of 11 narrowly joining that of 12. Dorsum of joints 4-6 dull brown-red infiltrated, of 7-12 blackish olivaceous with a dorsal median submaculate bright blue line, from 5 posteriorly to 8. Skin wrinkly-shagreened in clear curved ridges. Dorsal depressed

spaces (1) forming transverse whitish lines between the blue band and subdorsal band; a narrow whitish lateral line cut by depressed spaces (4), the lateral space narrow, livid-infiltrated on each side of the white line, the line itself replaced by bright blue on joints 6-11; Depressed spaces (5 and 6) level, forming glandular dots at the bases of the lateral horns against the yellow band. Later the infiltration of red in the dorsal space is more distinct and occurs also on joint 10; blue spots laterally on joints 4, 5, 10, and 11 and a white line along the ventral edge. Length, 10 to 14 mm.; in another specimen, 10.5 to 13.5 mm. Duration of the stage, four to five days.

Stage VII.—Subdorsal horns of joints 4 and 5 long, stout, conical; of 3 smaller about two-thirds as long; of 6 small; of 7-9 distinct, longer than wide; of 10 small; of 11 similar to those of 4-5 but not so long; of 12 half as long as that of 11; of 13 slender, longer than that of 11, nearly equal to those on 4-5. Lateral horns of joints 3 small, conical; of 4 longer, equal to the subdorsals of 3; of 6 small; of 7-9 large; of 10 small; of 11, three-fourths as long as that of 12; of 12 slender, as long as the subdorsal of 13. Horns yellow-cored, black-spined. Elliptical, the sides parallel, three times as long as wide, the middle a little contracted; dorsum arched, sides slightly sloping, subventral region moderately retracted. Some caltrops-spines at the bases of the subdorsal horns of joint 13 and the lateral horns of 12. Dorsum infiltrated with red to the lateral horns on joints 3-6 and 10-11 in narrow dorsal and lateral spaces, else darkly livid, cut by a blue dorsal line on joints 6-10 and lateral white one on 6 posteriorly to 10 anteriorly; a yellow transverse line on joint 3 to the lateral horn, a bridge between the subdorsals of 4, a spot touching the cores of the horns on 11, a bridge between the subdorsals of 12 and another on 13; the whole of the lateral ridge broadly yellow. Subventral space colorless, with a white subventral edge line. Diffuse blue lateral patches on joints 4, 5, 6, 10, and 11. Skin wrinkly-shagreened. Depressed spaces slight, with glandular centers indicated laterally by colorless dots, not shown dorsally. Length, 14 to 18 mm.; another specimen, 13.5 to 19 mm. Duration of the stage, five to seven days.

Stage VIII.—Subdorsal horns of joint 3 short; of 4 longer; of 5 longest; of 6 and 10 minute; of 7-9 very small; of 11 like that of 4; of 12-13 small, about like those of 3. Lateral horns of joint 3 very small; of 4 like the subdorsals of that joint; of 6-10 a little smaller; of 11 and 12 equal to the subdorsal of 12. Horns greenish yellow, the spines yellow with black tips. A little bunch of caltrops at the bases of the subdorsal horns of joint 13 and the lateral of 12 above, pale brownish. Dorsum dark purple in dumb-bell shape, the anterior widening the larger; widened at the lateral horns on joints 3-5 and 10-13, marked with bright blue in the incisures and in lateral spots

on the widenings. The rest bright yellow, except a narrow band in the lateral space and the subventral area, which are translucent greenish. Lateral line and subventral edge yellow. Depressed spaces slight, the dorsal (1) glandular centers showing pale, paired; lateral (4) more distinct, showing centrally as a yellowish dot in a translucent area, yellow-edged below. A yellow bridge on joints 3 and 4; triangular dots on 5; a broken bridge on 11; continuously yellow to 12-13, forming a pattern like a grill between the horns of these segments. Skin clear-granular, the granules irregular in shape, shagreened. Joint 2 purplish; the cervical shield green with several black spots. Head within the hood, largely black. Creeping disk honey yellow. Length, 18 to 24 mm. Duration of the stage, seven days.

At the end of the stage the larvæ became slightly more livid in color, left the leaves, and traveled upon the branches of the tree to find a fork or crotch, where the cocoon was spun.

Cocoon.—Elliptical, rounded, smooth, hard, and dense, firmly attached upon one side to the bark of the tree. White and gray-brown, marked in a peculiar pattern. Usually there are several broad brown streaks radiating from each pole of the cocoon, but the colors may also be variously intermixed, or even nearly uniform gray. The moth emerges by a circular lid, of which there is no sign from the exterior.

Food-plants.—Various deciduous trees and shrubs. Gribodo records pear and rose. Kraepelin found the cocoon on maple. Pryer found them on birch, elm, *Celtis*, and Japanese persimmon. Fernald found the Norway maple the preferred food, but also pear, apple, cherry, and less commonly willow, birch, oak, elm, blackberry, beech, poplar, mountain-ash, buckthorn, and rose. My larvæ fed readily on wild cherry, though the liberated moths did not oviposit on this tree, but on maple, rose, and cultivated plum.

EXPLANATION OF PLATE XIV.

- FIG. 1. Larva of *Cnidocampa flavescens*, stage I, diagrammatic.
2. Young larva of same, stage V.
3. Mature larva.
4. Caltrops spines of mature larva, greatly enlarged.