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## Green Fruitworms

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## INTRODUCTION

Young apple and pear fruits may be fed upon by several species of relatively large, stout-bodied green caterpillars (Fig. 1). Their dominant green color is relieved by dots, dashes, lines, and stripes of white, cream, or yellow. For more than a century now, these native insects have been known to commercial and amateur fruit growers as "green fruitworms" (6, 10, 17, 21, 22).

Ten species of green fruitworms occur in New York. Taxonomically, these constitute an artificial assemblage for while all are members of the same family (Noctuidae), four genera are represented in the group. However, six are members of the genus *Lithophane*. Justification for treating these species as a unit rests on the fact that they form a quite distinctive pest complex. Thus, in the larval or caterpillar stage, they are of very similar appearance and habits, feed at the same season, cause the same kind of feeding injury, and produce single generations annually.

So, while the primary reason for treating these insects collectively has an economic basis, we expect the information given here will prove useful both to those having a technical interest in these species as well as to those having to cope with them as pests.

Whatever the area of interest, there is a need for having practicable means for identifying the insects in the larval stage. This will be the only stage most persons will ever see. Distinctive and relatively easily seen diagnostic characters are present in the larvae. These are illustrated in Plate 1, developed in the larval keys, and discussed in the coverage given on each species. A high percentage of the green fruitworms encountered in New York will be one of only three species; viz., *Orthosia hibisci*, *Amphipyra pyramidoides*, and *Lithophane antennata*. These can be identified readily from the use of the first of the two keys given later. In attempting to identify these insects to species, it will be helpful to examine them under some magnification. A good 10X hand lens will serve this purpose admirably,

Eggs, with the exception of *A. pyramidoides*, are laid in the spring when new growth is appearing in the buds. *A. pyramidoides* eggs are laid in the fall and overwinter in this stage. The eggs of all species, however, start to hatch when the buds have reached the half-inch green bud stage (2) for apple. The young larvae feed on the unfolding leaves, and it is not uncommon to find them occupying a rolled leaf in much the same manner that tortricid or leafroller larvae do.

Feeding may or may not be extended to include the fruit. Where this does occur, fifth and sixth instar larvae will be involved. This feeding takes place from the time the young fruits are newly set, or when they are about  $\frac{1}{4}$  inch in diameter, until they measure about  $\frac{1}{2}$  inch across (Fig. 2).

Figure 1.—(Cover) Speckled green fruitworm.

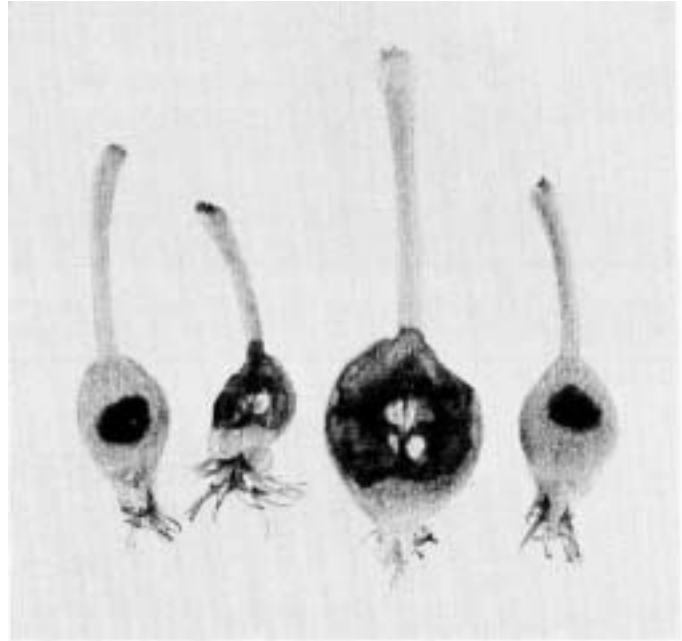


Figure 2.—Young apple fruits showing green fruitworm feeding injury.

After completing their feeding, the larvae drop to the ground and enter it to a depth of from 2 to 4 inches. What transpires thereafter depends on the species, details of which will be found in the separate discussion given on each species.

Prentice (16) classifies the green fruitworms as "solitary defoliators," meaning that they occur singly—and presumably, well separated—and are leaf feeders. It is of course true that they also feed on the fruits of fruit trees. This latter feeding is often extensive and many fruits so attacked fail to survive (10). Saunders and Dustan (21) have claimed that about 72 per cent of the injured fruit will fall into this category. The wounds on the fruits which do survive attack gradually become sealed over with corky tissue. Such fruits will bear brownish corky scars at harvest and they may be so dwarfed or deformed (Figs. 3 and 4) as to be rendered unsalable.

Typically, a caterpillar feeds on more than one fruit (10, 21, 22). Knight (10) claims that a single larvae may feed on up to a dozen or more. Presumably, such promiscuous feeding would occur where three or four fruits were set per spur and several such spurs closely adjoined each other. This worker also illustrated (Plate 17, Fig. 65) the extent of damage done by one larva to five pear fruits. These all are as badly misshapen as those shown in Figure 4.

A century ago and earlier, or before orchardists adopted the use of pesticides to any appreciable extent, green fruitworms were sometimes quite destructive. The earliest published report of such injury took place in Missouri and Illinois in 1870(22). In New York, serious losses occurred in Niagara County in 1877 (22). That year, Professor J. H. Comstock found that 45 per cent of the pear fruits at one site had been damaged. Green fruitworm injury was again

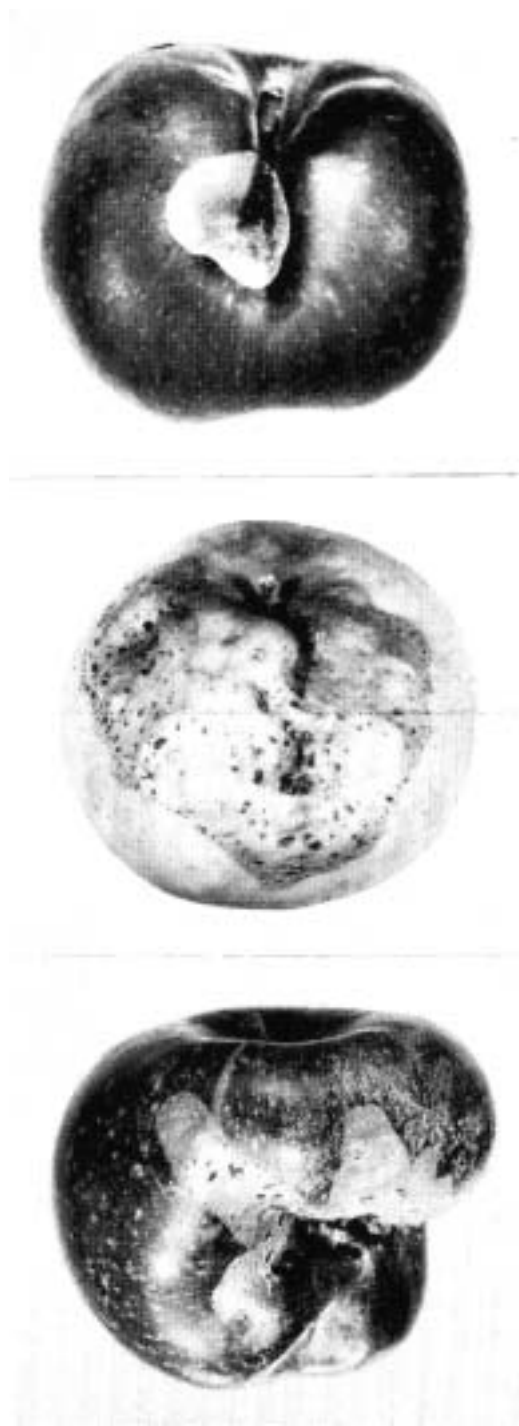


Figure 3.— Apple fruits at harvest bearing healed green fruitworm feeding injuries.

reported in New York in 1896 when Slingerland (22) found that "at least 25 per cent of the apple crop was injured in many localities" in western New York.

Just which species were involved in these early reports is not always clear. In 1954, Forbes (6) wrote, "The injurious species in the east is perhaps most often (*Lithophane*) *laticinerea* or (*L.*) *antennata* but the records are hopelessly

confused." Rings (19) discussed this same subject in 1970. He revealed that Slingerland (22) illustrated the larva of *Orthosia hibisci* but erroneously called it *Xylina* (*Lithophane*) *laticinerea*. Rings (19) points out that Knight (10) duplicated this error in 1922. Forbes (6) published a key for the identification of last instar larvae of members of the genus *Lithophane* in 1954. This has proved a very useful guide.

Until quite recently, green fruitworms have rarely been encountered in commercial orchards. Insecticidal treatments applied to control such pests as the plum curculio, redbanded leafroller, and others, have usually kept plantings essentially free from "minor" pests like the green fruitworms. Recent reports of the occurrence of fruitworms in commercial orchards is attributed to a tendency for some growers, of late, to use only fungicides in sprays applied directly before and directly after the blossom period. Presumably, losses from these pests could be greatly reduced or eliminated by the inclusion of a suitable insecticide in these sprays.

While at present the green fruitworms are to be found principally in home orchards, abandoned commercial orchards, and in wild fruit trees, they have lost none of their potential for damage. This easily could be realized in commercial plantings should there be a major relaxation in pesticide use.

Since all of our tree fruits have been introduced from Europe (3), their use by the green fruitworms represents a relatively recent adaptation. The original food plants of these insects were various deciduous trees and shrubs. However, the species most commonly found on our tree fruits, *Orthosia hibisci*, may also feed on some conifers (16).

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#### CLASSIFICATION AND SPECIES' NAMES

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The green fruitworms are members of our largest family of moths, the Noctuidae. Some of the larvae of this family are known as cutworms and army worms. The green fruitworms are cutworm-like in gross appearance, but they remain on their hosts continuously during the larval stage. The true cutworms use the soil as a base of operations. They do most of their feeding at night, often cutting off herbaceous hosts at the ground line, and then rest either under trash on the soil's surface or in the soil itself during the daylight hours. Fruit trees are sometimes attacked by true cutworms. These forms ascend the trees at night but return to the ground in early morning to rest during the daytime. These climbing cutworms, as they are commonly called, come in dull grays or browns and sometimes with elaborate dark markings on the dorsal half of the body. They are not apt to be confused with the green fruitworms either on the basis of color or feeding habits.

No generally accepted common names have been applied to any of the 10 species of green fruitworms. True, the Entomological Society of America has designated in its official Common Names List one of them, *Lithophane*



Figure 4.—Pear fruits at harvest bearing healed green fruitworm feeding injuries.

*antennata*, as the green fruitworm. This is unfortunate for this species is much less commonly encountered than either *Orthosia hibisci* or *Amphipyra pyramidoides*. Some common names are proposed for certain species in this publication. It should be recognized, however, that none of them have official standing.

The scientific names of the 10 species of green fruitworms occurring in New York are given below. Common names are included where we believe they serve a useful purpose. The numbers following the scientific names are those assigned to the species by McDunnough (12) in his standard Check List. The species are listed in the approximate order of the frequency of their occurrence in New York apple and pear trees.

*Orthosia hibisci* Guenee 1943  
speckled green fruitworm

(This common name was proposed by Rings [19]. It refers to the presence of numerous white flecks over the body in last instar larvae.)

*Amphipyra pyramidoides* Guenee 2584 humped green fruitworm, copper underwing (The first common name refers to the hump on the eighth abdominal segment in the larval stage. Rings [17] has proposed the name "pyramidal green fruitworm." We prefer our common name principally because we believe humped is a more common term than pyramidal. "Copper underwing," of course, refers to the adult stage.)

*Lithophane antennata* Walker 2242  
widestriped green fruitworm

(A possible objection to the use of this common name for this species is that it is equally applicable to *L. laticinerea*. However, *L. antennata* is the more common species attacking fruit trees.)

*Lithophane unimoda* Lintner 2247

*Himella intractata* Morrison 1840

fourlined green fruitworm

(Reference is made here to the occurrence in the larva of four white lines on the sides of the body below the prominent subdorsal stripe.)

*Lithophane laticinerea* Grote 2245

*Lithophane grotei* Riley 2246

*Lithophane baileyi* Grote 2234  
Bailey green fruitworm

*Lithophane georgii* Grote 2244

*Morrisonia distincta* Hubner 1671

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## SPECIES IDENTIFICATION

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While species identification in insects is usually based on characters found in the adult stage, it is often possible to separate them in the larval or other immature stages. The green fruitworms can be rather readily identified to species from characters found in the larvae. In fact, most persons will find it easier to separate these species in the larval than in the adult stage. (To test the validity of this assertion, the reader is asked to compare his or her ability to separate the species based on their representations in Plate 1 and Figure 7.)

It should also be possible to separate these insects on the basis of characters found in the egg and in the pupal stages. Whether this is possible and practicable we have not examined; anyway, such considerations lie outside the scope of the present publication. Egg and pupal stages of *O. hibisci* are shown in Figures 5 and 6. These are included only for the purpose of illustrating the general appearance of these stages among members of the green fruitworm complex.

Green fruitworm larvae pass through six growth stages

or instars. Rings (19) found the larva of *O. hibisci* at hatching time, or when it is in the first instar, had an overall length of 2.5 mm. For the five succeeding instars, the lengths averaged 5.7 mm, 7.8 mm, 16.6 mm, 25.3 mm, and 32.3 mm, respectively. With the exception of *L. grotei*, the last three larval instars in green fruitworms are of very similar appearance. Ordinarily, these will be the instars that will be involved in identification. However, anyone desiring to obtain information on each of the six instars is referred to Rings (17,18,19, 20). He has supplied this information for *A. pyramidoides*, *O. hibisci*, *L. laticinerea*, and *L. unimoda*. In the present publication, species identification is based, primarily, on the last larval instar.

We have elected to provide two larval keys. The first key involves only three species—the three which are by far the

most common—while the other treats all 10 species. It is suggested that one attempt to use the first key first. If the larva being examined appears to lie outside this key, then the second key may be used. The chances are, however, that in at least 9 out of 10 cases, a larva in question can be identified by use of the first key.

In the keys, reference is made to the spiracles, to the spiracular area (a fairly narrow strip lying above and below an imaginary line drawn through the spiracles), and to various areas of the body surface. These are identified in Figure 9. As will be seen, the spiracles are quite small, oval in shape, and occur only in the first thoracic segment and in the first eight abdominal segments. These spiracles are openings or valves in the body wall through which the larva breathes. The keys follow:

### KEYS FOR THE IDENTIFICATION OF LAST INSTAR LARVAE

#### *Key to the Three Most Common Species*

1. Bearing prominent hump on eighth abdominal segment (Plate 1) .....*Amphipyra pyramidoides*  
—hump lacking .....2
2. Whitish spiracular stripe narrow, not equal to height of spiracle except on last proleg (Plate 1) . . . *Orthosia hibisci*  
Spiracular stripe very wide, about three times height of spiracles (Plate 1)..... *Lithophane antennata*

#### *Key to all Species*

1. Bears prominent hump on eighth abdominal segment (Plate 1) .....*Amphipyra pyramidoides*  
—hump lacking .....2
2. Prominent subdorsal whitish stripe with four more or less evenly spaced whitish lines on sides; spiracles lying within next to lowest line (Plate 1) ..... *Himella intractata*  
—not so marked .....3
3. Whitish lines or stripes lacking; generally a plain green caterpillar ..... *Lithophane grotei*  
—bearing continuous or broken white or yellowish lines or stripes .....4
4. Spiracles black. A continuous yellowish stripe lying just below spiracles and about their height .*Lithophane unimoda*  
—spiracles pale, rimmed or not, with brown; sometimes difficult to see .....5
5. Spiracular stripe wide (about three times height of spiracles). Abdominal spiracles one through seven at top of stripe. Subdorsal line broken (Plate 1)..... *Lithophane antennata*  
—Spiracular stripe of similar width but spiracles lying at its center. Subdorsal line continuous .....  
*Lithophane laticinerea*  
—Spiracular line(s) narrower, two times height of spiracles, at most .....6
6. Body flecked with numerous white spots. Single spiracular stripe present .....7  
—body not so flecked. Has two continuous or broken lines in the spiracular area .....8
7. Spiracular stripe narrower than height of spiracles except on last proleg and lying above abdominal spiracles one through seven (Plate 1)..... *Orthosia hibisci*  
—spiracular stripe nearly two times height of spiracles, yellowish and lying below spiracles . . . *Lithophane georgii*
8. The two spiracular lines broken (Plate 1) ..... *Lithophane baileyi*  
—lines continuous ..... *Morrisonia distincta*

### PREVALENCE OF THE SPECIES

Rings (17) has reported the results of systematic collections made of green fruitworms in Ohio over a 6-year period

(1961 -1966). He does not advise specifically which hosts were sampled, stating: "Collections were made in five Ohio arboretums, abandoned orchards, and from isolated seedlings of various fruit trees." Based on 369 collections made, he reports the number of individuals of each species collected expressed as percentages was as follows:

	% of total
<i>Orthosia hibisci</i>	34.5
<i>Amphipyra pyramidoides</i>	22.3
<i>Lithophane antennata</i>	15.4
<i>Lithophane unimoda</i>	8.9
* <i>Orthosia rubescens</i>	5.7
<i>Himella intractata</i>	4.5
Misc. species	8.7

\*Strictly speaking, this species should not be included here for it is one of the non-green fruitworms (see page 13).

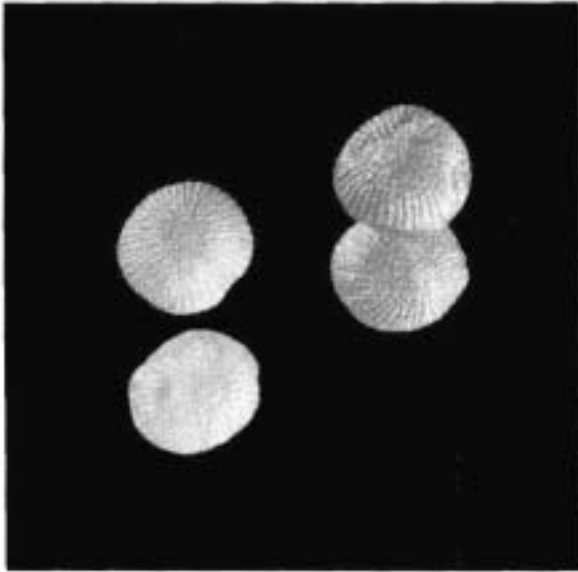


Figure 5.—Eggs of *Orthosia hibisci* (enlarged 22X).

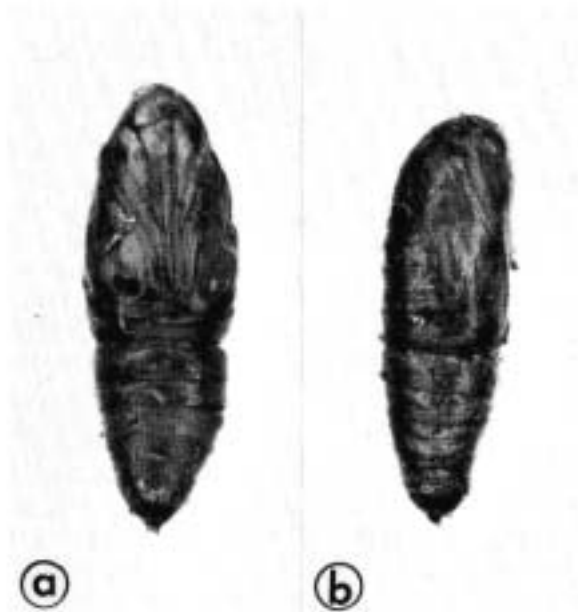


Figure 6.—Pupal stage of *Orthosia hibisci* (a) ventral view (b) lateral view (enlarged about 3X).

Our findings are in general agreement with those of Rings (17). Our collections, however, were limited to apple trees—uncared for cultivars and wild seedlings. These trees were sampled for their green fruitworm and other insect populations at about 35 Stations representing all of the geographic regions of New York (3). We would estimate that of all green fruitworm larvae collected or observed, about 60% were *O. hibisci*, 20% *A. pyramidoides*, 10% *L. antennata*, and 10% miscellaneous species. The three species named were statewide in their distribution; the seven remaining ones exhibited localized distributions.

#### INDIVIDUAL STATEMENTS ON SPECIES

In this section, information is given for each of the 10 species: on the appearance of the last instar larva and the adult; on the species' life history; on its food plants; and on its distribution. The terms used in the descriptions of the larvae are given in Figure 9. The reader is referred to Forbes (6) for similar information on the adults.

#### *Orthosia hibisci* Guenee speckled green fruitworm (Plate 1, Figs. 1, 5, 6, 8, 10, 11)

As stated earlier, this is the green fruitworm most commonly found feeding on fruit trees in New York.

**Descriptions.**—Last instar larvae (Plate 1, Fig. 1) measure from about 1  $\frac{1}{4}$  to 1  $\frac{1}{2}$  inches (30-40 mm) in length. The head is pale green and faintly reticulated with brown, or not. Body color is a yellowish green and covered with numerous whitish flecks. Skin is smooth. A narrow but continuous middorsal white stripe is present and a less distinct and broken subdorsal white line. The spiracular stripe is white or cream, slightly narrower than the height of the pale, dark rimmed spiracles except on the anal proleg where it slightly exceeds the spiracles in height. This stripe lies just above the spiracles on abdominal segments one through seven but below the prothoracic and eighth abdominal ones.

When *O. hibisci* larvae are reared under crowded conditions, the body of some individuals may become dark green above the spiracles. This phenomenon was first reported in this species by Parrott and Hodgkiss (15). All of the stripes are more prominent in these darker forms. This is a melanic occurrence and is known to take place under high populational conditions in many insects (9). Before reviewing our notes, intensively, we did not recall having seen any of these dark phase individuals in nature. But in going through our records for 1960, we found this entry: "Cherry Valley, 5/30: green fruitworms abundant, mostly *O. hibisci*; a fair number were quite dark green just like those produced under confinement in the lab." From this record, we must say then, that these dark phase caterpillars can occur in nature. However, in our experience, this is most uncommon. We consider the light green individuals to be the "normal" form in nature. The gross appearance of the two color phases is shown in Figure 10.

The adult is shown in Figure 8c. As in all members of this group, a considerable range in color intensity exists in the forewings. The individual illustrated may occupy an intermediate position in this range. The base color is a soft grayish pink and unevenly overlaid with slightly darker grayish brown or fuscous tipped scales. The reniform and orbicular spots are of conventional size and appearance, are narrowly pale outlined, and fully or partially filled with darker purplish gray scales. Based on 68 individuals measured, the average length of the forewing is 16.4 mm. Hindwings, pinkish gray and only slightly lighter than forewing in color intensity. The vestiture or "hair" on the head and thorax is fairly prominent (Fig. 11) and averages out grayish tan or brown. In a close relative, *O. rubescens*, the vestiture is distinctly reddish (auburn). This color difference offers a ready means of separating the two forms. For another description, see Forbes (6).

**Life History.**—The species overwinters underground in the pupal stage. Adults may appear as early as late March at Geneva, New York and continue to be on the wing into May (4, 6, 19). The earliest eggs are laid when apple buds are in the half-inch green bud stage (2). An enlarged view of the egg is shown in Figure 5. Their diameter is approximately 0.8 mm. When confined to a plastic box or bag, gravid females will lay their total output of eggs, presumably, at one time and place. They are deposited in a single pile or mass and up to 10 eggs deep, depending on where they are laid. The eggs are usually deposited in a pocket (plastic bag) or corner of the container (plastic box). The number of eggs found in three of these piles was: 329, 513, and 384.1 in each case, these represented the total egg production of the three moths observed. We have no information on how *O. hibisci* adults deposit their eggs in nature. Circumstantial evidence suggests that no more than an egg or two may be deposited at any given site.

The young larvae feed on the new leaves and sometimes are found within a rolled leaf in much the same manner as tortricid or leaf roller larvae. When the newly set fruits of apple and pear are present, they may be fed upon by fifth and sixth instar larvae. Where the fruits occur in clusters of from three to five on a fruit spur, a single larva may feed on several or all of them producing injuries similar to those shown in Figure 2. The larvae complete development as early as the end of May, some late in June in New York. Whenever this occurs, they then drop to the ground, enter it to a depth of 2-4 inches, construct a pupal chamber, and then enter the pupal stage. The gross appearance of the pupa is shown in Figure 6. The species remains in the pupal stage until the following spring. There is only one generation annually.

**Food Plants and Distribution.**—In Canada, Prentice (16) reports recovering larvae from 38 trees and shrubs including 10 species of conifers. The first 10 hosts he lists, and the numbers of larvae recovered from each follows: trembling aspen, 612; willow, 220; white birch, 157; balsam poplar, 144; white spruce, 90; speckled alder, 50; Manitoba maple, 36; elm, 28; choke cherry, 22; and basswood, 20.

Prentice states that in the prairie region the preferred host is trembling aspen; in the province of Ontario, white birch. Tietz (23) lists 16 hosts in Pennsylvania, while Rings (19) recovered larvae from apple, crab apple, plum, cherry (several species), hawthorn, rose, quince, Japanese apricot, Russian almond, strawberry, and blackthorn. It is evident that *O. hibisci* has a wide range of hosts. Generally, these consist of deciduous trees and shrubs.

*O. hibisci* has been collected extensively in the northeastern quadrant of the United States and across all of southern Canada. Isolated collections have also been made in Georgia, Oklahoma, Colorado, Utah, and California (19). Until further records are available, however, one must conclude *O. hibisci*, basically, is a northern ranging species.

***Amphipyra pyramidoides* Guenee**  
**humped green fruitworm**  
**copper underwing**  
(Plate 1, Figs. 1, 8d)

Although the caterpillars of this species are usually outnumbered at a given site by those of *O. hibisci*, it occurs commonly throughout New York on apple and pear. The species is easily recognized from the prominent hump which occurs on the eighth abdominal segment; it is present in instars three through six (17).

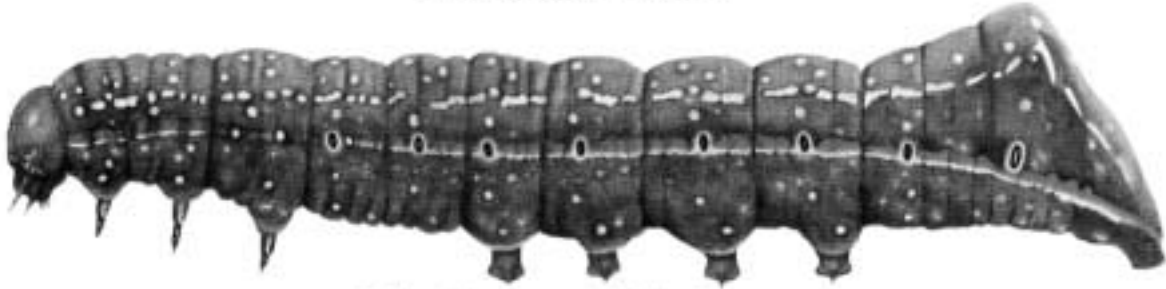
**Descriptions.**—The general color of last instar caterpillars (Plate 1, Fig. 1) is apple green overlaid, or not, on the dorsum with a milky overcast. Skin, smooth. A continuous white middorsal line is present and a much broken subdorsal one which angles dorsad into the hump. Spiracles, black. The white spiracular line, which is covered to a varying extent with bright yellow, lies below the prothoracic and eighth abdominal spiracle but is in line with the others or slightly below them. The spiracular line is strong on the first two thoracic segments, especially on the second, almost disappears on the third thoracic and first abdominal segments, but continues strongly from the third abdominal segment posteriorly and out onto the anal proleg. Length 1<sup>X</sup>A to 1 Vz inches (+ 35 mm).

The general appearance of the adult is shown in Figure 8d. The forewings are abruptly divided into a dark proximal two-thirds and a lighter distal third. In the former instance, most of the scales are dark fuscous, but some blackish areas are also present. In the distal portion, the grays are lighter on the average and include some quite light gray areas. The usual spots in the center of the wing apparently lacking except for the reniform which is small and often indistinct. Based on 26 individuals measured, the average length of the forewings is 20.8 mm. Hindwings coppery orange with the costal area fuscous. One common name used for this species, copper underwing, is based on the color of the hindwings. For another description of the species see Forbes (6).

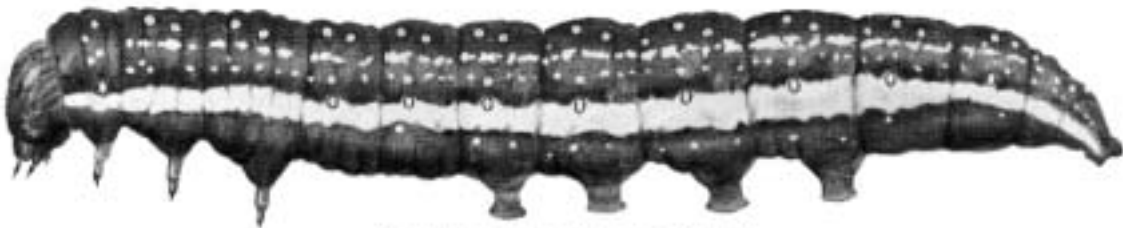
**Life History.**—Unlike the other nine green fruitworms, the present species overwinters in the egg stage. Adults are on the wing from July into November, but egg-laying



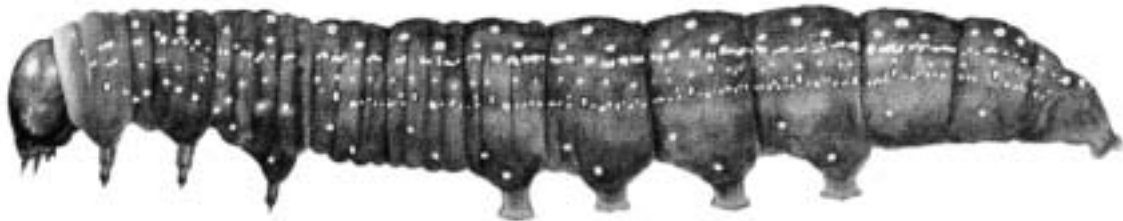
A. *Orthosia hibisci* Guenee  
speckled green fruitworm



B. *Amphipyra pyramidoides* Guenee  
humped green fruitworm



C. *Lithophane antennata* Walker  
widestriped green fruitworm



D. *Lithophane baileyi* Grote  
Bailey green fruitworm



E. *Himella intractata* Morrison  
fourlined green fruitworm



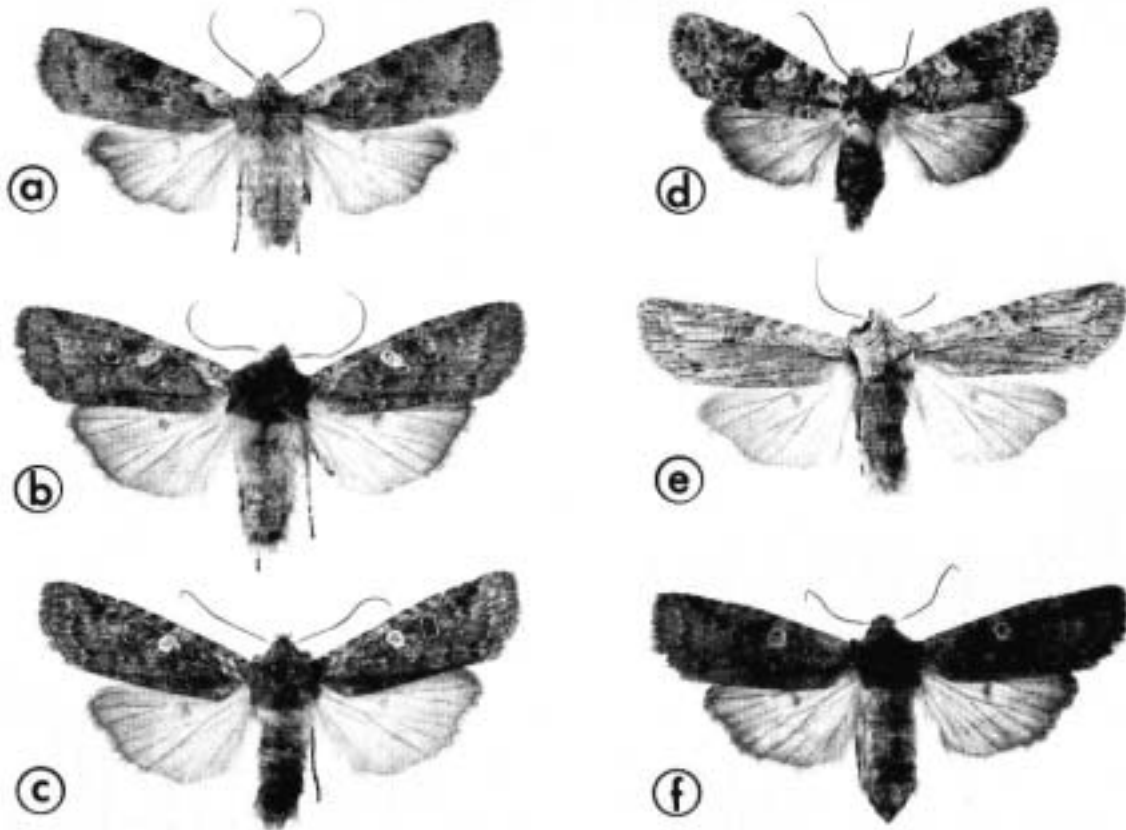


Figure 7.—Green fruitworm adults of the genus *Lithophane*: (a) *antennata*, (b) *laticinerea*, (c) *grotei*, (d) *baileyi*, (e) *georgii*, (f) *unimoda* (enlarged 1<sup>1</sup>/<sub>2</sub>X).

does not start until late September (17). The eggs hatch in the spring about the same time that the other green fruitworm eggs do or when apple buds are in about the half-inch green bud stage (2).

**Food Plants and Distribution.**—Rings (17) collected larvae from apple, plum, peach, black cherry, flowering almond, and crab apple in Ohio. In Canada (16), it was recovered from 20 deciduous forest trees and shrubs of which basswood, elm, oak, white birch, and willow appeared favored. Tietz (23), in Pennsylvania, lists 41 hosts, all deciduous trees and shrubs. It is evident this species breeds in about all of the deciduous woody plants within its range.

*A. pyramidoides* has been collected most commonly in the northeastern quadrant of the United States and in the adjoining provinces of Canada. Limited records also place the species in British Columbia, Washington, California, Arizona, New Mexico, Kansas, Texas, and Georgia (5, 6, 16, 17, 23).

***Lithophane antennata* Walker**  
**widestriped green fruitworm**  
 (Plate 1, Fig. 7a)

In our observations, this has proved to be the most common of the six green fruitworms of the genus *Lithophane*. It may represent about 10 per cent of the state's green fruitworm population.

**Descriptions.**—Last instar larvae (Plate 1) measure from about 1<sup>1</sup>/<sub>4</sub> to 1<sup>1</sup>/<sub>2</sub> inches in length. General color light green; skin, smooth. The head is green, unmarked, and "roughened, but not granulose (5)." Bears a continuous middorsal line of white, a broken subdorsal line, and between this line and the spiracles a line composed of fairly widely spaced dots. The spiracular band is very wide and is white or cream. This band is three times the depth of the spiracles, which are pale and dark-ringed, or not, and occur at the upper edge of the band (Plate 1).

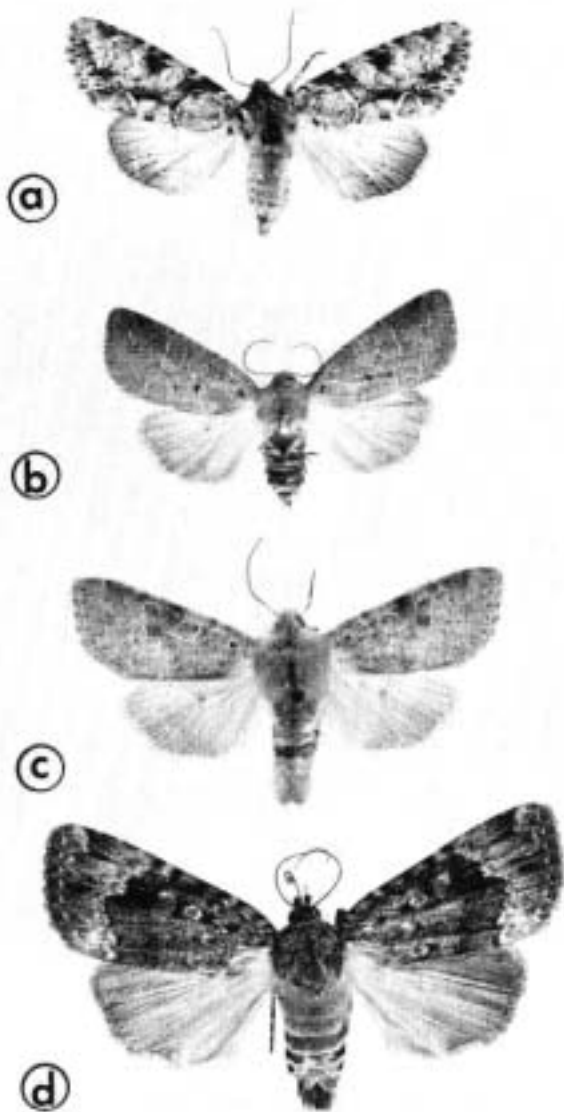


Figure 8.—Green fruitworm adults other than the *Lithophane* spp. (a) *Morrisonia distincta*, (b) *Himella intractata*, (c) *Orthosia hibisci*, (d) *Amphipyra pyramidoides* (enlarged 1 'hX).

The adult is shown in Figure 7a. Although resembling *L. laticinerea* and *L. grotei* in general appearance, the basic color of the forewings is bluish or steel gray; whereas, the other two are brownish gray and are devoid of a bluish cast and average darker. The orbicular and reniform spots are inconspicuous, incompletely outlined with black, filled with scales nearly concolorous with the surrounding except for a reddish patch in the reniform. A pale patch is found at wing base along costal edge. The average length of the forewing, based on the measurement of 55 individuals, is 17.7 mm. Hindwings fuscous only slightly paler than forewings. For additional descriptive information see Forbes (6).

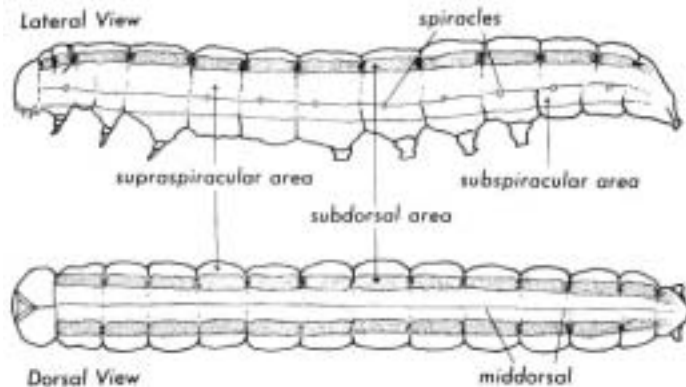


Figure 9.—Location of structures and areas of the body referred to in larval descriptions.



Figure 10.—Light (normal) and dark phase *Orthosia hibisci* larvae.

**Life History.**—There are several points of difference in the life history of the *Lithophane*, typified by the present species, and the two preceding forms. First, they overwinter in the adult stage and withhold egg laying until spring (18, 20). Furthermore, while the larvae complete their development at about the same time as other green fruitworms, the insects remain in the larval stage within the pupal chamber until the middle of September before pupating (6, 22). The new or overwintering adults emerge from the soil in late September and October. Eggs are laid in the spring. The time of egg hatch in relation to host development and nature and duration of larval feeding is about as given for *O. hibisci* and *A. pyramidoides*.

**Food Plants and Distribution.**—Tietz (23) found *L. antennata* feeding on the following plants in Pennsylvania: maple, hickory, ash, apple, poplar, rose, willow, linden, and fruit trees. Prentice (16) classifies it as "rare" in the intensive survey he and his colleagues have made of insect feeders on forest trees in Canada. Crumb (5) gives the following list of hosts: apple, plum, elm, maple, willow,

hickory, and wild cherry. Franclemont, in Forbes (6), reared the larvae readily on chokecherry. On distribution, the species has been collected in the northeastern quadrant of the United States and to a more limited extent in Canada. Thus, it has been reported to occur in the provinces of British Columbia, Ontario, Quebec, New Brunswick, and Nova Scotia (11, 21).

### ***Lithophane laticinerea* Grote**

(Fig. 7b)

In the larval stage, this and the preceding species have wide spiracular stripes in common and are easily confused with each other. According to Forbes (6) the species discussed as *Xylinagrotei* by Slingerland (22) is *L. laticinerea*.

**Descriptions.**—Full grown larvae have an overall length ranging from 1 VA to 1<sup>1</sup>/<sub>2</sub> inches (30-35 mm). The head is pale green, reticulated with white. Body color light green; "skin with some coarse granules in the white markings (5)." Mid-dorsal white stripe continuous, while a subdorsal white line is essentially continuous. Spiracular stripe wide, about three times the height of the spiracles which are pale and dark rimmed, or not, and lie *near the center* of the stripe.

The general appearance of the adult is shown in Figure 7b. The basic color of the forewings is brownish gray; some rather vaguely defined patterns are present which are darker gray and blackish. In color intensity, this species averages darker than *L. antennata* but slightly lighter than *L. grotei*. The orbicular spot fairly prominent, black outlined, and filled with pale scales; reniform spot obscure and filled with scales concolorous with surrounding area. Length of forewing, based on the measurement of 63 individuals, is 19.2 mm. Hindwing fuscous, darkening towards costal margin. For additional descriptive information, see Forbes (6).

**Life History.**—The life history is essentially the same as given for *L. antennata*.

**Food Plants and Distribution.**—As with other green fruitworms, the food plants of this species are rather broad, but are essentially limited to deciduous trees and shrubs. In addition to the tree fruits, the species is reported to feed on maple, willow, ash, elm, white birch, basswood, wild cherries, chestnut, and dogwood (16,18,23). Franclemont, in Forbes (6), reared the larvae readily on chokecherry. Bailey (1) reported the occurrence in 1937 of relatively heavy infestations of *L. antennata* and *L. laticinerea* causing defoliation of soft maple, swamp oak, ash, willow, and other trees at the mouth of the Lamoille River in Chittenden County, Vermont.

The species appears to be essentially confined in its distribution to the northeastern quadrant of the United States and to the adjoining provinces of Canada. Westernmost records include South Dakota, Manitoba, and Saskatchewan (16, 18).

### ***Lithophane grotei* Riley**

(Fig. 7c)

**Descriptions.**—This is a green unmarked caterpillar in

the last instar, although the head may be faintly reticulated with white. Skin rough. Spiracles pale, yellowish, and rimmed with brown. Overall length about 1-1/3 inches (32-35 mm). While we have not observed fifth instar and younger larvae, Forbes (6) writes "the ordinary lines are present in the younger stages." His reference to "lines" presumably means white or cream colored lines or stripes.

A general view of the adult is shown in Figure 7c. Forewings, dark gray and blackish, with some flecking of white or lighter gray scales. Generally marked as in *L. antennata* and *L. laticinerea*, but the present species averages the darkest of the three. Orbicular spot prominent and filled with light gray scales; reniform spot, pale outlined, not conspicuous and filled with scales concolorous with surrounding area. Patch of lighter scales at wingbase off costal margin: (This patch is also present in *L. antennata* and *L. laticinerea*, but it is not so distinct as in *L. grotei*). Length of forewing, based on the measurement of 25 individuals, averaged 20.2 mm. Hindwings fuscous strikingly paler than forewings. For further descriptive information, see Forbes (6).

**Life History.**—Available evidence (6) suggests the life history of the species is the same as that given for *L. antennata*.

**Food Plants and Distribution.**—Under the name *Grapto-litha cinerosa* Grote, which Forbes (6) claims is a synonym of the present species, Tietz (23) gives this host list for the species: maple, apple, European cherry, black cherry (*Prunus serotina*), and fruit and forest trees. Franclemont, in Forbes (6), has reared the species successfully on chokecherry. Like most of the other green fruitworms, *L. grotei* is probably a rather general feeder.

On distribution, Forbes (6) writes "Canada to the District of Columbia where it is the commonest of the three species (i.e., *antennata*, *laticinerea*, and *grotei*) west to Nebraska." While we do not have specific records to support this claim, it seems probable that *L. grotei* occurs in the northeastern quadrant of the United States and in the southern portions of the adjacent provinces of Canada.

### ***Lithophane unimoda* Lintner**

(Fig. 71)

**Descriptions.**—Full grown larvae can be fairly readily recognized from the black color of the spiracles and the texture of the skin which is coarse and covered with white-flecked granules. Head, pale green. Markings consist of a middorsal broken white line, a suggestion of a subdorsal line but composed only of scattered dots, and a prominent subspiracular stripe touching the spiracles. The color of this stripe has been described as yellowish white (6) and lemon yellow (20). Overall length of the larva is about 1 VA to 1<sup>1</sup>/<sub>2</sub> inches (30-35 mm).

A general view of the adult is given in Figure 7f. Forewings an almost uniform dark bluish gray and relieved slightly by a darker wavy subterminal line and an even less distinct postmedial line. The only pale marking is the orbicular spot which is small, round, and pale filled. Based on

the measurement of 21 adults, the length of the forewing is 18.4 mm. Hindwings fuscous distinctly paler than forewings, darkest towards margins. For other descriptive information, see Forbes (6).

**Life History.**—The life history is essentially that given for *L. antennata* (20).

**Food Plants and Distribution.**—According to Franclemont, in Forbes (6), the preferred host of this species may be black cherry (*Prunus serotina*), but it completes development readily, on chokecherry. Other hosts reported are: oak, maple, trembling aspen, pin cherry (*P. pennsylvanica*), willow, plum, pear, crab apple, and apple (11, 16, 20).

Apple, apparently, is not a common host of this species. In Ohio, Rings (20) states, "Although hundreds of apple trees were sampled over an 8-year period, no larvae of this species were recovered from this source." However, he did find larvae feeding on pear and crab apple. *L. unimoda* is reported to feed on apple in the provinces of Ontario and Quebec and has caused appreciable damage, at least on occasion, to apple in Nova Scotia (11).

*L. unimoda* has been collected in Wisconsin, Illinois, Michigan, Indiana, Ohio, New York, Pennsylvania, Virginia, Maryland, and in the New England States. In Canada it has been found in Nova Scotia, Ontario, Manitoba, and at White Horse in the Yukon Territory (16, 20).

### ***Lithophane georgii* Grote**

(Fig. 7e)

This species has been reported to be a minor pest of apple in Nova Scotia, Saskatchewan, and British Columbia (11, 14).

**Descriptions.**—The head of the last instar larva is light green, faintly reticulated with darker green. Body color green, covered with small whitish dots, not unlike the condition found in *O. hibisci* larvae. A continuous white middorsal stripe is present along with a thin broken white subdorsal line. Spiracles pale, dark rimmed, or not, while the spiracular stripe which is twice the height of the spiracles is subspiracular but touches the yellowish spiracles. The body length is about 1-1/3 inches (32 mm).

A view of the adult is found in Figure 7e. Forewings a pale slightly bluish gray or ash gray overall. The veins blackish and fairly prominent and also a row of blackish subterminal dots. Orbicular and reniform spots definitely visible, but inconspicuous from the fact that they are pale outlined and filled with scales which are almost concolorous with the surrounding areas. The forewing averages about 19.7 mm in length based on measurement of four individuals. Hindwings faintly fuscous and contrasting with the more dense if not darker, forewings. For additional descriptive information, see Forbes (6).

**Life History.**—Apparently the life history is the same, for all practical purposes, as given for *L. antennata*.

**Food Plants and Distribution.**—Prentice (16) reports that the larvae have been found feeding on willow, white birch, Manitoba maple, rose, buffalo berry, red alder, yellow

birch, ash, apple, pin cherry, and hazel. He also advises that *L. georgii* larvae feed principally on low-growing woody plants. Crumb (5) adds antelope brush and raspberry to the host list. Doubtless, this insect has a more extensive number of food plants than has been recorded.

*L. georgii* occurs in northeastern United States and across southern Canada from New Brunswick to British Columbia. Crumb (5) adds Arizona, California, Utah, Colorado, Oregon, Washington, Montana, and Nebraska.

### ***Lithophane baileyi* Grote**

#### **Bailey green fruitworm**

(Plate 1, Fig. 7d)

**Descriptions.**—The last instar larva (Plate 1) has a light green unmarked head. The body skin is smooth and uniformly bright apple green. The middorsal and subdorsal lines are composed of whitish dashes and are almost continuous. Two lines composed of whitish dots occur in the spiracular area of which the lower one, in which the spiracles are found, contains the larger number of dots. The overall length of the larva is about 1-1/3 inches (32-35 mm).

The gross appearance of the adult is shown in Figure 7d. The forewings are light gray with the fairly extensive markings of darker gray or blackish. The orbicular spot is fairly distinct, outlined with black, and filled with light gray scales. Reniform spot black outlined and filled with a patch of reddish scales. A terminal row of blackish dots present. Based on the measurements of 13 individuals, the length of forewing averages 16.5 mm. Hindwings fuscous but not paler than forewings. For further descriptive information, see Forbes (6).

**Life History.**—The life history of this species is believed to be very similar to that given for *L. antennata*.

**Food Plants and Distribution.**—The published list of hosts for this species is meager. It consists of: apple, chokecherry, white birch, cottonwood, and surprisingly, jack pine (6, 16, 21). Doubtless the food plants of *L. baileyi* are much more extensive than has been recorded.

In distribution, the species has been collected in: Pennsylvania, Massachusetts, New York, New Hampshire, and in Canada the provinces of Nova Scotia, New Brunswick, Quebec, Ontario, and southeastern Manitoba. These records suggest this is a northern ranging form and is largely confined to northeastern North America (5, 6, 16, 21).

### ***Himella intractata* Morrison**

(Plate 1, Fig. 8b)

This is a rather southern ranging species, although Franclemont, in Forbes (6), has collected it at Ithaca, New York. Our collections were limited to the lower reaches of the Hudson Valley area.

**Descriptions.**—The last instar larva (Plate 1) is a rich apple green with an unmarked head. The body markings consist of white lines or stripes as follows: a thin middorsal slightly broken line, a prominent white subdorsal stripe, and

on the sides between the subdorsal stripe and subspiracular area, four thin, rather wavy, white lines. Spiracles inconspicuous, pale yellow; they lie within, next to the lowest of the four lateral lines. Length of full grown larva, about 1/4 inches (30 mm).

The gross appearance of the adult is shown in Figure 8b. Forewings covered with soft reddish gray and bluish gray scales with the former usually dominant. A pale subterminal line present. A prominent black spot is found near wing base. One or two similar black spots may occur in some individuals and when present, fall within the crease line. Orbicular and reniform spots large and narrowly pale outlined. Based on the measurement of seven individuals, the average length of forewing is 15.1 mm. Hindwings are nearly concolorous with forewings and paler in proximal third. For additional descriptive information, see Forbes (6).

**Life History.**—This species, like *O. hibisci*, overwinters in the pupal stage (4, 7). Since its life history is believed to closely parallel that of *O. hibisci*, it will not be repeated here.

**Food Plants and Distribution.**—Oak appears to be a preferred host of this species. Others reported are shagbark hickory, blackcherry, and chokecherry(8). Rings (17), apparently, has collected it from various fruit trees.

In distribution, *H. intractata* is reported to occur in the Atlantic States at least as far north as Massachusetts to South Carolina (8). McFarland (13) has collected it in Kansas.

### ***Morrisonia distincta* Hubner**

(Fig. 8a)

**Descriptions.**—The last instar larva is green overall with whitish markings as follows: a middorsal line, a subdorsal stripe which is the most prominent of all its markings, and a line just above and one just below the pale, dark rimmed spiracles.

The appearance of the adult is illustrated in Figure 8a. The base color of the forewings is a light or silver gray, but the wings are rather extensively patterned with darker colored scales of brownish gray and blackish. Orbicular and reniform spots not always clearly visible, black margined and filled with light colored scales. Based on the measurement of 26 individuals, the length of forewing averages 15.7 mm. Hindwings pale in proximal portion, becoming fuscous in distal one-third. For additional descriptive information, see Forbes (6).

**Life History.**—The species apparently overwinters in the pupal stage (4). Moths are on the wing in April and May (6). For information on the life history, see the account given for *O. hibisci*.

**Food Plants and Distribution.**—The larvae of this species have been found feeding on linden, oak, black walnut, white birch, butternut, white ash, and maple (8). We would add apple to this list (4). Early reports that grape was a host appear to have been in error (8).

While distribution records on this species are obviously incomplete, it would appear to occur over most of the United States excepting the southwestern portion (8).

## **NON-GREEN FRUITWORMS**

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Eight of the 10 green fruitworms are members of the genera *Lithophane*, *Orthosia*, and *Morrisonia*. Some other members of these genera also feed on fruit trees, such as apple, and perhaps could be called fruitworms. But since their caterpillars are not green in color—usually coming in grays, browns, or bearing dark patterns in their dorsal area—they lie outside the scope of the present publication. Added to this, we have neverfound any of them causing injury to the fruits of fruit trees in New York. However, we decided to at least list these forms for some may have pestiferous potentials. Technical information will be found on these species in Forbes (6). The reference(s) refers to instances where the species was found feeding on apple.

*Orthosia rubescens* Walker 1937 (4, 17)

*Lithophane bethunei* Grote and Robinson 2220 (4, 11, 21)

*Lithophane disposita* Morrison 2225 (11)

*Lithophane petulca* (=ferrealis) Grote (11)

*Lithophane pexata* Grote 2252 (11)

*Lithophane innominata* Smith 2221 (4)

*Lithophane hemina* Grote 2226 (4)

*Lithophane oriunda* Grote 2227 (4)

*Morrisonia evicta* Grote 1903 (4) *Morrisonia confusa* Hubner 1904 (4)

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## **CONTROL OF THE GREEN FRUITWORMS**

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In commercial apple orchards, green fruitworms may readily be controlled by the inclusion of one of the standard organophosphorus insecticides in sprays applied just ahead of bloom (pink bud stage) and one directly after bloom (calyx or petal fall stage). Trade names for current suitable products are: Guthion, Imidan, and Zolone. The same treatments and timing also apply to pear.

Homeowners desiring to protect their fruit trees from these pests must carry out practices which are essentially identical to those just suggested for commercial fruit growers. Rather than applying a separate spray containing one of the organophosphorus materials listed above, however, many homeowners will find it advantageous to use one of the *general purpose fruit spray mixtures*. These products are available at larger garden and agricultural supply stores. The insecticides found in these mixtures may vary but should include one or more of the following: malathion, methoxychlor, or carbaryl (Sevin). All of these are toxic to green fruitworm larvae, and if the trees are sprayed thoroughly just before and just after bloom with one of the general purpose fruit spray mixtures, good control should result.

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*Figure 11.*—*Orthosia hibisci*.