

SOME EGGS OF MOTHS AMONG THE GEOMETRIDAE-LEPIDOPTERA¹

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The author has been investigating the eggs of moths for several years. To date the eggs from more than 300 species, representing 31 families, have been collected, photographed, preserved and studied. Approximately two-thirds of them come from species that belong to the three largest families of Lepidoptera, namely the Phalaenidae, Pyralidae and Geometridae. The information assembled on eggs of the Geometridae warrants a publication on this family at this time, the first of a proposed series on species from given families.

Many species of geometrids are attracted in numbers to "black lights" on warm nights. Females caught at night on a white cloth adjacent to a light are placed in polyethylene bags or in broad glass vials lined with polyethylene. Some moths of most species will deposit some to many eggs, especially if the containers are kept in a warm place and adjacent to a west or north window. A few species deposit more readily if the containers possess repository objects which may be foliage, twigs, paper toweling or other materials.

After eggs were obtained and their characteristics noted, an effort was made to locate them in nature. Those deposited in clusters are easier to find than single isolated eggs. To date comparatively few have been found, consequently their host plants remain unknown.

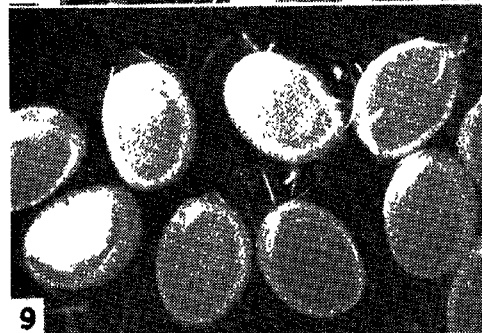
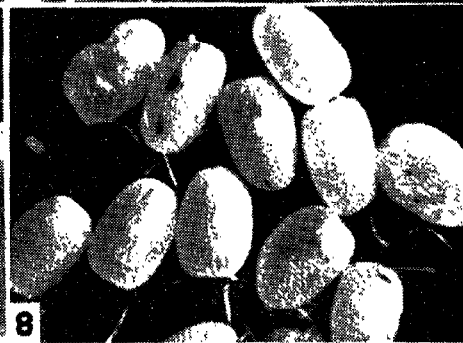
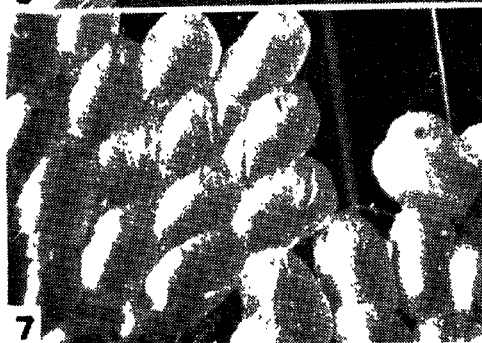
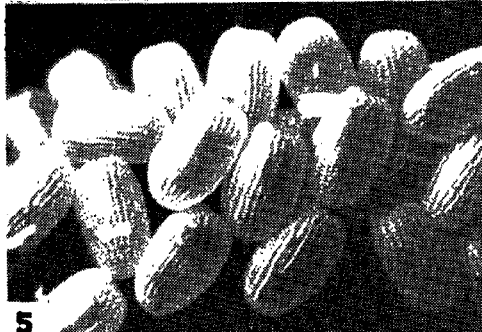
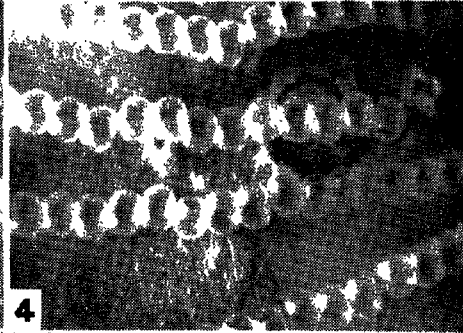
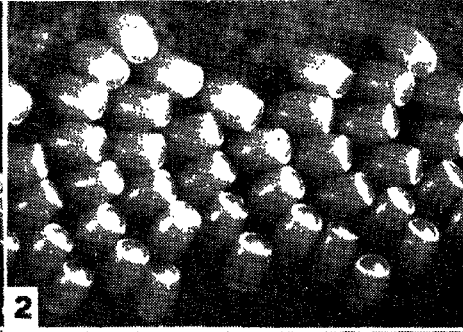
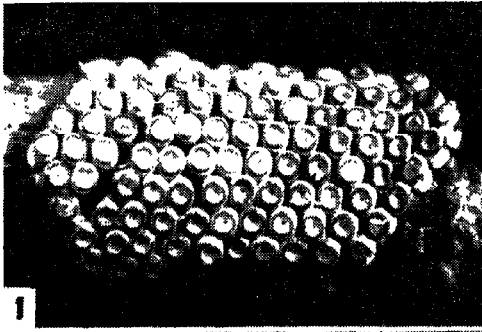
The author is aware of the fact that egg deposition by moths in a small space may be abnormal, especially among some species that produce a fairly uniform cluster pattern on given objects outdoors. When a female, confined in a small container, deposits most of her eggs in one or several clusters one may be fairly certain that this species naturally deposits her eggs in clusters. Species that deposit single isolated eggs in nature, when confined in a small container, will do likewise; however, if the species deposits numerous single eggs some of them will be close together and a few may be in contact with each other.

In general it can be said that an abnormality in the distribution pattern of eggs has little or no influence on the shape, size, color or surface structure of individual eggs. These important characteristics can be learned from eggs deposited in confinement.

Some general facts about eggs of geometrids that relate to their shape, size, position, distribution, surface structure, chorion consistency, and color will be presented before descriptions of species and genera are given.

The great majority of geometrid eggs are distinctly oval or elliptical, especially if viewed from above. None are spherical even though the tops, when in a compact mass, may be circular. From a side view most geo-

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metrid eggs are somewhat flattened. A few are distinctly flat or wafer-like (9-10)². Most geometrid eggs are deposited on their sides and seldom overlap. A few species deposit their eggs in a vertical or nearly vertical position. When vertical or nearly vertical eggs are in a compact mass, the eggs are cylindrical (1) or oval (2) with rounded bottoms and flattened tops that are circular or oval in shape. Vertical deposition may also occur among single eggs (22) or eggs deposited in small groups (20,23). Exceptional shapes or positions among geometrid eggs are illustrated in figures 1, 2, 9, 10, and 21-23.

Egg size correlates closely with female size, the largest moths producing the largest eggs and the reverse situation with small moths. All of the eggs figured, except 1, 2 and 4, were photographed at the same magnification, consequently a comparison will show size differences. Sizes vary in length from 0.45 mm. to 1.3 mm. and in width from 0.35 mm. to 0.75 mm. Some of the smallest eggs from the smallest moths are shown in figures 20, 21, 31 and 32 while the largest eggs from large moths occur in figures 3, 35 to 40.

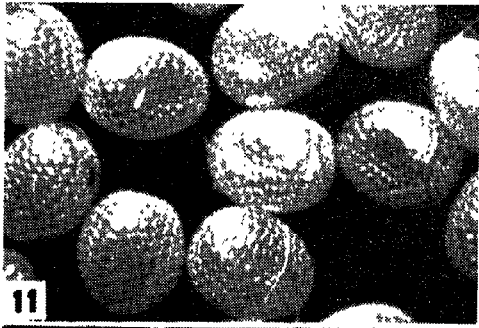
Eggs of geometrids may be deposited in dense and single-layered masses (1, 2, 5 to 7), in linear strands (4), in loose, single-layered clusters (8, 29, 37 and 40) in small groups (16, 17, 19, 20, 23, 25) or singly (31, 32) in isolated spots. Individual eggs in most clusters are firm and maintain their normal shape (1, 2, 29, 37). Among some species the chorion is pliable when the egg is deposited. When eggs are pliable (7) their shape within a cluster may be altered. Eggs shown in figure 8 are pliable yet their shape is not altered because they are not in contact with each other. Eggs of geometrids as rule do not overlap when they are deposited. Those shown in figure (2) are an exception.

The surface structure of the chorion among geometrid eggs varies con-

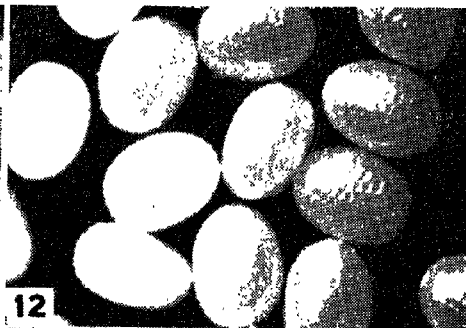
² Numbers in parentheses refer to figures.

Plate I.

- Figure 1. *Alsophila pometaria* (Hbn.), fall cankerworm. Egg mass partially surrounds a twig.
- Figure 2. *Ennomos subsignarius* (Hbn.), elm spanworm. Top view of a portion of an elongated egg mass.
- Figure 3. *Neptyia semiclusaria* (Wlk.): Enlarged view of eggs that have shriveled somewhat.
- Figure 4. *Deuteronomos magnarius* (Gn.). Hatched eggs in a linear band on bark of gumbo-limbo, Dade County, Florida.
- Figure 5. *Anavitrinella pampinaria* Gn. A cluster of firm eggs tightly fixed to polyethylene and to each other.
- Figure 6. *Tornos scolopacinarius* (Gn.). A cluster of firm eggs tightly fixed to polyethylene and to each other.
- Figure 7. *Anacamptodes defectaria* (Gn.). A mass of pliable eggs tightly fixed to polyethylene and to each other. Note shape of eggs when surrounded by others.
- Figure 8. *Anacamptodes humaria* (Gn.). Single pliable eggs attached to polyethylene. The same eggs in a mass resemble those in figure 7.
- Figure 9. *Racheospila livaria* Gn. Scattered wafer-like eggs attached to polyethylene.
- Figure 10. *Synchlora denticularia* (Wlk.). Three wafer-like eggs attached to a leaf.



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siderably and is useful in the determination of genera and species. Among a few species the surface is smooth (33, 36) with no apparent depressions or elevations. Eggs of a few species possess a chorion that appears to be granular (2, 7, 8) in structure. Eggs of most species possess faint to prominent pits or depressions or ridges and transverse striae. When the pits or depressions are prominent or moderate in size (5, 6, 11-16) they are usually arranged in more or less parallel rows running lengthwise on each egg. The depressions or pits may be irregular, circular, hexagonal or oblong in shape. Often they are larger (16) near the blunt end of the egg. The hexagonal reticulations among some species are very small and inconspicuous. Many can be seen only under a microscope on living eggs or in magnified colored transparencies. In a few eggs of geometrids the rows of depressions are such that they produce faint (30) or prominent ridges (21, 22) with faint to distinct striae between them.

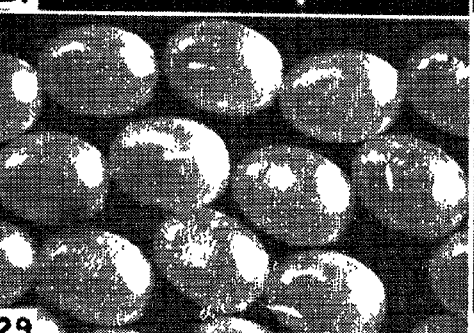
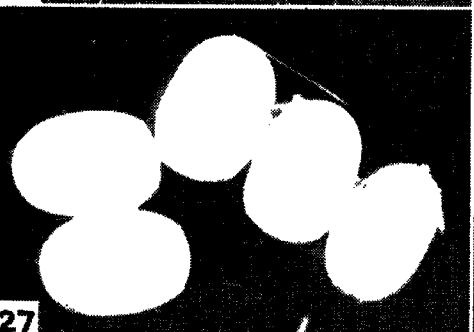
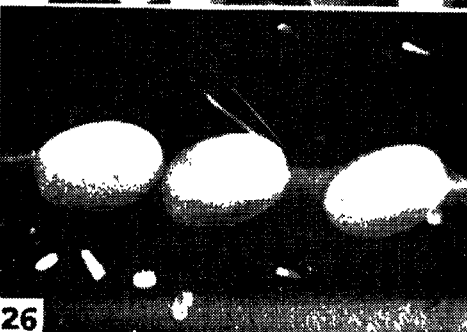
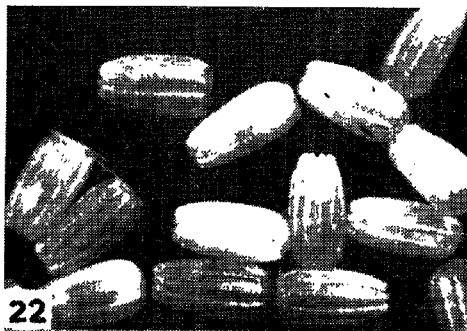
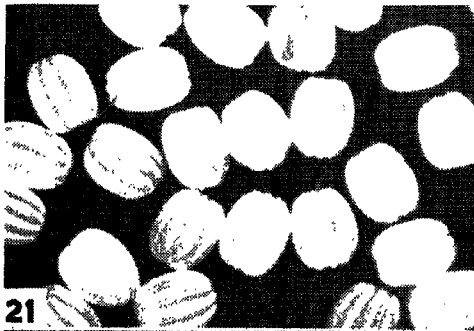
Eggs of most geometrids are covered with a thin, clear adhesive coating when they are deposited, consequently they cling to their substrate on which they rest and to each other when deposited in tight clusters. A few species deposit eggs that are moderately or slightly adhesive. These usually fall off readily when touched, especially if they are deposited on polyethylene. Figures 12, 15, 30, and 38 illustrate single eggs that have been pushed off of polyethylene and placed in a glass dish for photographing. Some of the eggs, that are on their sides or upside-down, show fragments of the dried adhesive material that failed to hold them to their substrate. Eggs shown in figure 21 appear to be free possessing little or no adhesive when they are deposited. In this respect they resemble eggs of *Crambus* (Pyralidae) and *Acrolophus* (Acrolophidae).

Geometrid eggs vary in color. When deposited each species usually has a uniform color. The colors of those seen to date are near white, light yellow, beige, cream colored, orange, yellowish green and varying shades of green, red, grey or brown. The original color among some species may change during incubation. Light yellow or green may become orange, red or deep brown before they hatch (21, 22, 35, 39, and 40).

To date the author has photographed in color the eggs of more than 60 species of geometrids. In this paper, 40 species, in 35 genera, are illustrated. They represent all of the types seen. In general it can be said that

Plate II.

- Figure 11. *Euchlaena muzaria* (Wlk.). Lightly attached eggs on polyethylene.
Figure 12. *Euchlaena astylusaria* (Wlk.). Eggs removed from polyethylene and placed in a dish, some are upside down.
Figure 13. *Euchlaena marginata* Minot. Scattered eggs on polyethylene.
Figure 14. *Euchlaena tigrinaria* (Gn.). Scattered eggs on polyethylene.
Figure 15. *Eubaphe mendica* (Wlk.). Eggs removed from polyethylene and placed in a dish, some are upside down.
Figure 16. *Melanolophia canadaria* (Gn.). A small cluster on polyethylene.
Figure 17. *Semiothisa bicolorata* (Fabr.). A small cluster on a leaf.
Figure 18. *Operophtera brumata* (Linn.). An injured winter moth egg on bark under lichen.
Figure 19. *Itame brunneata* (Pack.). Three eggs on a leaf.
Figure 20. *Metasiopsis ossularia* (Hbn.). An erect cluster of eggs on a leaf.



the eggs of species in a given genus resemble each other rather closely. This fact and others will be noted under the following discussions of the species or genera.

Eggs of (1) *Alsophila pomataria* Harr., the fall cankerworm, are deposited in compact clusters on the bark of twigs or small branches of their host plants. Each single-layered cluster may contain 100 to 150 short, cylindrical, perpendicular eggs which may partially surround a small twig. The eggs are laid in rows parallel with the twig and possess rounded bottoms and flat circular tops with dark rings about a greyish center.

Eggs of (2) *Ennomos subsignarius* (Hbn.), the elm spanworm, are deposited on elm twigs in elongated, narrow bands approximately 3 cm. in length. The 150, more or less, eggs in a loose continuous mass stand at an angle ($45^{\circ} \pm$) to the twig. They are arranged in irregular, curved, transverse rows each possessing three to eight eggs. Each egg is elongated, oval in shape, somewhat flattened and greyish brown with the lower end rounded and the upper end flat and bordered with a light colored edge.

Eggs of (3) *Neptyia semiclusaria* (Wlk.) occur on sand-pine trees in central Florida. The specimens figured came from L. A. Hetrick. He confined females in a cage with pine bark and they deposited irregular batches of beige to light brown, flattened eggs. The exposed surface of each egg is covered with tiny depressions which may be irregular or somewhat parallel in their distribution.

Eggs of (4) *Deuteronomos magnarius* (Gn.) occur on loose bark of celtis and gumbo-limbo trees in Dade County, Florida. Only hatched eggs have been seen and these were deposited in a linear manner. Named specimens are in the U. S. National Museum, Washington, D. C.

Eggs of (5) *Anavitrinella pampinaria* (Gn.) and (6) *Tornos scolopacinaris* (Gn.) have a firm structure and are light to medium green. On polyethylene they are deposited in irregular, flat, compact masses firmly attached to their substrate. Each egg, from a top view, possesses 12 to 14 distinct rows of pits. These are somewhat larger and more irregular in (6) *Tornos scolopacinaris* (Gn.) than in (5) *Anavitrinella pampinaria* (Gn.)

Eggs of (7) *Anacamptodes defectaria* (Gn.) and (8) *Anacamptodes humaria* (Gn.) have a pliable chorion and are a light to medium green

Plate III.

Figure 21. *Sterrha demissaria* (Hbn.). Non-adhesive free eggs in a dish.

Figure 22. *Scopula aemulata* (Hulst). Erect eggs on polyethylene removed and placed on their sides in a dish.

Figure 23. *Sterrha taturata* (Wlk.). Erect eggs on edge of a leaf.

Figure 24. *Scelolophia pannaria* (Gn.). A cluster of eggs on polyethylene.

Figure 25. *Semiothisa gnophosaria* (Gn.). Several eggs attached to edge of polyethylene.

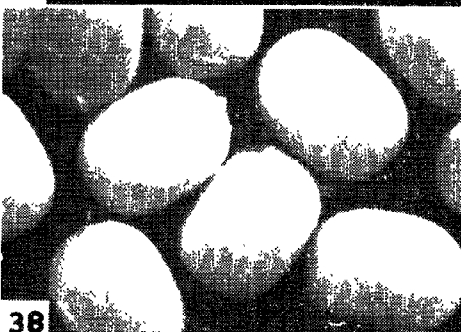
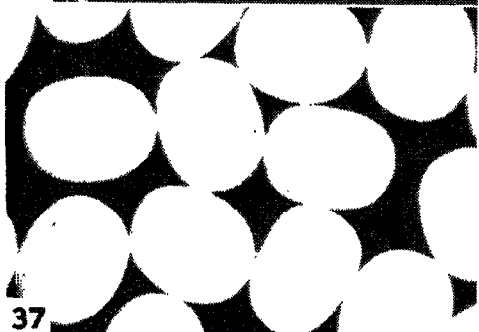
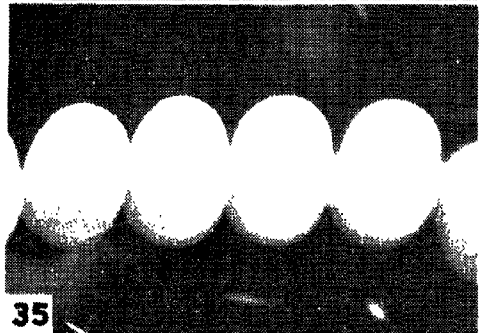
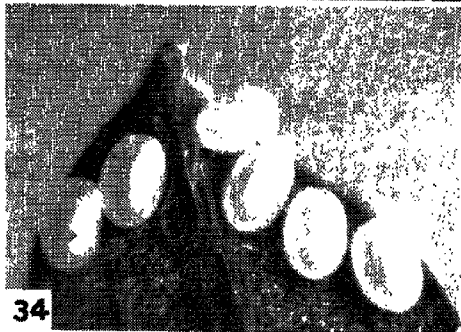
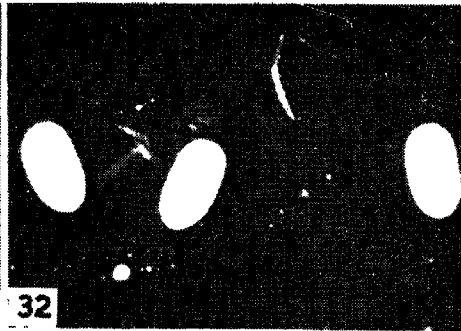
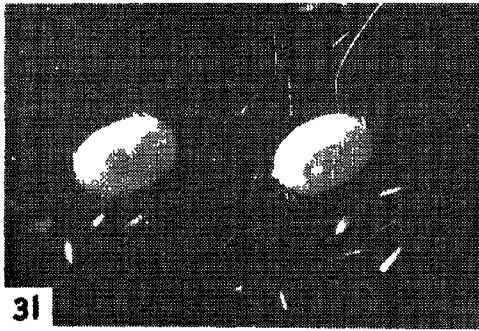
Figure 26. *Semiothisa orillata* (Wlk.). Three eggs on vein of a leaf.

Figure 27. *Lambdina pellucidaria* (G. and R.). Adhesive eggs on polyethylene.

Figure 28. *Euphyia unangulata* Haw. A cluster of eggs on polyethylene.

Figure 29. *Xanthotype sosepta* (Dru.). A cluster of adhesive eggs on polyethylene.

Figure 30. *Syssaura olyzonaria* (Wlk.). Eggs removed from polyethylene and placed in a dish, some are upside down.



color. On polyethylene they may be deposited singly or in compact, irregular, flat masses. All of the eggs located within a mass (7) may vary in shape. When deposited singly (8), where they are not in contact with other eggs, all have the same shape. The surface of each egg (7 and 8) is finely and irregularly pitted producing a granular appearance.

Eggs of (9) *Racheospila lixaria* Gn. and (10) *Synchlora denticularia* (Wlk.) on foliage or polyethylene are scattered, flattened, wafer-like objects firmly attached to their substrate. All eggs seen among species of *Racheospila* are orange colored while those seen among *Synchlora* were yellow to yellowish-green. The upper surface of these eggs is covered with tiny circular to hexagonal pits. Near the margin of each egg a continuous depression may be present.

Eggs of four species (11-14) of *Euchlaena*, namely *E. muzaria* Wlk., *E. astylusaria* (Wlk.), *E. marginata* Minot., and *E. tigrinaria* (Gn.) are light yellow to medium green and resemble each other. All four species scatter their loosely attached eggs on polyethylene, from whence they can be pushed off easily into a glass dish to be photographed. Conspicuous, more or less hexagonal pits occur on the exposed surfaces. They are arranged in more or less parallel rows and from a top view 10 to 12 rows are visible. Most of the pits are hexagonal and usually possess at their six corners tiny light-colored papillae. During incubation some of the species change color. This was very noticeable with *E. muzaria* (Wlk.) changing from a medium green to a distinct red. The above four species of *Euchlaena* (Geometridae) serve to demonstrate the similarity of eggs among species in a given genus.

Eggs of (15) *Eubaphe mendica* (Wlk.) are a medium green and resemble the eggs of species of *Euchlaena*, especially those of *E. astylusaria* (Wlk.), in that the hexagonal pits are large and light colored papillae occur at their corners.

Eggs of (16) *Melanolophia canadaria* (Gn.) are yellow to reddish and possess distinct but smaller pits than those found in eggs of *Euchlaena*; also the pits near the blunt end are somewhat larger than the remainder and possess near white papillae.

Eggs of (17) *Semiothisa bicolorata* (Fabr.) have a greyish green color

Plate IV.

- Figure 31. *Chlorochlamys indiscriminata* (Wlk.). Single eggs on polyethylene.
Figure 32. *Pleuroprucha insularia* (Gn.). Single eggs on polyethylene.
Figure 33. *Plagodis keutzingaria* (Pack.) Two eggs on polyethylene.
Figure 34. *Nycterosea obstipata* (Fabr.). Several eggs on tip end of a leaf.
Figure 35. *Tetracis lorata* Grt. Several adhesive eggs attached to polyethylene.
Figure 36. *Hyperetis alienaria* (H.-S.). Five eggs attached to polyethylene.
Figure 37. *Metarranthis obfirmaria* (Hbn.). Adhesive eggs in a cluster on polyethylene.
Figure 38. *Stenaspilates zalissaria* (Wlk.). Loosely attached eggs on Polyethylene placed in a dish. One is upside down.
Figure 39. *Pero barnesi* C. and S. Four eggs on a cork stopper.
Figure 40. *Abbottana clemataria* (A. and S.). A cluster of eggs on polyethylene.

and possess distinct pits on the surface that are somewhat irregular in their distribution and do not possess distinct papillae.

Eggs of (18) *Operophtera brumata* (Linn.), winter moth, are light yellowish to reddish brown before hatching. They are deposited singly on bark, frequently adjacent to or under the edge of lichens. Their surface possesses an irregular distribution of pits.

Eggs of (19) *Itame brunneata* (Pack.) have a bluish green color, and possess distinct small pits that are somewhat irregular in their distribution.

Eggs of (20) *Metasiopsis ossularia* (Hbn.) have a conspicuous red shade, and are deposited, more or less erect, in small clusters on foliage. They possess distinct pits with white papillae about their margins and prominent lighter colored bumps near the top of each egg.

Eggs of (21) *Sterrha demissaria* (Hbn.) and *S. flavescens* (Hulst) resemble each other closely. They are light yellow and change to a light orange. Their width approximates their length. From a side view five or six prominent ridges and conspicuous transverse striae are visible, also the eggs are almost nonadhesive. In general, they resemble the eggs of *Crambus* sp. (Pyrilidae). The eggs of (23) *Sterrha taturata* (Wlk.) are very different from the foregoing species in that they are firmly attached in a vertical position to their substrate and are vivid red, also their surface is covered uniformly with small hexagonal pits. Assuming that the identification of this moth is correct, the eggs of this species are markedly different from others in the same genus. In this respect this genus differs from other genera of Geometridae.

Eggs of (22) *Scopula aemulata* (Hulst.) are green to reddish and unusual in that they are deposited singly and in a vertical position. Each egg possesses distinct longitudinal ridges with faint transverse striae. They are lightly attached to polyethylene and in the figure have been removed from their substrate and assembled on their sides in a glass dish for a photograph.

Eggs of (24) *Scelolophia pannaria* (Gn.) are yellow to greenish, somewhat elongated and possess a rough surface with irregular longitudinal rows of shallow pits that are not very distinct.

Eggs of (25) *Semiothisa gnophosaria* (Gn.) and (26) *S. orillata* (Wlk.) resemble each other in color and surface consistency. They are pea green and the surface has a granular appearance due to the minute elevations and depressions present. The two species differ in size, also the eggs of *S. gnophosaria* (Gn.) are somewhat flatter than the eggs of *S. orillata*.

Eggs of (27) *Lambdina pellucidaria* (G. and R.) are iridescent and golden in appearance. The surface is smooth, shiny and possesses very inconspicuous, tiny, rounded reticulations seen through the adhesive coat.

Eggs of (28) *Euphyia unangulata* (Haw.) are of moderate size, somewhat adhesive and have a shiny beige-white color. Very tiny hexagonal reticulations are present on the entire surface.

Eggs of (29) *Xanthotype sospeta* (Dru.) are light yellowish green and are deposited firmly on polyethylene in flat masses. Each egg possesses small irregular reticulations that are not very distinct.

Eggs of (30) *Syssaura olyzonaria* (Wlk.) are yellowish green and from a top view show 11 or 12 faint longitudinal ridges with elongated and

slightly elevated, parallel, transverse striae producing oblong depressions. These eggs are removed easily from polyethylene.

Eggs of (31) *Chlorochlamys indiscriminata* (Wlk.) are small, adhesive, yellowish green and scattered on polyethylene. Each egg shows a faint network of fine elevations on the upper surface. The periphery of the egg possesses a ring-like collar.

Eggs of (32) *Pleuroprucha insularia* (Gn.) are small and near white. They possess faint reticulations of moderate size partially distributed in rows.

Eggs of (33) *Plagodis keutzingaria* (Pack.) are a very light yellowish green. The bright smooth surface appears to be without reticulations.

Eggs of (34) *Nycterosea obstipata* (Fab.) are small and yellowish white. They possess faint hexagonal reticulations of medium size that are scattered over the egg, mostly in parallel rows.

Eggs of (35) *Tetracis lorata* Grt. are light yellow turning to orange during incubation. They are firmly attached to each other and to the substrate. Their surface is smooth and somewhat granular in appearance.

Eggs of (36) *Hyperetis alienaria* (H.-S.) are a bright yellowish white, very adhesive and have a smooth surface with no reticulations or pits.

Eggs of (37) *Metarranthis obfirmaria* (Hbn.) are large, adhesive and bright cream-white. They are deposited on polyethylene in flat, loose masses. Each egg is covered with very small faint hexagonal reticulations that vary in size.

Eggs of (38) *Stenaspilates zalissaria* (Wlk.) are large, somewhat adhesive and beige to muddy green. They possess tiny, inconspicuous reticulations scattered over the entire surface. For this photograph the eggs were removed from the polyethylene and placed in a glass dish. One egg is upside down and shows fragments of the torn adhesive coat.

Eggs of (39) *Pero barnesi* C. and S. are large and dull, muddy, yellowish green. Forty-eight hours after deposition they change to a muddy brown color. In this figure the four eggs are located on the edge of a cork stopper. The surface of each egg is smooth with tiny reticulations visible under a microscope, especially in reflected light areas.

Eggs of (40) *Abbottana clemataria* (A. and S.) are bright green when deposited. During incubation they become reddish brown. Their surface is smooth with faint indications of tiny reticulations.

SUMMARY

Eggs of geometrids vary considerably in structure and manner of deposition yet there are a few characteristics which are common to most species and genera. Most geometrid eggs are oval in shape and are deposited on their sides. Many species possess surfaces that are rough, granular or smooth, but the great majority have a rough surface consisting of reticulations (pits or depressions) or ridges with transverse striae. When reticulations occur they vary from microscopic, faint pits or depressions to conspicuous ones that are arranged in longitudinal rows. Many species deposit their eggs in clusters. As a rule these are flat, decidedly adhesive, and consist of a single, naked layer without a protective coat of waxy secretions above them. When eggs are deposited singly and isolated they may not be firmly attached to their substrate, especially if deposited on polyethylene.

