Commun. Fac. Sci. Univ. Ank. Serie C
V. 6. pp. 9-28 (1988)

STUDIES ON THE EXTERNAL MORPHOLOGY OF THE EGGS OF SOME *ARGYNNINAE* SPECIES *(SATYRIDAE: LEPIDOPTERA)*

by ZEKİYE SULUDERE

Department of Biology, Faculty of Arts and Sciences, Gazi University, Ankara, TÜRKİYE

ABSTRACT

The eggs cf six species representing six genera of the subfamily *Argynninae* were studied by scanning electron microscopy.

Key Words: Lepidoptera, egg, morphology, SEM.

INTRODUCTION

Previous studies of Lepidoptera eggs have shown, how the morphological and structural features of the chorion may be used to advantage for taxonomic purpose (Salkeld, 1973, 1975, 1976; Suludere, 1988a,b; Downey and Allyn, 1980, 1981, 1984; Arbogast et al., 1980; Arbogast and Byrd, 1981). Besides, some literature deal with the eggshell and plastron respiration (Hinton, 1969, 1970, 1981; Margaritis, 1985).

Although the fine structure of the eggshell of the different insect has been studied in recent years, accurate knowledge of egg morphology is still lacking in many taxonomic groups, and including *Arygnninae*.

This paper is a part of the forthcoming studies on this subject.

MATERIALS AND METHODS

In this paper, the eggs of six species representing six genera of the subfamily *Argynninae (Satyridae)* were examined by scanning electron microscope. The species examined from each genus, and their collecting data are as follows:

Mesoacidalia aglaia (Linnaeus)

1 ♀ Turkey: Bolu, Abant, 14.8.1969

1 ♀ Turkey: Kars, Ardahan, 4.8.1972

Argynnis paphia (Linnaeus)

1 ♀ Turkey: Kars, Posof, 4.8.1972

Issoria lathonia (Linnaeus)

1 ♀ Turkey: Bolu, Abant, 20.6.1968

1 ♀ Turkey: Amasya, Akdağ, 7.7.1976

Boloria pales (Denis et Schiffermüller)

2 ♀ Turkey: Trabzon, Meryemana, 30.7.1972

2 ♀ Turkey: Rize, Trevit, 13.8.1984

Brenthis hecate (Denis et Schiffermüller)

1 ♀ Turkey: Ankara, Kepekli, 20.6.1970

1 ♀ Turkey: Kars, Sarıkamış, 20.7.1973

Fabriciana niobe (Linnaeus)

2 ♀ Turkey: Ankara 25.5.1967

The eggs were obtained from the dried specimens as they were in previous paper (Suludere, 1988α). Emptied eggs were dehydrated in alcohol and were dried in the air.

The dried eggs were mounted on jeol stubs by means of double-sided tape, coated with gold and examined in an Jeol 100 CX II electron microscope at 20 KV.

Approximately 30 eggs of each species were examined. The egg sizes, between the broadest points and the heights, were measured from a sample of 10 eggs of each species on the display screen of the SEM at a magnification of x100. The maximum dimension of micropylar pits and the aeropyles on the different eggs were determined from the screen or photographs at x 5000. Counts of the primary cells and the ridges were made on the examined eggs either from the screen or from the micrographs.

Result are presented in both descriptive and photographic forms. The terminology used in describing the chorionic features of the eggs follows that of Salkeld (1984).

RESULTS

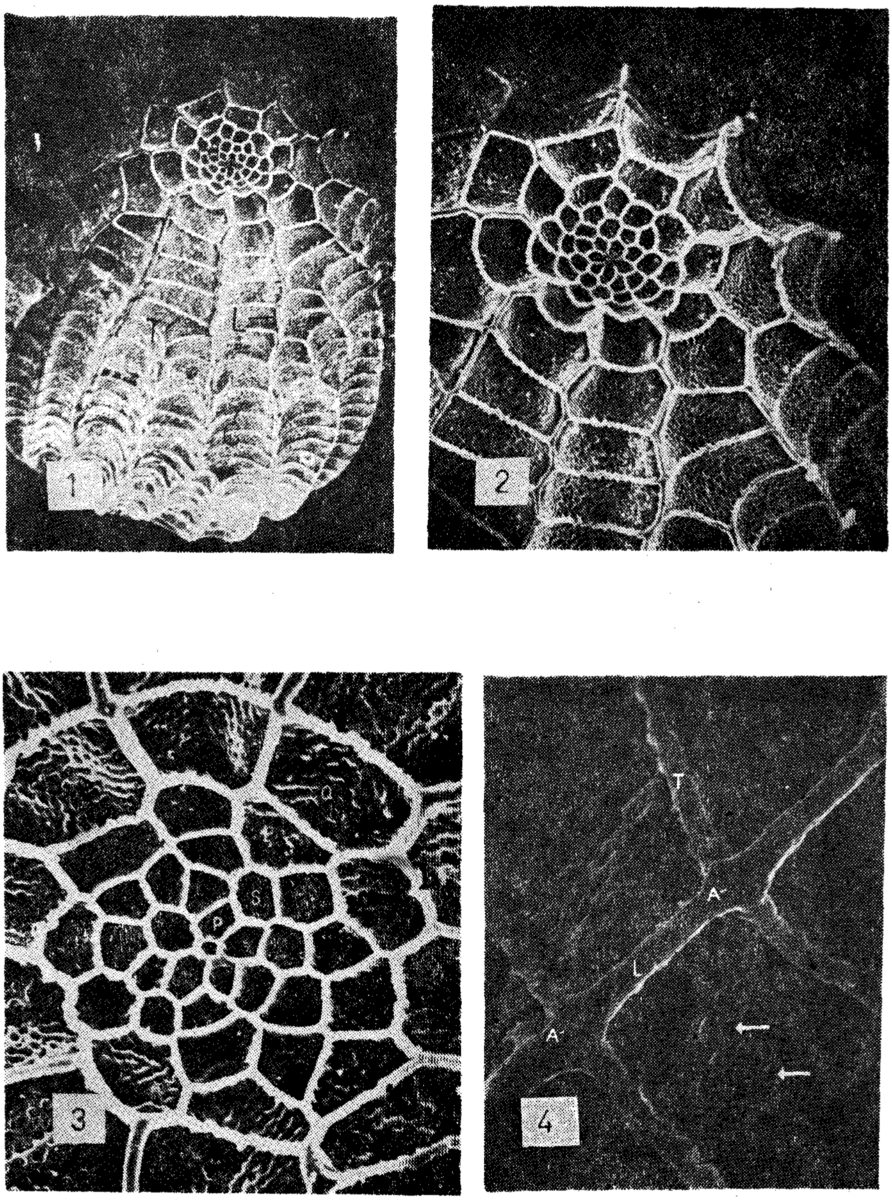
1- *Mesoacidalia aglaia*

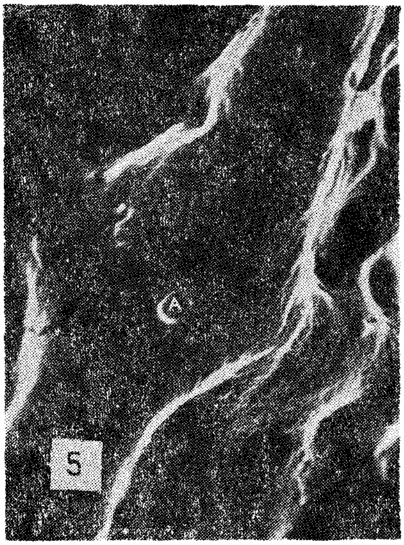
The eggs are irregularly circular in outline, and hemispherical in shape (Fig. 1), except the depressed micropylar area (Fig. 2). The height (H.) is greater than the width (W.), H. 0.97 ∓ 0.01 mm, W. 0.82 ∓ 0.02 mm. The eggs are distinctly and heavily ridged with both vertical and crossribs.

The micropylar rosette is composed of 5–8 primary cells (Fig. 3). The central micropylar pit is ovoid or circular and 7–8 μm in size. The rosette, secondary, tertiary and quaternary cells are relatively short, heavy–walled, and usually polygonal in shape.

From 8 to 10 longitudinal ridges radiate from the micropylar area. As the egg becomes wider below the apical region, more rows of columnar cells occur and the number of longitudinal ridges increases to 22–27 at the widest part of the egg. All of them are slightly elevated and disappear at the base of the egg. Conspicuous transverse walls occur among the longitudinal ridges to form the rows of rectangular areas. The transverse walls are sometimes discontinuous because of the alternate arrangement of the columnar cells in the adjacent columns. The height of the cell is about 1 / 3 – 1 / 4 of its wide in the equatorial area. Aeropylar openings are located at some junctions of columnar cell walls (Fig. 4). They are ovoid or circular in shape and their sizes vary from 1.3 μm to 2.6 μm (Fig. 5). The other openings or perforations occur on both cells of micropylar area and columnar cells which are called the pores or the plastonopores. They are numerous, and rather large openings in various sizes. These pores are remarkably smaller and more dense on the ventral surface of the egg (Fig. 6).

Abrevations: A. Aeropyle, Arrow. Pore, C. Columnar cell, F. Frilly reticulum, L. Longitudinal ridge. M. Micropylar area, P. Primary cell, Q. Quaternary cell, S. Secondary cell, t. Tertiary cell, T. Transverse wall.





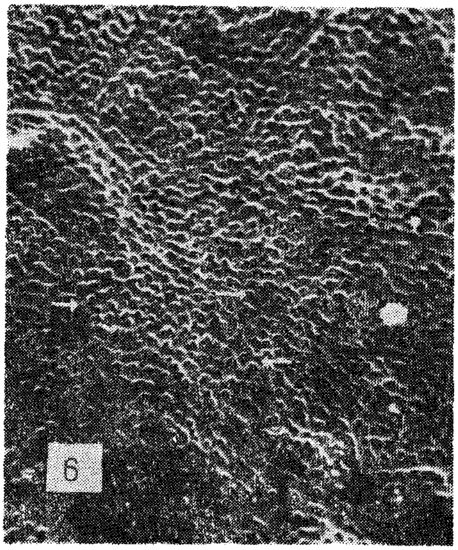


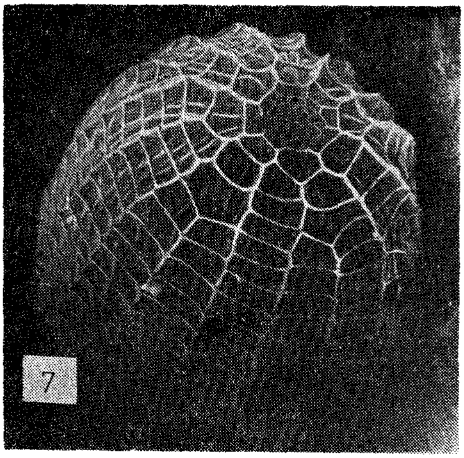
Figure 1–6. The eggs of *M. aglaia*. 1. Side angled agg, x100. 2. Depressed micropylar area, x200. 3. The cells of micropylar area, X500. 4. The aeropyles at the junctions of the longitudinal ridges and the transverse walls, X 1000. 5. An aeropyle, X 5000. 6. The pcres on the ventral surface of egg, X 1000.

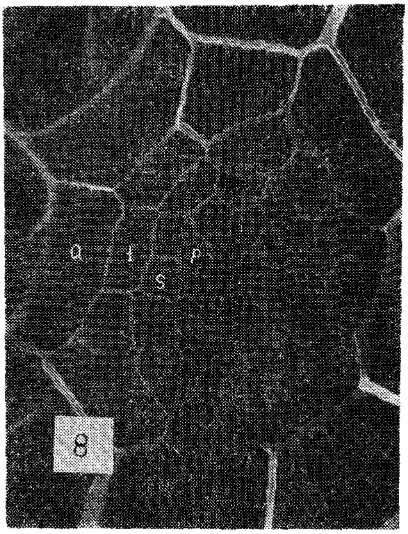
2– *Argynnis paphia*

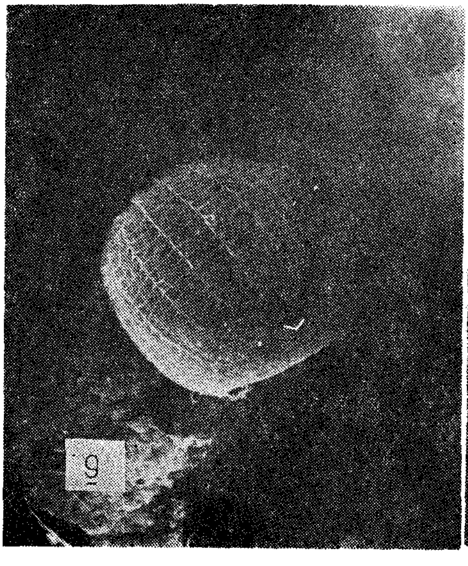
The egg has irregularly circular in outline and hemisperical in shape (Fig. 7), except the slightly depressed micropylar area. Its height is slightly greater than the width, H. 0.80 ∓ 0.01 mm, W. 0.75 ∓ 0.01 mm. The egg is distinctly and heavily ridged with both vertical and crossribs.

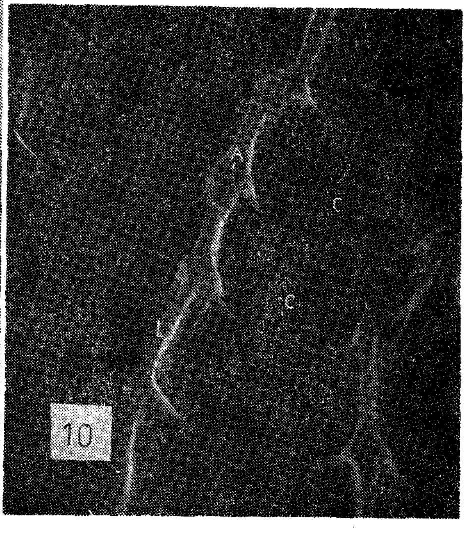
The micropylar rosette is composed of 6–7 primary cells (Fig. 8). The central micropylar pit is ovoid or circular, and 8–12 μm in size. The rosette, secondary, tertiary and quaternary cells are relatively short, heavy–walled, and usually similar polygonal in shape.

8–10 of the 20–28 longitudinal ridges radiate from slightly depressed micropylar area. The other ridges originate from below the micropylar area among the longest ridges, almost at the same level. All of them are slightly elevated and disappear near the base of egg (Fig. 9). Transverse walls are well developed all over the egg, and almost parallel to each other. Thus, they form regular rows among the longitudinal ridges. The columnar cells are rectangular and their height are about 1 / 3 of their wide in the equatorial area. The aeropyles are situated on the longitudinal ridges at some junctions with transverse walls (Fig. 10). Aeropylar openings vary from 0.8 μm to 1.4 μm (Fig. 11). The other openings on the surface, the pores, occur on the micropylar and columnar cells. They are numerous and rather large openings in different sizes. Their size are smaller on the ventral surface of eggs, and they are sparsely distributed on it.









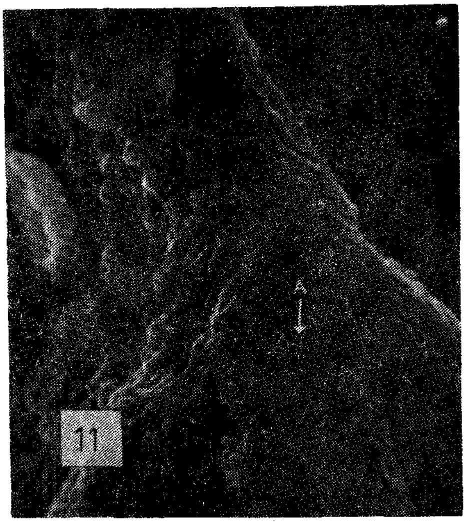


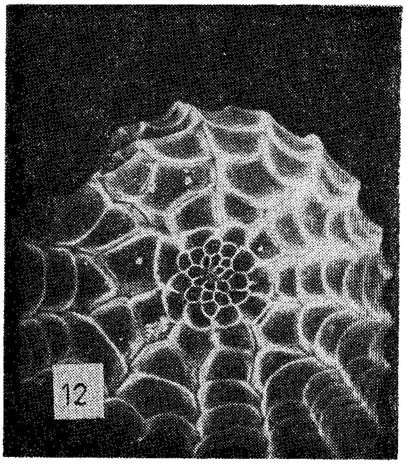
Figure 7–11. The eggs of *A. paphia*. 7. Side-angled egg, X100. 8. The cells of micropylar area, X 500. 9. The egg from ventral side, X 50. 10. The junctions of the longitudinal ridges and the transverse walls, X 500. 11. An aeropyle, X 5000.

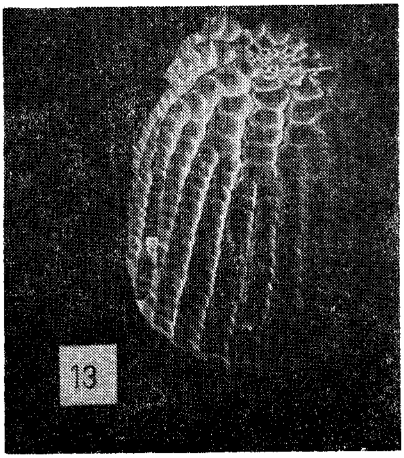
3– *Issoria lathonia*

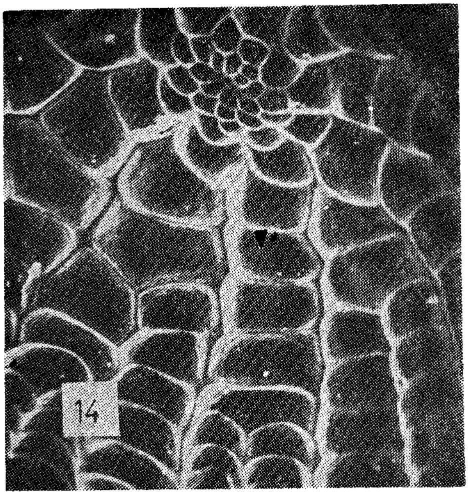
The egg has irregularly circular in outline (Fig. 12), and subcylindrical in shape (Fig. 13), except the slightly depressed micropylar area (Fig. 14). The height is greater than the width, H. 0.73 ∓ 0.03 mm, W. 0.56 ∓ 0.02 mm. The egg has a ridged chorion with both vertical and crosribs clearly defined.

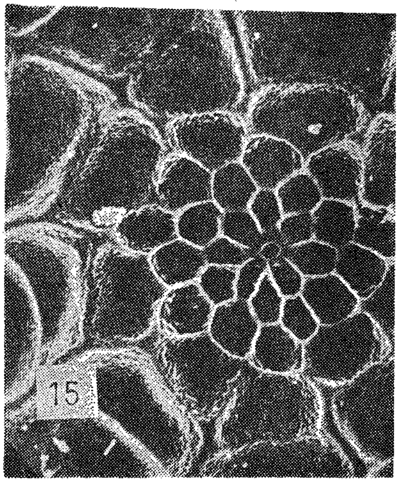
The micropylar rosette is composed of 6–9 primary cells (Fig. 15). The central pit of micropyle is ovoid or circular, and 5–9 μm in size. All cells of micropylar area are depressed, heavy–walled, relatively short and similar polygonal in shape.

9–11 of the 22–29 longitudinal ridges radiate from slightly depressed micropylar area. The other ridges originate at various points of upper part of eggs. All of them are considerably elevated and almost parallel to each other. Transverse walls and columnar cells depressed remarkably among the longitudinal ridges. The transverse walls form rows of rectangular cells among the longitudinal ridges, which are continuous in adjacent columns, especially lower 2 / 3 parts of the egg. All of them disappear at the base of the egg. The height of a columnar cell is about 1 / 2 of its wide in the equatorial area. No reticulum was observed on the ridges. The aeropyles are situated on the longitudinal ridges at some junctions with the transverse walls (Fig. 16). Aeropylar openings are ovoid or circular in shape and their size vary from 1.2μm to 1.4 μm (Fig. 17). The other pores occur on the micropylar and columnar cells including the ventral area of egg.









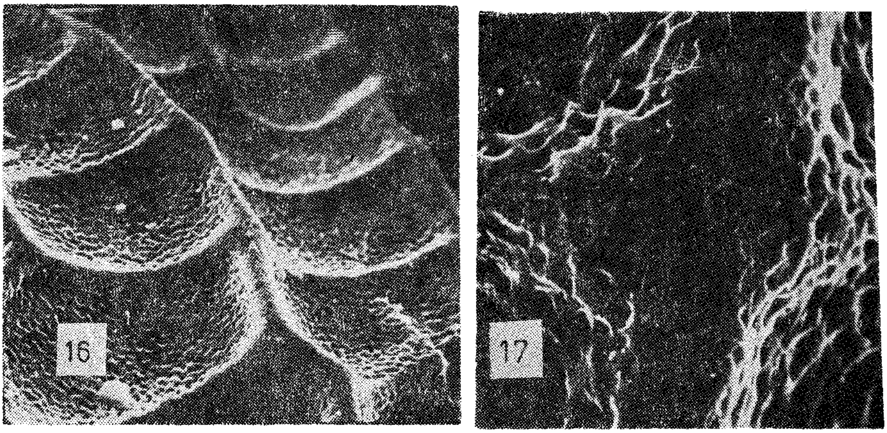


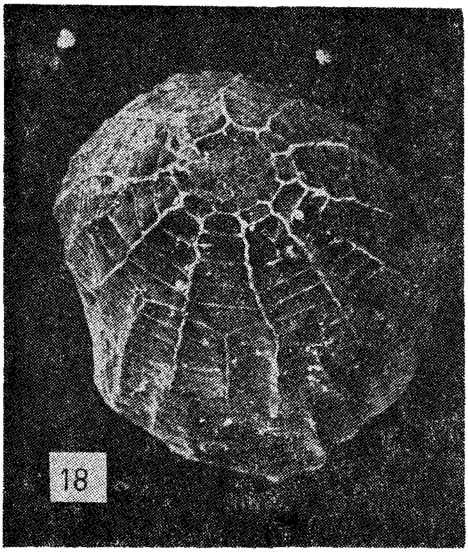
Figure 12–17. The eggs of *I. lathonia*. 12. Top view of egg, X 100. 13. Side view of egg, X 100. 14. The depressed micropylar area, X 300. 15. The cells of micropylar area, X 500. 16. The Junctions of the longitudinal ridges and the transverse walls, X 1000. 17. An aeropyle, X 5000.

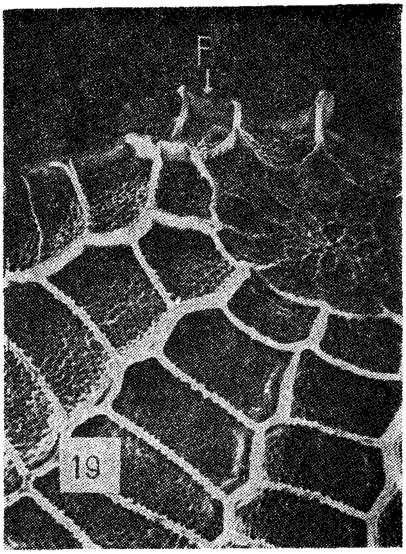
4– *Boloria pales*

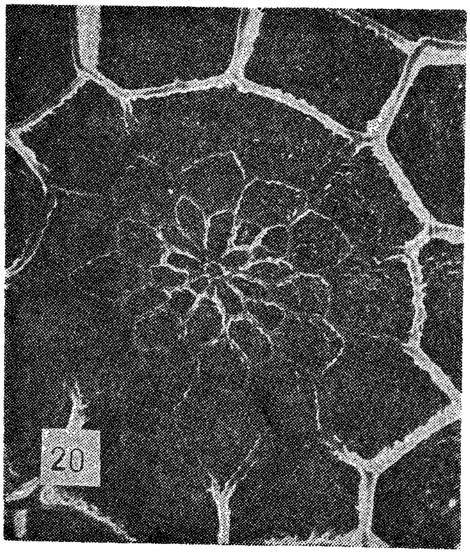
The egg has almost circular in outline and hemispherical in shape (Fig. 18), except the slightly depressed micropylar area (Fig. 19). The height is greater than the width, H. 0.82 ∓ 0.02 mm, W. 0.68 ∓ 0.02 mm. The egg has a ridged chorion with both vertical and crossribs clearly defined, especially on the upper half of the egg.

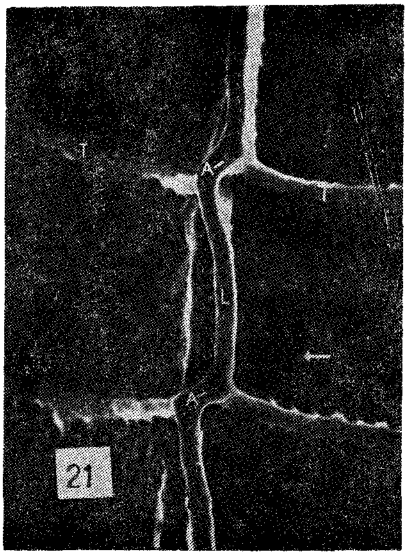
The micropylar rosette is composed of 9–12 wedge shaped primary cells (Fig. 20). The central pit of micropyle is ovoid or circular, and 6–9 μm in size. The secondary, tertiary, and quaternary cells are heavy –walled and almost similar polygonal in the each series.

9–10 of the 30–34 longitudinal ridges radiate from slightly depressed micropylar area. The ridges are overlaid by narrow, deep and frilly reticulum, similar to that of some noctuid eggs (Salkeld, 1984). Anterior portions of the longest ridges are higher and steeply elevated. Other ridges originate from almost the same level above the equator. At the upper half of the egg, the transverse and the longitudinal ridges are more distinct than those of the lower half due to the reticulum. The longitudinal ridges are zig–zag shaped at the upper part. All ridges disappear gradually towards the ventral pole. The columnar cells are almost rectangular in shape. The height of a cell is about 1 / 3 of its wide in the equatorial area. The aeropyles are situated at some junctions of the longitudinal ridges and the transverse walls (Fig. 21). They are circular or ovoid, and their sizes vary from 0.4 μm to 2.2μm (Fig. 22). The pores are scattered in both micropylar and columnar cells. The ventral surface is devoid of pores, but it is shallowly wrinkled.









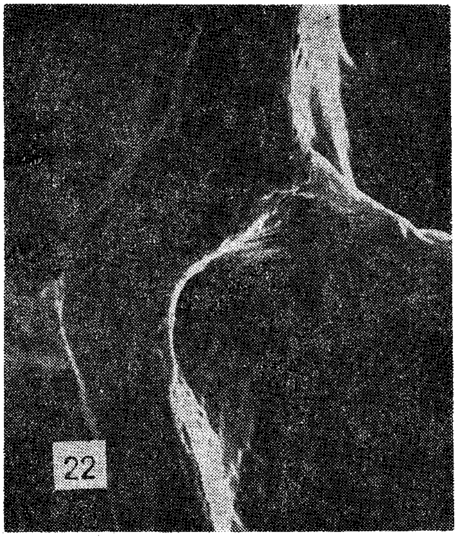


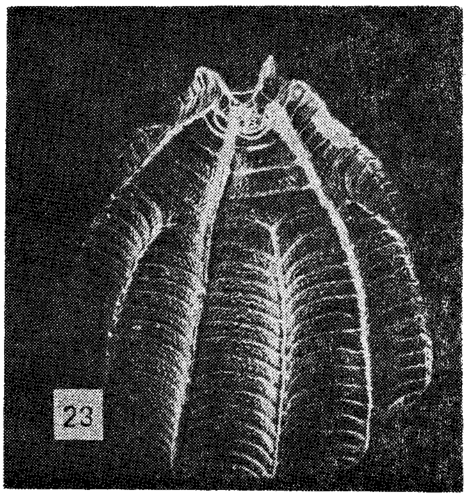
Figure 18–22. The eggs of *B. pales*. 18. Side-angled egg, X 100. 19 Frilly reticulum and depressed micropylar area, X300. 20. The cells of micropylar area, X 500. 21. The Junctions of the longitudinal ridge and the transverse walls, X 1000. 22. An aeropyle, X 5000.

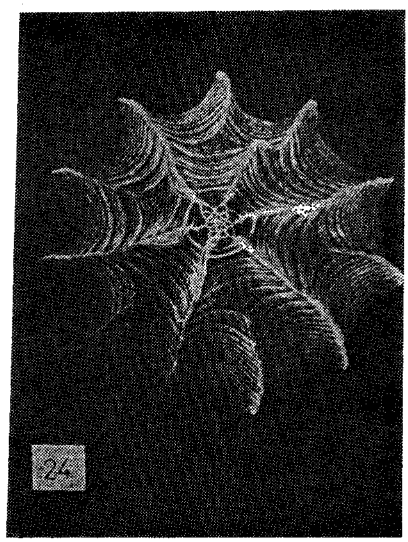
5– *Brenthis hecate*

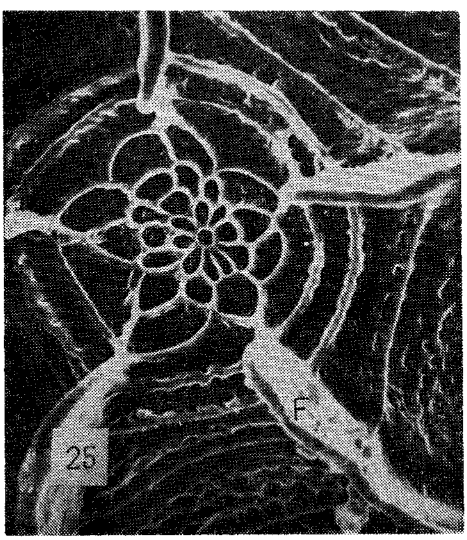
The egg is a cone like from side view (Fig. 23). From above the egg has a radial symmetry and circular in outline with regularly jutted longitudinal ridges (Fig. 24). It has a ridged chorion with both vertical and crossribs clearly defined. Its height is greater than the width, H. 0.98 ∓ 0.01 mm, W. 0.80 ∓ 0.01 mm.

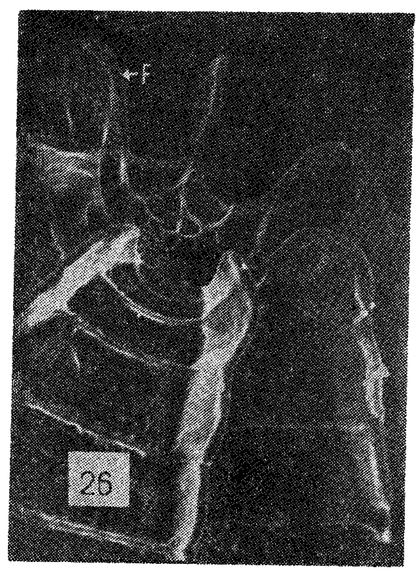
The 8–9 wedge–shaped primary cells of micropylar rosette surround the ovoid or circular central pit, 6–9 μm (Fig. 25). All cells of micropylar area are heavy–walled. The secondary, tertiary and quaternary cells vary considerably in size and shape. The secondary cells are usually shorter than the primaries.

From 5 to 7 of the 11–12 longitudinal ridges radiate from the pointed outer ends of secondary or tertiary cells in the depressed micropylar area. The ridges are overlaid by narrow, very deep, frilly reticulum. The anterior portions of the longest ridges are higher and very steeply elevated and topped by deeper reticulum (Fig. 26). The other longitudinal ridges originate from almost the same level above the equator. Transverse walls are also well developed all over the egg. The transverse walls of adjacent tertiary and quaternary cells and of first 1–2 series of columnar cells often abut to form concentric rings about the egg. In the other parts of egg, conspicuous transverse walls occur among the longitudinal ridges to form rows of rectangular area which are continuous adjacent columns. The height of the cell is about 1 / 5 of its wide. All of them evanesce the base of eggs. The aeropyles are located at almost all junctions of the longitudinal ridges and transverse walls (Fig. 27). They are ovoid, somewhat elongate (Fig. 28). The maximum dimension of the aeropyles varies from 2.8 μm to 8.0 μm. This pores are scattered in both micropylar and columnar cells. The ventral surface of the egg is devoid of pores, but it is shallowly wrinkled (Fig. 29).









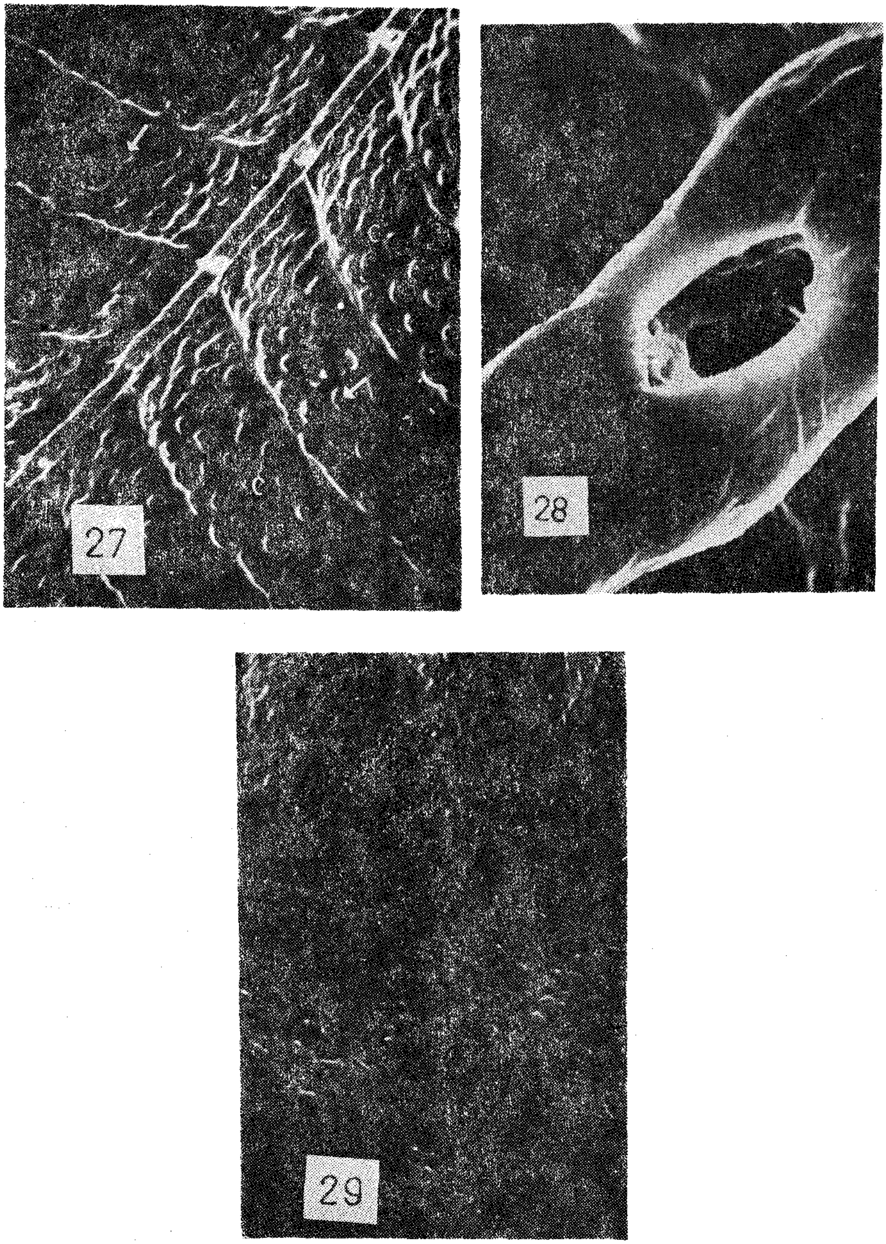


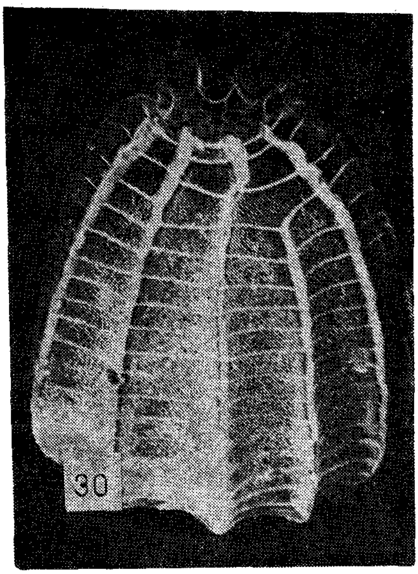
Figure 23–29. The eggs of *B. hecate*. 23. Side view cf egg, X 100. 24. Top view of egg, X100. 25. The cells of micropylar area, X 500. 26. Frilly reticulum and depressed micropylar area, X300. 27. The Junctions of the longitudinal ridge and the transverse walls, X 500. 28. An aeropyle, X 5000. 29. The wrinkled ventral surface, X 1000.

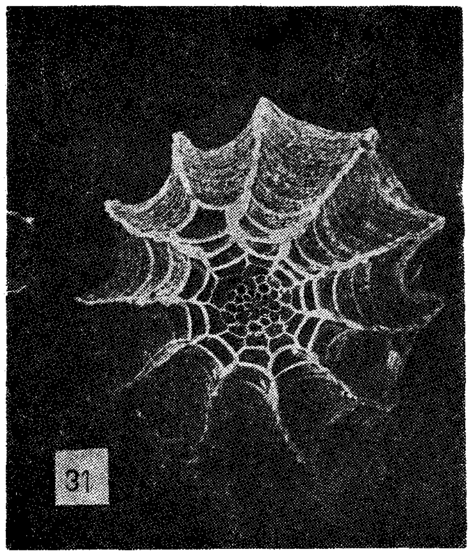
6– *Fabriciana niobe*

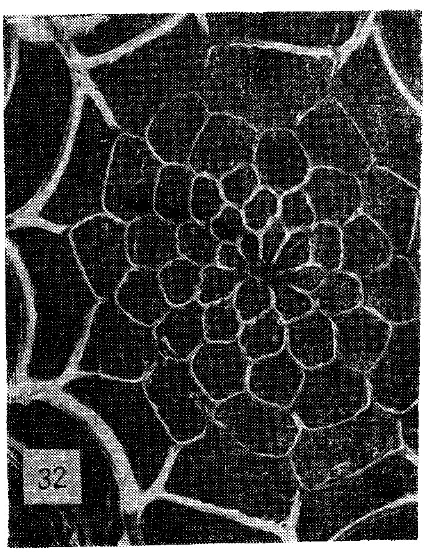
The egg is cone like from side view (Fig. 30). The micropylar area is depressed, the opposite side is slightly convex. From above, the egg has a radial symmetry and circular in outline with jutted longitudinal ridges (Fig. 31). The height is greater than the width, H. 0.86 ∓ 0.02 mm, W. 0.73 ∓ 0.02 mm. The egg has a ridged chorion with both vertical and crossribs clearly defined, especially on the upper half of the egg.

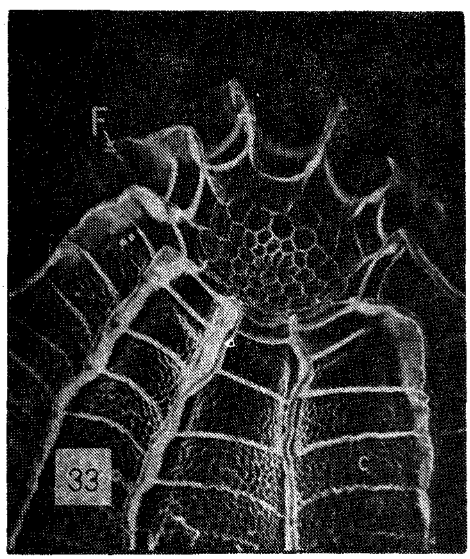
The micropylar rosette is composed of 7–8 primary cells which surround the ovoid or circular central pit, 7–11 μm (Fig. 32). The secondary cells are not longer than the primaries, and have slightly pointed outer ends. The tertiary cells usually are about as wide as their length, but occasionally are wider. The quaternary cells are wider than their length.

9–11 of the 10–12 longitudinal ridges radiate from depressed micropylar area. The ridges are overlaid by narrow, very deep, frilly reticulum. Anterior portions of the longitudinal ridges are higher and very steeply elevated and topped by deeper reticulum (Fig. 33). Only one or very rare two longitudinal ridges originate from below the micropylar area. The transverse walls, especially, of first 6–7 series of columnar cells are very distinct. They occur between the longitudinal ridges to form rows of rectangular cells which are continuous in adjacent columns. The height of a columnar cell is about 1 / 4 of its wide in the equatorial area. All of them evanesce the base of eggs. The aeropyles are located at most of the junctions of the longitudinal ridges and the transverse walls (Fig. 34). They are circular or ovoid and 1.4–4.6 μm in sizes (Fig. 35). The other openings, the pores, are scattered in both micropylar and columnar cells. The ventral surface of egg is devoid of pores, but it is shallowly wrinkled (Fig. 36).


30


31


32


F
33

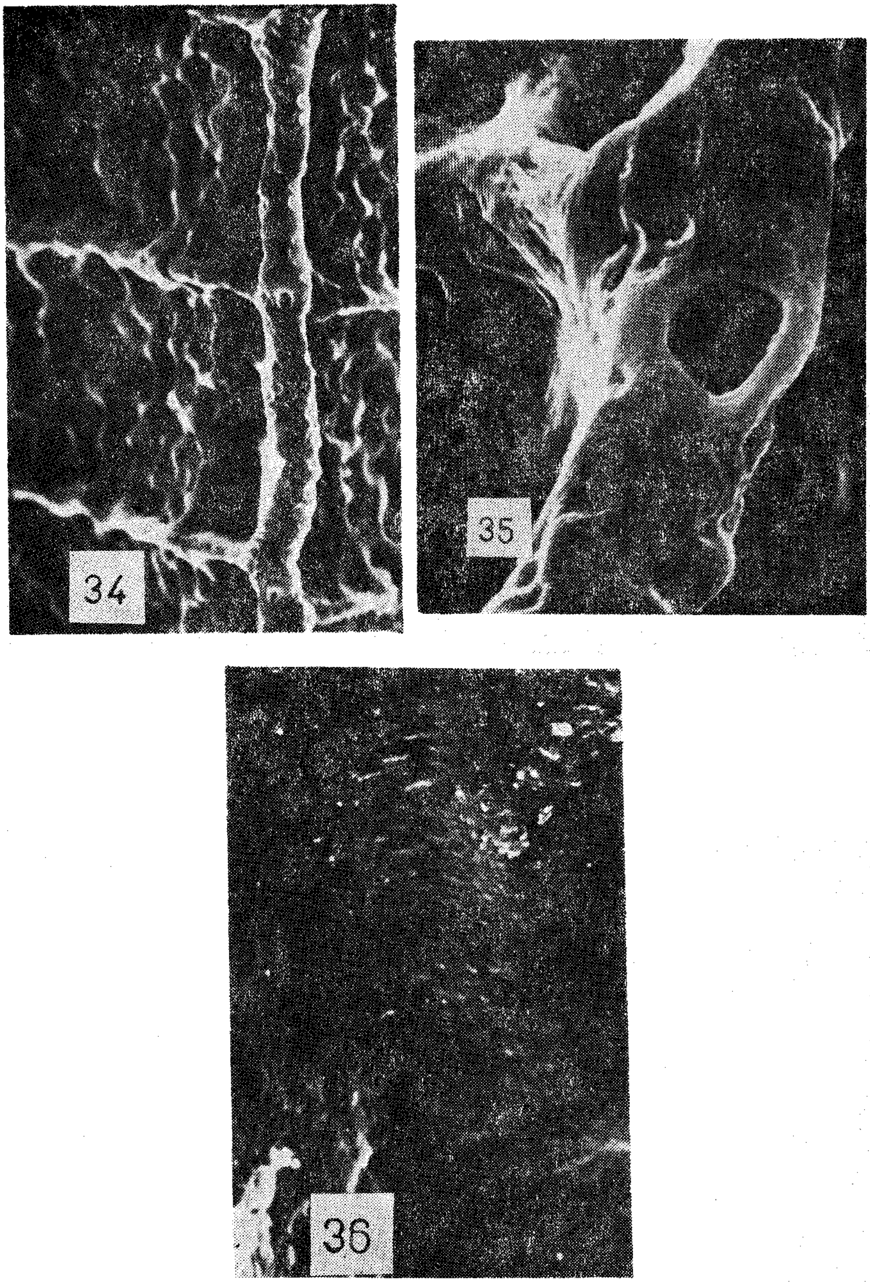


Figure 30–36. The eggs of *F. niobe*. 30. Side view of egg, X 100. 31. Top view of egg, X100. 32. The cells of micropylar area, X 500. 33. Frilly reticulum and depressed micropylar area, X 200. 34. The junctions of the longitudinal ridge and the transverse walls, X 1000. 35. An aeropyle, X 5000. 36. The wrinkled ventral surface, X 1000.

DISCUSSION

The eggs used in this study were extracted from the females in the collection as in the previous paper (Suludere, 1988 a). According to Salkeld (1975) and Downey and Allyn (1981), chorionic sculpturing was the same on both laid and dissected eggs provided that the dissected eggs were obtained from the fully developed oviduct.

The eggs of all species examined here are distinctly ridged. The egg shape may be divided into three groups from the side view. a. Hemispherical, as in *M. aglaia, A paphia,* and *B. pales;* b. Subcylindrical, as in *I. lathonia;* c. Cone–like, as in *B. hecate* and *F. niobe.* From above, all the eggs are almost circular in outline and with the jutted longitudinal ridges in *B. hecate* and *F. niobe.*

The height is greater than the width in all the eggs. The egg size varies among the species from the smallest *(I. lathonia)* with an average width of 0.56 mm and height of 0.73 mm to the largests *(M. aglaia* and *B. hecate)* with the average width of 0.82 mm and 0.80 mm, height of 0.97 mm and 0.98 mm, respectively. Salkeld (1975), Downey and Allyn (1981) suggest that the egg size is useful for separating only those species whose eggs are either very small or very large. Size may prove to be a useful character *M. aglaia* and *B. hecate* since they have larger eggs than those of *A. paphia, I. lathonia, B. pales* and *F. niobe.* The eggs of *I. lathonia* is the smallest one in these six species.

The shape of the central pit of micropyle is similar in the species, but sizes vary and overlap both intra– and interspecifically. The design of micropylar rosette is a useful diagnostic character, even though there is often considerable intraspecific variation in the shape and in the number of primary cells (Arbogast et al., 1980). In the *Argynninae,* the number of primary cells varies and overlaps both intra– and interspecifically. The shape of the primary cells is polygonal in *M. aglaia, A. paphia,* and *I. lathonia,* while it is wedge shaped in *B. pales, B. hecate* and *F. niobe.* The secondary cells are also polygonal in these species except *B. hecate.* All cells in the micropylar area are heavy walled.

One of the best differences in the eggs of six species examined here is in the longitudinal ridges. The genera are separated into two groups according to the number of their longitudinal ridges. The total number of longitudinal ridges varies from 20 to 34 in *M. aglaia, A. paphia,* *I. lathonia* and *B. pales,* from 10 to 12 in *B. hecate* and in *F. niobe.* This feature seems to be important character taxonomically. The number of longitudinal ridges, originating from the micropylar area varies from 8 to 11 except *B. hecate.* In *B. hecate,* the originate from the outer pointed walls of the secondary cells in the micropylar area. The number varies from 5 to 7.

The ridges are overlaid by narrow, very deep, frilly reticulum in *B. pales, B. hecate* and *F. niobe.* In the last two species, the anterior portions of the longest ridges are higher and very steeply elevated and topped by deeper reticulum such as *Aglais urticae, Vanessa atalanta, Nymphalis io* (Hinton, 1981) and also in some Noctuidae (Salkeld, 1984). The transverse walls are also well developed in all the eggs. In *B. hecate,* the transverse walls of adjacent tertiary and quaternary cells and often the first 1–2 series of the columnar cells form two or more concentric rings above the egg.

In the equatorial area, the distance among the transverse walls, or the height of columnar cells, are different in the species. The height of a cell is about 1 / 5 of its wide in *B. hecate,* 1 / 4 in *F. niobe,* 1 / 3 in *M. aglaia, A. paphia,* and *B. pales,* 1 / 2 in *I. lathonia.* This may be a useful character for separating the species. The columnar cells are rectangular in all species examined here.

The aeropyles are conspicuous in general and are located at the some junctions of the longitudinal ridges and the transverse walls in *M. aglaia, A. paphia, I. lathonia,* and *B. pales;* at most of the junctions in *B. hecate* and *F. niobe.* The size of aeropyles are different in the last two species from the others. Largest aeropyles (Max. 8μ) exist only in *B. hecate* and their shapes are ovoid, somewhat elongated. In the other species, they are much smaller in size, ovoid or circular in shape.

The pores, called by some authors as plastonopores, aeropores (Downey and Allyn, 1981; Hinton, 1981), occur in the columnar and micropylar cells. On the other hand, the ventral side of the eggs of *B. pales, B. hecate,* and *F. niobe* are devoid of pores, but with the shallowly wrinkled surface. In *M. aglaia,* the pores are remarkably smaller and more dense on the ventral surface, while they are sparse in *A. paphia.*

According to the forementioned knowledge, it is safe to say that the fine chorionic structure of the eggs has a considerable importance from the taxonomical and morphological standpoints. Further research may contribute to the knowledge of the egg morphology of the Lepidoptera.

ACKNOWLEDGMENTS

I wish to express my gratitude to Doç. Dr. A.Ö. Koçak for allowing me to examine and dissect the identified specimens of his collections. I am greatly indebted to Prof. Dr.S. Karol for her criticism of manuscript and SEM facilities at EM Laboratory, Faculty of Sciences, Ankara University. I would like to thank Miss N. Gül and R. Verimli for their kind cooperations in the laboratory.

REFERENCES

ARBOGAST, R.T. and BYRD, R.V., 1981. External morphology of the eggs of the meal moth, *Pyralis farinalis* (L.), and the murky meal moth, *Aglossa caprealis* (Hübner) (Lepidoptera: Pyralidae). Int. J. Insect Morphol. Embryol., 10: 419–423.

ARBOGAST, R.T., LeCATO, G.L., and BYRD, R.V., 1980. External morphology of some eggs of stored-product moths (Lepidoptera: Pyralidae, Gelechiidae, Tineidae). Int. J. Insect Morphol. Embryol., 9: 165–177.

DOWNEY, J.C. and ALLYN, A.C., 1980. Eggs of Riodinidae. J. of Lepidopterist's Society, 34 (2): 133–145.

————, 1981. Chorionic sculpturing in eggs of Lycaenidae. Part. I. Bull. Allyn Mus., 61: 1–29.

————, 1984. Chorionic sculpturing in eggs of Lycaenidae. Part II. Bull. Allyn Mus., 84: 1–44.

HINTON, H.E., 1969. Respiratory system of insect egg shells. Ann. Rev. Ent., 14: 343–368.

————, 1970. Insect eggshells. Sci. Ame. 223: 84–91.

————, 1981. Biology of Insect Eggs. 3 Volumes. Pergamon Press, Oxford.

MARGARITIS, L.E., 1985. Structure and Physiology of the Eggshell. In Comprehensive Insect Physiology, Biochemistry and Pharmacology, Vol. 1. Edited by G.A. Kerkut and L.I. Gilbert, Pages 153–231. Pergamon Press. Oxford.

SALKELD, E.H., 1973. The chorionic architectue and shell structure of *Amathes c-nigrum* (Lepidoptera: Noctuidae). Can. Ent. 105: 1–10.

————, 1975. Biosystematics of the genus *Euxoa* (Lepidoptera: Noctuidae). IV. Eggs of the subgenus *Euxoa* Hbn. Can. Ent., 107: 1137–1152.

———, 1976. Biosystematics of the genus *Euxoa* (Lepidoptera: Noctuidae). Eggs of subgenera *Chorizagrotis*, *Crassivesica*, *Longivesica*, *Orosagrotis*, and *Pleonectopoda*. Can. Ent., 108: 1371–1385.

———, 1984. A catalogue of the eggs of some Canadian Noctuidae (Lepidoptera). Mem. of the Entomological Society of Canada, 127: 1–167.

SULUDERE, Z. 1988 a Studies on the external morphology of the eggs of some *Melitaea* species *(Satyrıdae: Lepidoptera)*. Commun. Fa. Sci. Univ. Ank. Ser. C. In issue.

SULUDERE, Z. 1988 b. Description of the eggs of *Rhodostrophia meonaria* Guenee from North Pakistan *(Geometridae: Lepidoptera)*. Commun. Fa. Sci. Univ. Ank. Ser. C. In issue.