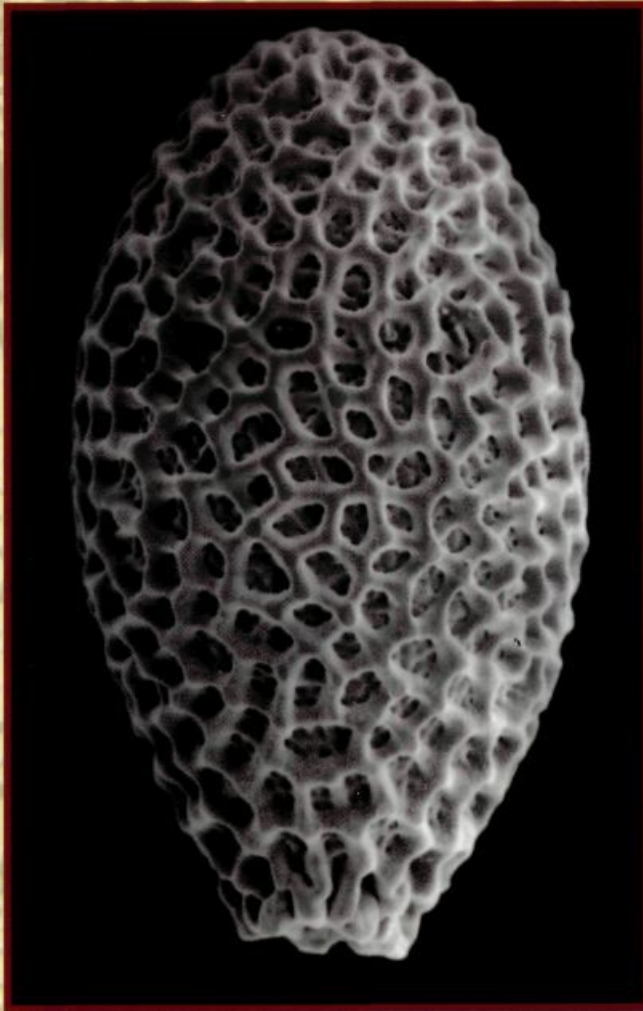




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The Species of *Perla* (Plecoptera: Perlidae): Evidence from Egg Morphology

Ignac SIVEC¹ and Bill P. STARK²

UDC (UDK) 595.735:591.4:591.9(045)=20

ABSTRACT

The genus *Perla* is reviewed with a scanning electron micrograph study of egg morphology. Twelve species are recognized and placed in six species groups. *Perla horvati*, sp. nov. and *P. zwicki*, sp. nov. are described from Turkey and *P. abbreviata* KLAPÁLEK and *P. persica* ZWICK are placed as synonyms of *P. caucasica* GUERIN.

Key words: Plecoptera, Perlidae, *Perla*, taxonomy, egg morphology, description of new species.

IZVLEČEK

Vrste rodu *Perla* (Plecoptera: Perlidae): določljivost po strukturi jajc. – Predstavljamo vrste rodu *Perla* na podlagi študije strukture jajc z elektronskim rastrskim mikroskopom. Ugotovili smo 12 vrst, ki jih uvrščamo v šest skupin vrst. *Perla horvati*, sp. nov. and *P. zwicki*, sp. nov. sta za znanost novi vrsti, ki ju opisujemo iz Turčije. *P. abbreviata* KLAPÁLEK and *P. persica* ZWICK sta sinonima vrste *P. caucasica* GUERIN.

Ključne besede: Plecoptera, Perlidae, *Perla*, sistematika, struktura površine jajc, opis novih vrst.

Perla, the oldest generic name still in use for a group of stonefly species, was proposed by GEOFFROY (1762) with the species type designated at *P. bipunctata* (PICTET) in 1963 through an opinion from the International Commission on Zoological Nomenclature. By the time of ILLIES (1966) catalogue this venerable name still retained considerable systematic baggage in the form of 293 species names, the majority of them listed as synonyms or as "Unsichere Arten", but also included were many poorly studied Asian species belonging to *Kamimuria* and other genera. SIVEC et al. (1988) accepted only eight species found generally from Britain, through the circum-Mediterranean region of Europe and North Africa to the Caucasus, but subsequent studies (MEMBIELA 1990; SIVEC & GRAF pers.com.) support addition of two species not recognized in that study.

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The genus has never been studied comprehensively and most species determinations follow the works of AUBERT (1959), DESPAX (1951) and ILLIES (1955) each of which included the same four species. As other valid species were added, supporting data for their recognition was given (e.g. BRAASCH & JOOST 1971; BERTHELEMY & TERRA 1980; ZWICK 1976) creating a mosaic array of literature needed for species determination, and because the majority of specimens collected are larvae or females, the determination of these, based on a few characters variable over a wide geographical area, has become quite unreliable.

We began acquiring egg material for a survey of all known *Perla* species in the mid 1980's and continued the intermittent study of this material with scanning electron microscopy throughout the 1990's. Our objectives were, 1) to discover egg characters which permit reliable determination of females and mature female larvae that contain eggs, and 2) to utilize these characters to gain a preliminary understanding of species groupings within the genus. The results given below support recognition of a minimum of 12 species, including two previously undescribed; these are placed in six species groups. The results also indicate significant polymorphism exists in *P. pallida* GUERIN and *P. marginata* (PANZER) which will require additional study.

Methods for this study are given in SIVEC et al. (1988). Specimens used were made available from the following museums and individuals. Abbreviations are used with specimen data to indicate the sources of material.

Bill P. Stark, Clinton, Mississippi (BPS), Biologische Station, Lunz (BSL), Limnologische Flusstation, Schlitz (LFS), Monte L. Bean Museum, Brigham Young University, Provo (BYU), Musée Zoologique, Lausanne (MZ), National Museum of Ireland, Dublin (NMI), National Museum of Natural History, Prague (NMP), National Museum, Skopje (NMS), Slovenian Museum of Natural History, Ljubljana (SMNH), Stanley W. Szczytko, Stevens Point, Wisconsin (SWS), Zoological Institute, Russian Academy of Sciences, St. Petersburg (ZISP).

The *Perla bipunctata* Group
***Perla bipunctata* PICTET, 1833**

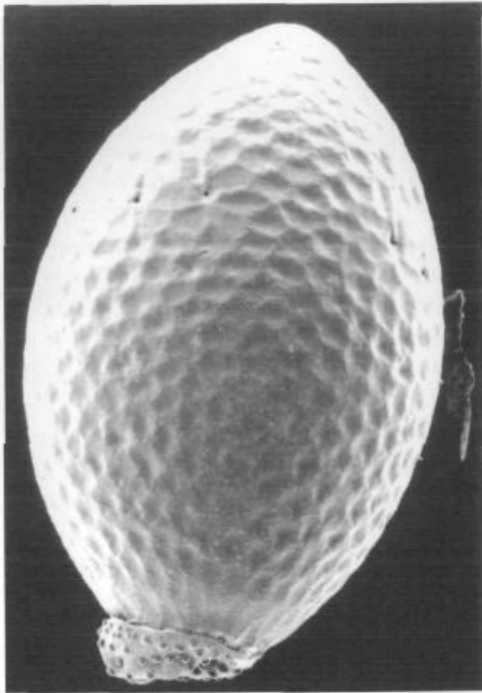
Figs. 1-6

Egg.- Length 0.45-0.47 mm, width 0.27-0.31 mm. Collar short, about 0.01 mm long and about 0.09-0.12 mm wide. Circumference of collar with about 18 irregularly spaced, obscure vertical ribs extending from rim onto shoulders of egg body; a single pit located between ribs at collar base. Rim relatively smooth and without incisions. Chorionic follicle cell impressions conspicuous and with center of each cell depressed creating a coarsely pitted appearance over the entire surface. Micropylar orifices moderately large with thin rim and vertical canal ridges extending about 0.03-0.04 mm from orifices; micropylar row set about 0.13 mm from pole.

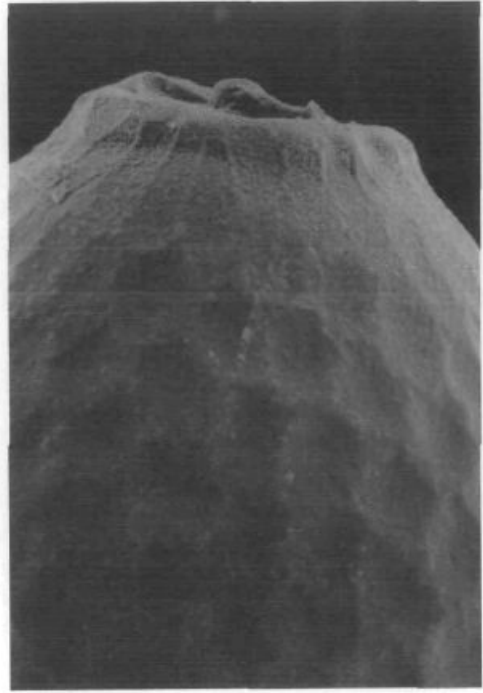
SEM Specimen Data.- Belgium, Streupa, June 1936 (MZ). Ireland, Killarney Kelly, Torc Stream, 30 May 1995, O'Connor (NMI). Scotland, Carluke (NMP).

Distribution.- Reported from Great Britain to the Balkans and North Africa. The only confirmed specimens we have seen are those listed above. Many specimens determined as *P. bipunctata* in European collections, including several of those from Morocco, are *P. pallida*, but figures in DESPAX (1951) of male genitalia and in BERTHELEMY & LAUR (1975) of eggs suggests populations of the species may remain in the Massif Central of France.

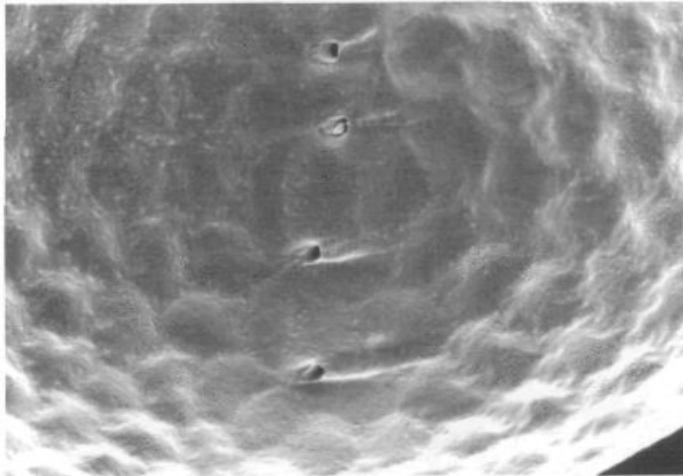
Comments.- The type of *P. bipunctata* from Switzerland is lost (ZWICK 1972) but the name has been applied rather consistently to a species which may never have occurred there. We are unable to locate specimens of *P. bipunctata* (in the sense of ILLIES 1955 and other authors) from mainland Europe, except for the possible specimen we list above from Belgium or the possible specimens of BERTHELEMY & LAUR (1975) or DESPAX (1951) if they still exist. Specimens of all the relatively common species (*P. grandis* RAMBUR, *P. pallida* GUERIN, *P. marginata* (PANZER), *P. burmeisteriana* CLAASSEN) have been incorrectly determined as *P. bipunctata*, so the literature is hopelessly entangled. The Belgium specimen we list has an egg that is generally similar to the egg of specimens from Ireland and to a *P. carlukiana* KLAPÁLEK paralectotype from Scotland, however, details of chorionic reticulation suggest two species may be involved. A careful study of more material is needed and the possible selection of a neotype or use of plenary powers of the ICZN may be required to assure stability of this name.



1

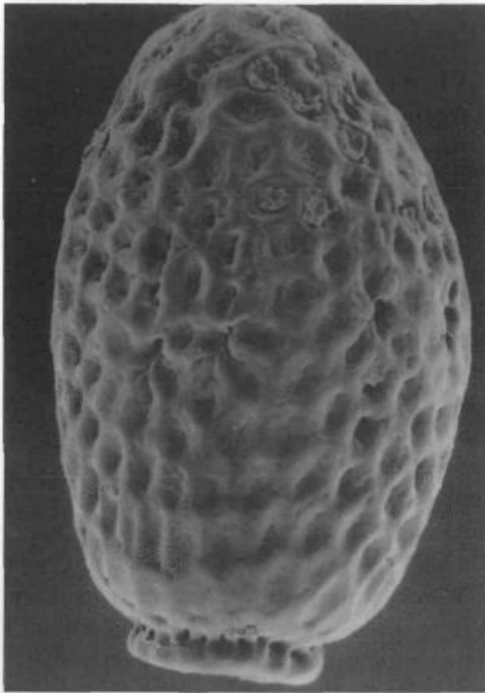


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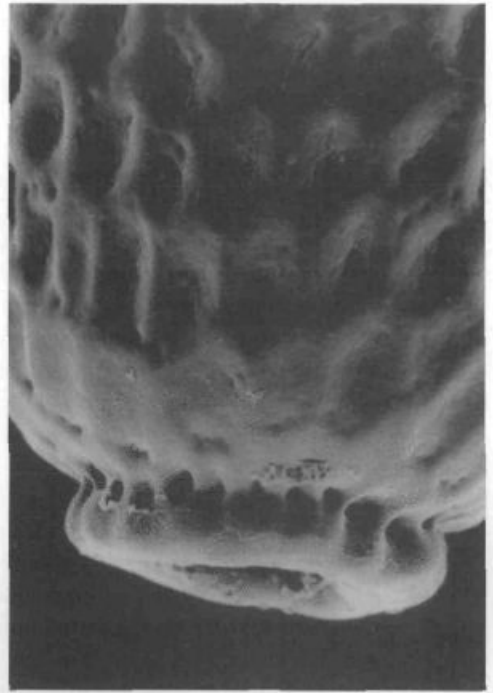


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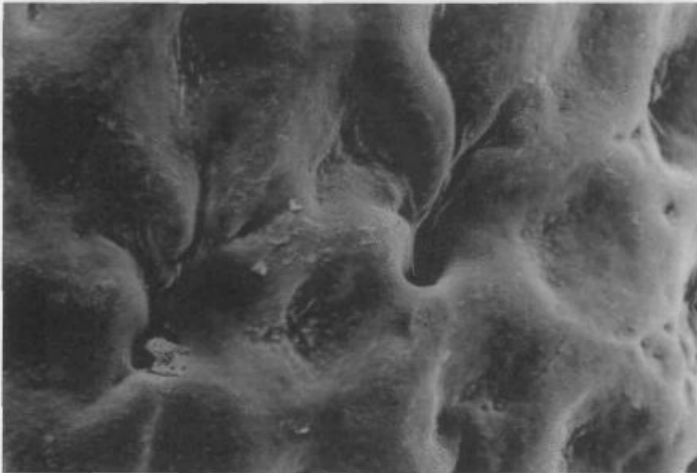
Figs. 1-3: SEM photomicrographs of eggs: *Perla bipunctata* PICTET [Ireland]; Egg lateral, 220x (1); collar end, 600x (2); detail of chorion and micropyles, 500x (3).



4



5



6

Figs. 4-6: SEM photomicrographs of eggs: *Perla bipunctata* PICTET [Belgium]: Egg lateral, 240x (4); collar end, 500x (5); detail of chorion and micropyles, 1010x (6).

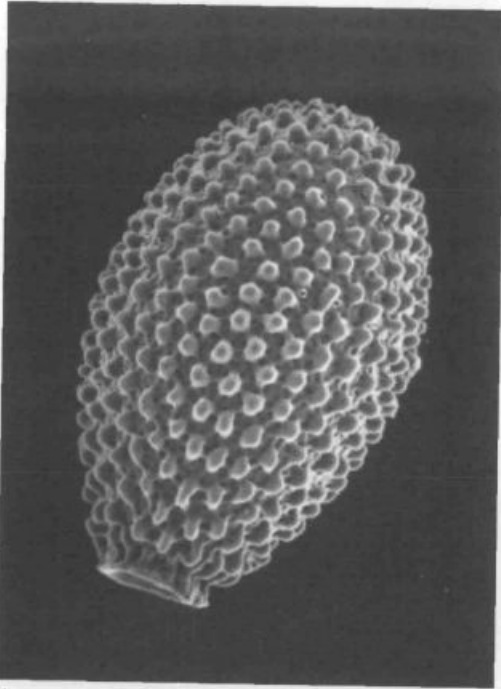
The *Perla burmeisteriana* Group
***Perla burmeisteriana* CLAASSEN, 1936**
Figs. 7-15

Egg.- Length 0.44-0.48 mm, width 0.28-0.30 mm. Collar short, about 0.02-0.03 mm long and about 0.10-0.12 mm wide. Circumference of collar with about 12 irregular thick ribs extending from rim to shoulder of egg body; ribs wide at rim and usually with a pit centered in the wide area at the rim; rim otherwise relatively smooth and only slightly flanged. Chorion distinctly tuberculate with prominent knob shaped processes covering entire surface; tuberculae vary in shape from rounded to irregularly linear outlines and the surface from smooth to emarginate or deeply invaginated; an irregular lattice of low connectives and irregular pits surround tuberculae. Micropylar orifices with thin raised rims set in low areas between tuberculae; micropylar row set about 0.16-0.20 mm from pole.

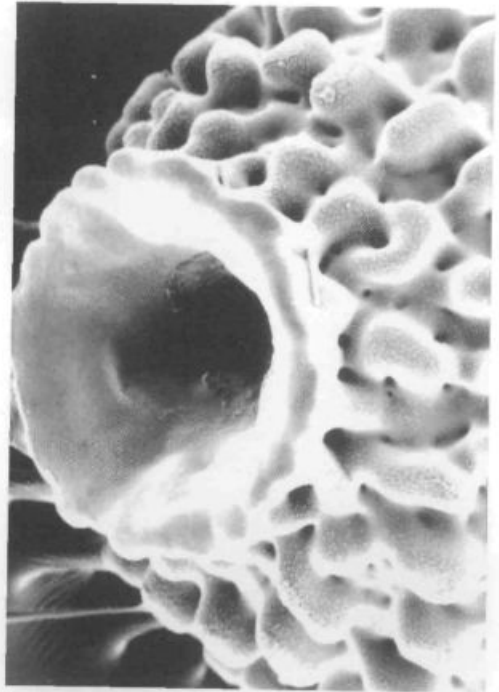
SEM Specimen Data.- Austria, no specific locality (NMP). Bulgaria, Beli Viti, 16 May 1969, D. Braasch (SMNH). Czech Republic, Librice, 28 May 1916, Komarek (NMP). Macedonia, Treska, Matka, 19 May 1976, P. Ikonov (NMS). Montenegro, Ibar River, Rožaj, 26 May 1979, I. Sivec (SMNH). Switzerland, Plateau Vaudois, Broie Payerne, 15-21 May 1942, J. Aubert (MZ).

Distribution.- Reported from Spain and North Africa north to Holland and Luxemburg, east to the Carpathian Mountains of Ukraine and south to Macedonia. We have confirmed specimens from Austria, Bulgaria, Czech Republic, Germany, Hungary, Macedonia, Montenegro, Slovenia and Switzerland.

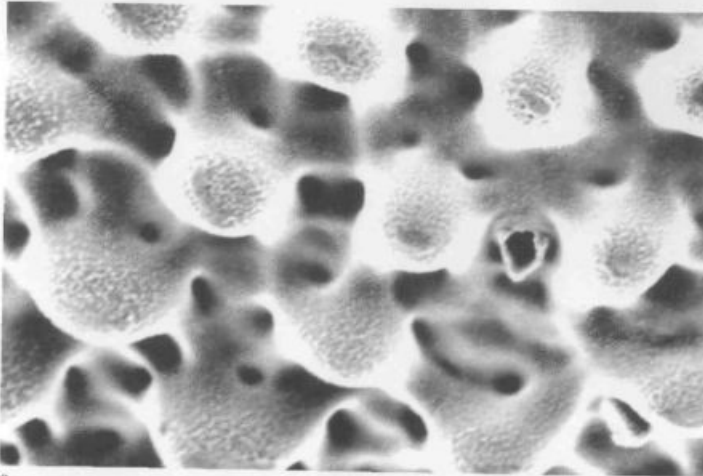
Comments.- This species was earlier recognized as *P. abdominalis* BURMEISTER before that name was found to be a junior homonym of *P. abdominalis* GUERIN and renamed by CLAASSEN (1936). The holotype male from Germany is in the Museum Halle and specimens we have seen from Bavaria agree closely in egg morphology with Swiss and Austrian specimens. The remarkable egg of this species has been illustrated by BRAASCH & JOOST (1971), ZWICK (1971) and SIVEC et al. (1988).



7

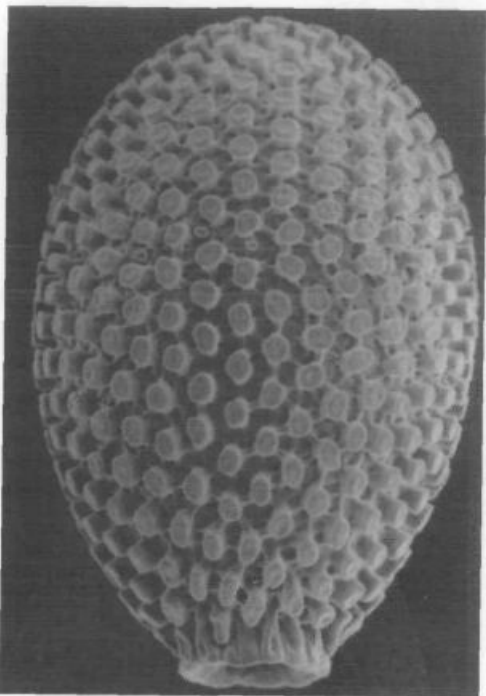


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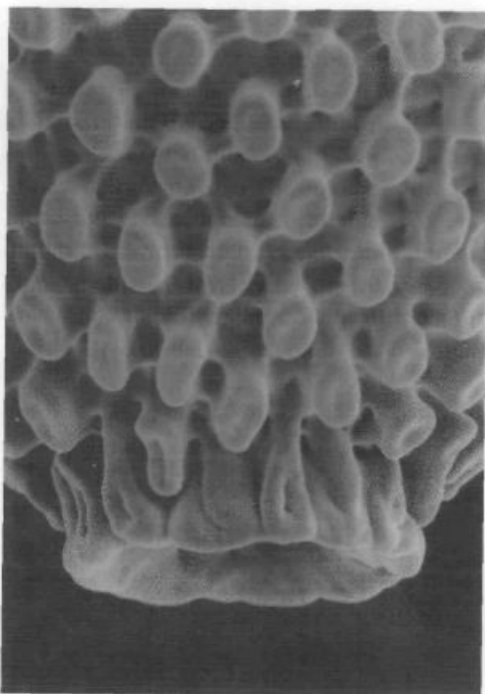


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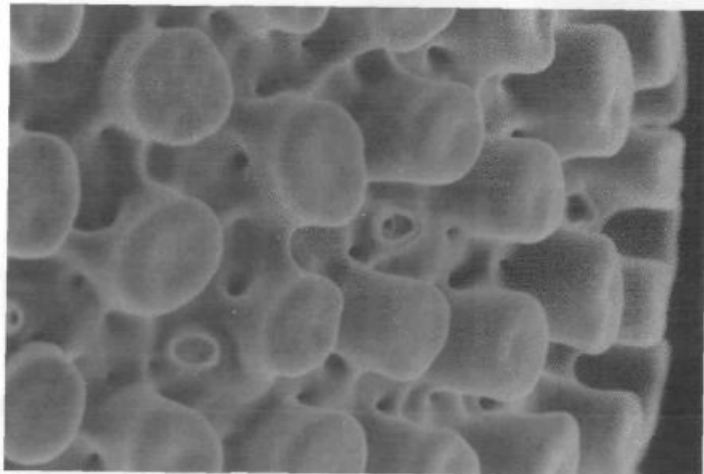
Figs. 7-9: SEM photomicrographs of eggs: *Perla burmeisteriana* CLAASSEN [Switzerland]: Egg lateral, 200x (7); collar end, 710x (8); detail of chorion and micropyle, 1210x (9).



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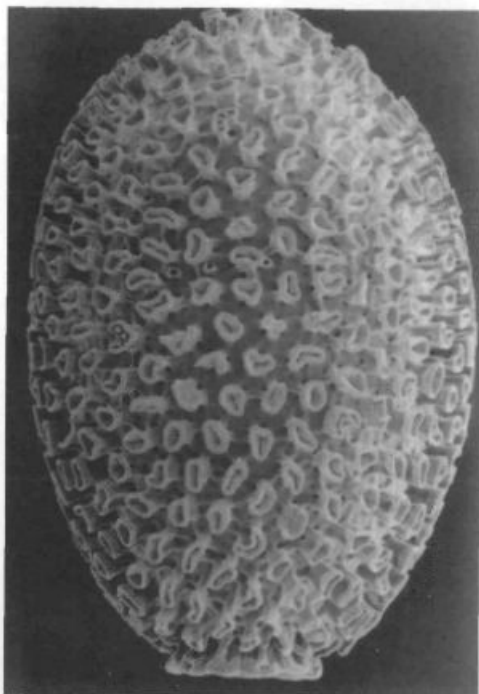


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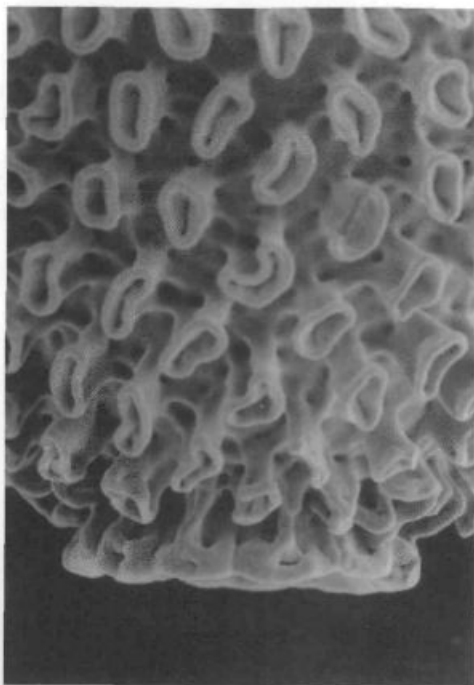


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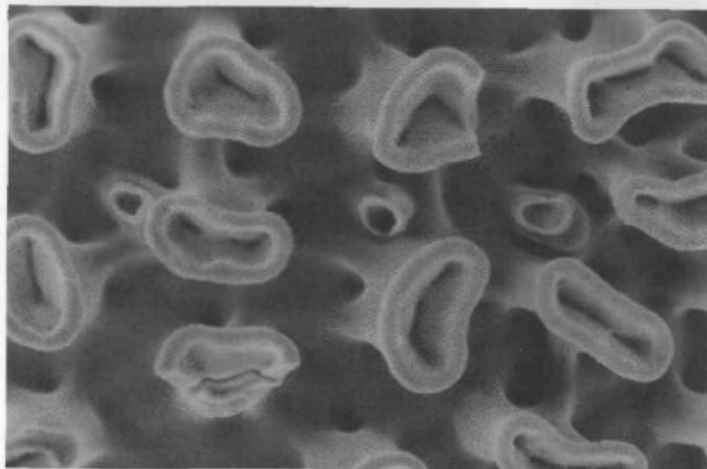
Figs. 10-12: SEM photomicrographs of eggs: *Perla burmeisteriana* CLAASSEN [Austria]: Egg lateral, 240x (10); collar end, 580x (11); detail of chorion and micropyles, 1020x (12).



13



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Figs. 13-15: SEM photomicrographs of eggs: *Perla burmeisteriana* CLAASSEN [Macedonia]: Egg lateral, 240x (13); collar end, 550x (14); detail of chorion and micropyles, 1080x (15).

Perla* sp. nov. SIVEC & GRAF**Figs. 16-18**

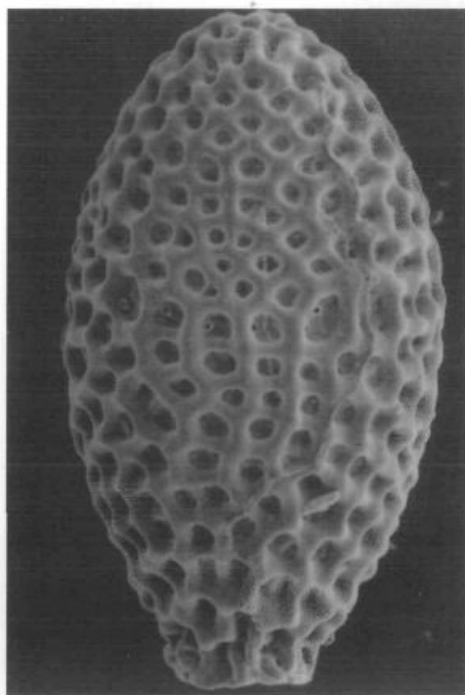
Egg.- Length 0.51-0.54 mm, width 0.28-0.30 mm. Collar short, about 0.02-0.03 mm long and about 0.10-0.12 mm wide. Circumference of collar with about 12 irregular thick ribs extending from rim and continuous with follicle cell impressions of egg body. Chorion covered throughout with a coarse lattice of raised follicle cell impression walls surrounding a finely pitted floor; cell impression shape irregularly hexagonal and size varies from about 0.017 to about 0.029 mm in inner diameter. Micropyles set in follicle cell impressions about 0.17-0.24 mm from pole; orifices with thin raised rims.

SEM Specimen Data.- Austria, Karnten Wolfnitz (SMNH). Austria, Vienna, 8 May 1999 (SMNH). Austria, Vienna, 17 May 1995 (SMNH). Slovenia, Ljubljana, 19 May 1899 (NMP).

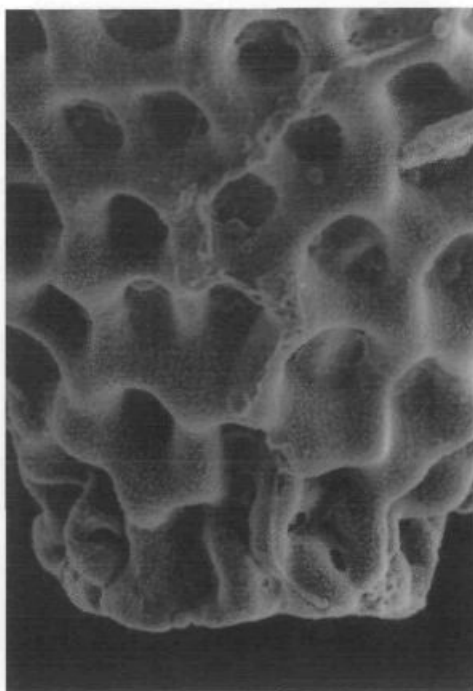
Distribution.- Known from a few sites in Slovenia and Austria (SIVEC & GRAF pers.com.).

Comments.- This species is another in the *P. burmeisteriana* complex as Klapálek's determination of *P. abdominalis* for the Ljubljana specimen reflects. The egg collar and the chorionic surface perforations in the follicle cell impressions are both suggestive of this association but the two are clearly distinct. The egg of this species is also somewhat similar to that of *P. horvati*, described below from Turkish specimens, but in that species only the coarser surface pits occur.

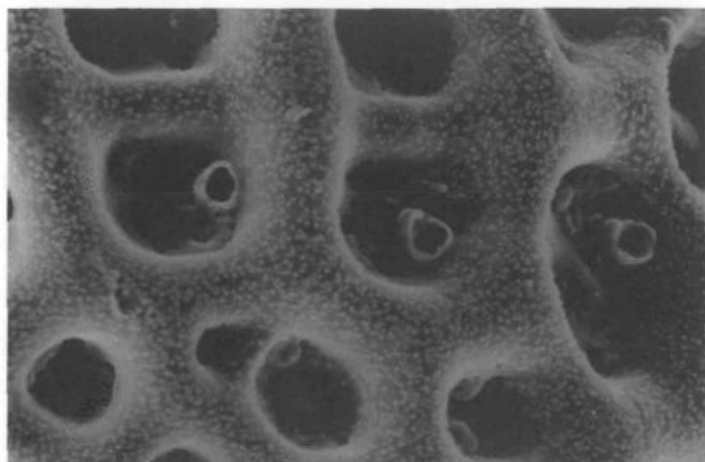
*Detail description of species will be published in other paper.



16



17



18

Figs. 16-18: SEM photomicrographs of eggs: *Perla* sp. nov. SIVEC&GRAF [Slovenia]: Egg lateral, 220x (16); collar end, 580x (17); detail of chorion and micropyles, 1050x (18).

***Perla zwicki*, sp. nov.**

Figs. 19-21

Types.- holotype, male: Turkey, Anatolia, 1 km NW Soğukpınar, 1000 m, 4.6.1992, leg. Malicky. Paratypes: 5 males, 3 females, same data (Type material is deposited in Slovenian Museum of Natural History, Ljubljana, Slovenia).

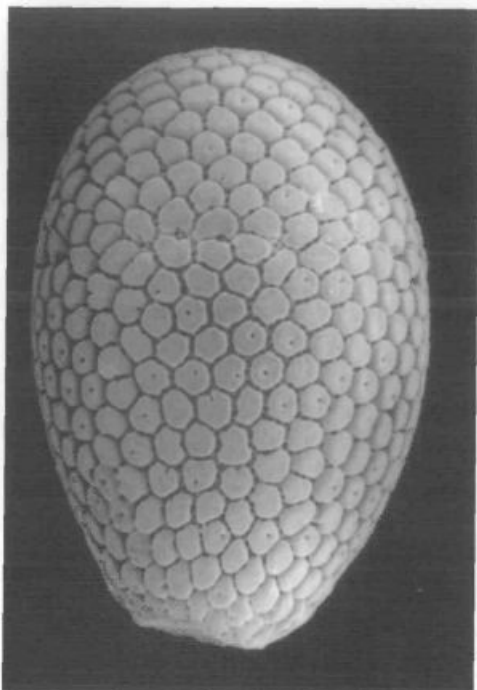
Male.- Length of fore wings 19-21 mm

Female.- Length of fore wings 25-29 mm

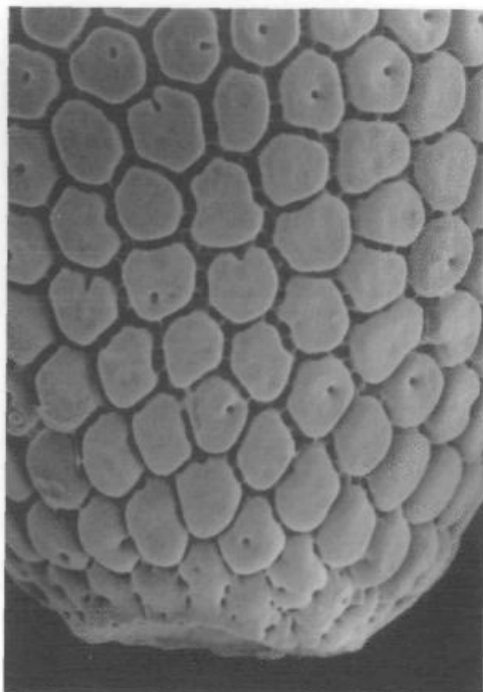
Egg.- Length 0.43-0.49 mm, width 0.28-0.32 mm. Collar short, about 0.01 mm long and about 0.10-0.11 mm wide. Circumference of collar with about 12-16 modified follicle cell impressions between rim and egg body. Chorion distinctly tuberculate with prominent, irregularly shaped hexagonal plates covering entire surface; tuberculae vary in size but those around equator are about 0.02-0.03 mm wide across the greatest distance; equator with about 12 plates in lateral aspect; plates rather tightly packed but surface surrounding plates with numerous shallow pits; some plates (about 30%) also have a single surface pit. Micropylar orifices with thin raised rims set in low areas between plates; micropylar row set about 0.14-0.17 mm from pole.

Etymology.- The patronym honors our friend and colleague Peter Zwick who, in 1971, had already recognized and illustrated (in Fig. 10d) this distinctive egg and speculated about the potential value of egg data in recognition of *Perla* species.

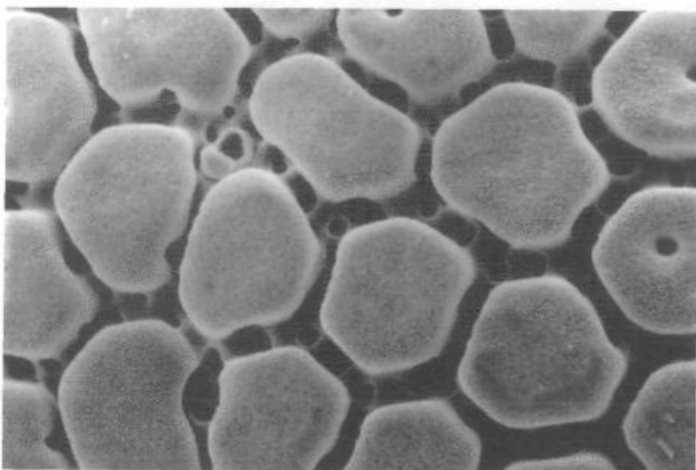
Comments.- Although this species was placed as *P. illiesi* BRAASCH & JOOST in ZWICK (1971) the egg is clearly more similar to *P. burmeisteriana* and we regard them as sister species.



19



20



21

Figs. 19-21: SEM photomicrographs of eggs: *Perla zwicki* sp. nov. SIVEC&STARK [Turkey]: Egg lateral, 210x (19); collar end, 460x (20); detail of chorion and micropyle, 990x (21).

The *Perla caucasica* Group*Perla caucasica* GUERIN*Perla abbreviata* KLAPÁLEK, 1921. **syn. nov.***Perla persica* ZWICK, 1976. **syn. nov.**

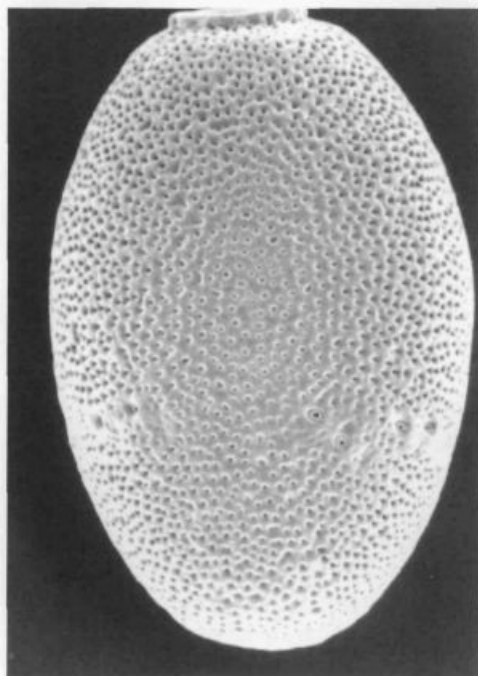
Figs. 22-24

Egg.- Length 0.45-0.48 mm, width 0.27-0.29 mm. Collar short, about 0.01 mm long and about 0.09-0.10 mm wide. Circumference of collar with about 20-24 irregular ribs extending from rim to shoulders of egg body; rim apex smooth with very slight irregular incisions visible in polar aspect. Chorion punctate throughout; punctations vary only slightly in diameter. Micropylar row set about 0.16-0.18 mm from pole; orifices set in pits and with thin raised rims.

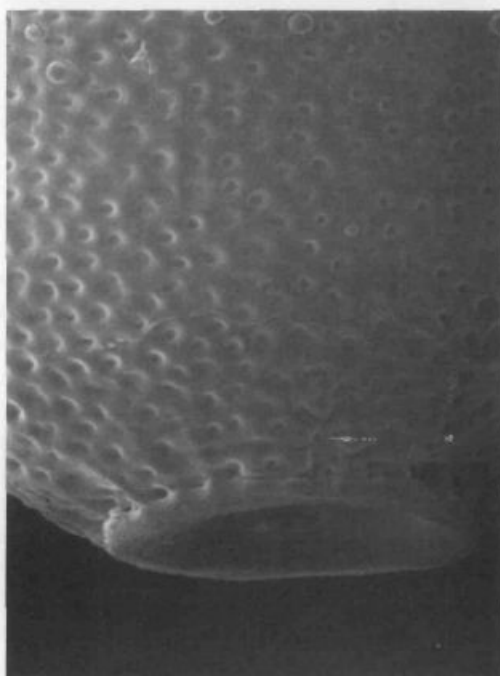
SEM Specimen Data.- Caucasus, no other locality data, 22 June 1957 (BYU). Caucasus, no other locality data, 8 June 1957, L. Zhiltzova (ZISP). Cyprus, Agiosnikolaus, 900 m, 12 May 1973, H. Malicky (LFS). Iran, Fars Province, 3 July 1965, J.W. Neal (BYU).

Distribution.- Reported from the Caucasus, Cyprus and Iran. We have confirmed specimens from each of these areas.

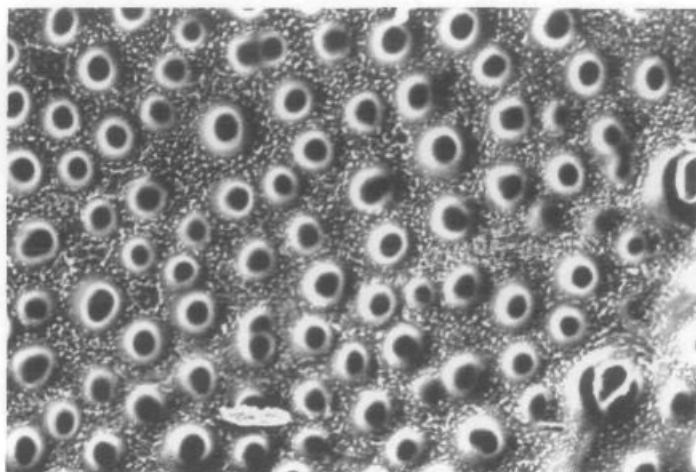
Comments.- The holotype of *P. caucasica* is lost but the concept of the species was fixed by ZHILTZOVA (1964). The synonymy of *P. persica* is suggested by comparison of eggs from topotype specimens from Iran with those from the Caucasus region provided by L. Zhiltzova. Eggs obtained from the holotype of *P. abbreviata* from Cyprus support the synonymy of that species. ZWICK (1978) reported *P. persica* from new material collected on Cyprus and considered at that time the possibility of the synonymy of *P. persica* with *P. abbreviata* but without study of the type the matter was left unresolved.



22



23



24

Figs. 22-24: SEM photomicrographs of eggs: *Perla caucasica* GUERIN [Caucasus]: Egg lateral, 230x (22); collar end, 600x (23); detail of chorion and micropyles, 1210x (24).

***Perla illiesi* BRAASCH & JOOST, 1971**

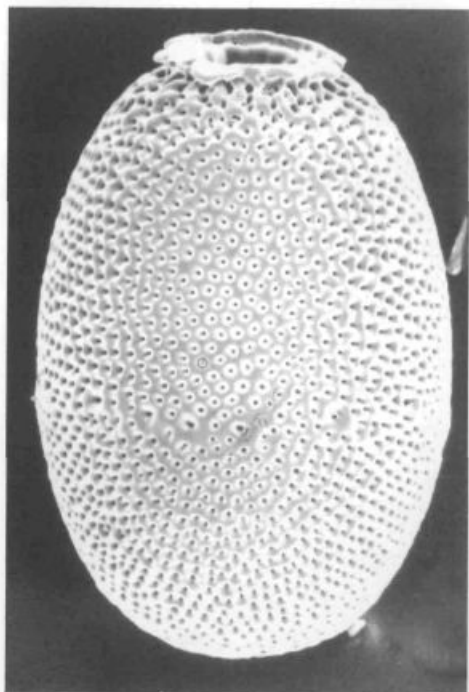
Figs. 25-27

Egg.- Length 0.39-0.40 mm, width 0.28-0.30 mm. Collar short, about 0.02 mm long and about 0.11-0.13 mm wide. Circumference of collar with about 18-20 irregular thick, vermiform ribs extending from rim onto egg body; rim flanged and irregularly incised with about 20 teeth, variable in width. Chorion punctate throughout; punctations vary only slightly in diameter. Micropylar row set about 0.15-0.18 mm from pole; orifices without raised rim.

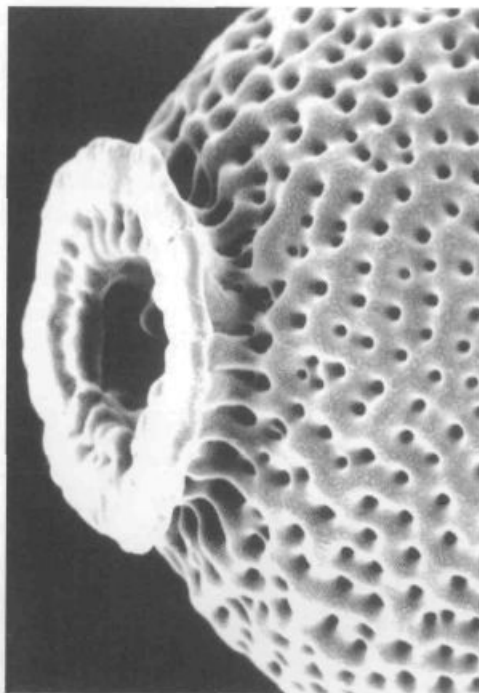
SEM Specimen Data.- Bosnia, no other data. Slovenia, Butoraj, 14 June 1984, I. Sivec (SMNH). Slovenia, Dragonja River near Koper, 25 June 1981, I. Sivec (SMNH).

Distribution.- Known from the Italian-Slovenian border region to Bulgaria and the southern part of the former Yugoslav Republic. We have confirmed specimens from Bosnia, Bulgaria, Croatia, Italy, Kosovo, Macedonia, Montenegro, and Slovenia.

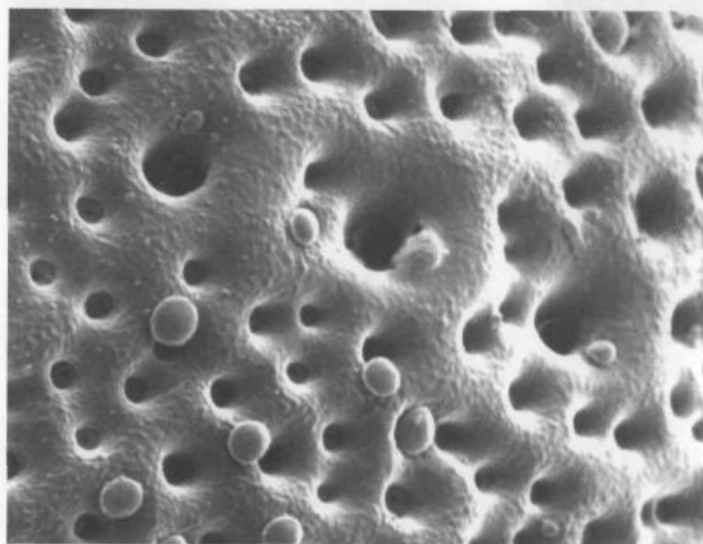
Comments.- Eggs of this species are quite similar to those of *P. kiritshenkoi* ZHILTZOVA and *P. caucasica* in being punctate over the entire chorionic surface. The most apparent differences are in the collar form which has only thin ribs extending to a straight rim in *P. caucasica* and a smooth, thick non-stalked form in *P. kiritshenkoi*. There are additional subtle distinctions in the micropylar orifices and in the size of the punctations. The punctations are larger and more regular in the latter species and somewhat finer in *P. caucasica* than in *P. illiesi*.



25



26



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Figs. 25-27: SEM photomicrographs of eggs: *Perla illiesi* BRAASCH&JOOST [Slovenia]; Egg lateral, 250x (25); collar end, 680x (26); detail of chorion and micropyles, 1200x (27).

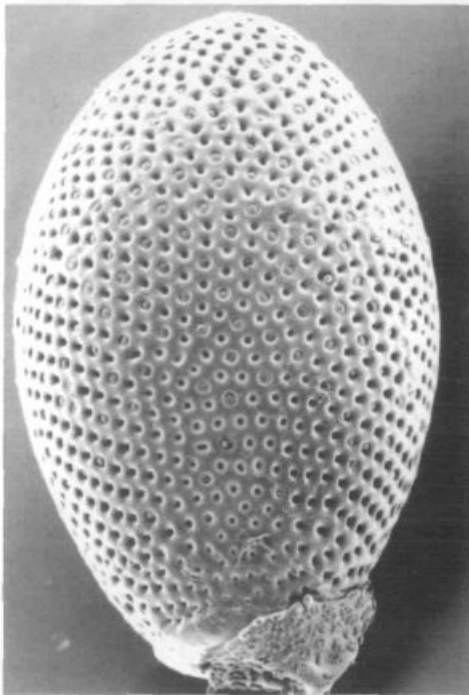
***Perla kiritshenkoi* ZHILTZOVA, 1961**

Figs. 28-30

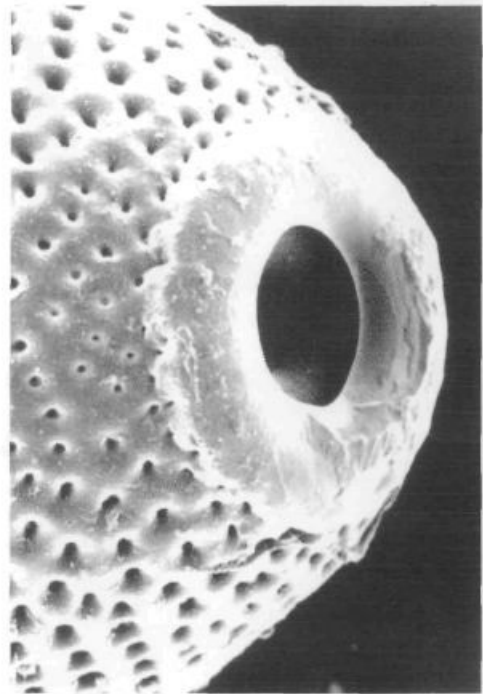
Egg.- Length 0.43 mm, width 0.29 mm. Collar short, about 0.02-0.03 mm long and about 0.12-0.13 mm wide; rim thick and smooth but with a series of small pits around base. Chorion punctate throughout; punctations relatively uniform in size and arranged in a hexagonal pattern of six punctations surrounding a single punctation in which a mushroom body is located. Micropylar row set about 0.14 mm from pole; orifices recessed into pits but with slightly raised thin rim.

SEM Specimen Data.- Iran, Elburs Mountains, SW Chalus, 2 May 1970, Ressler (LFS).

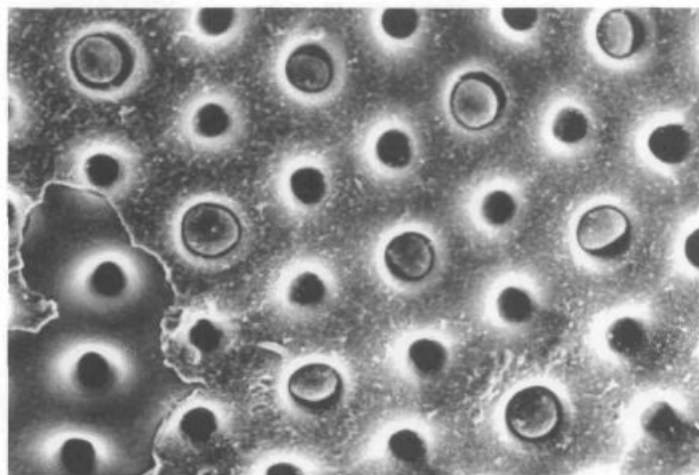
Distribution.- Reported from Armenia, the Caucasus and the Elburs Mountains of Iran. We have confirmed specimens from the latter area.



28



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Figs. 28-30: SEM photomicrographs of eggs: *Perla kiritshenkoi* ZHILTZOVA [Iran]: Egg lateral, 240x (28); collar end, 550x (29); detail of chorion, 1180x (30).

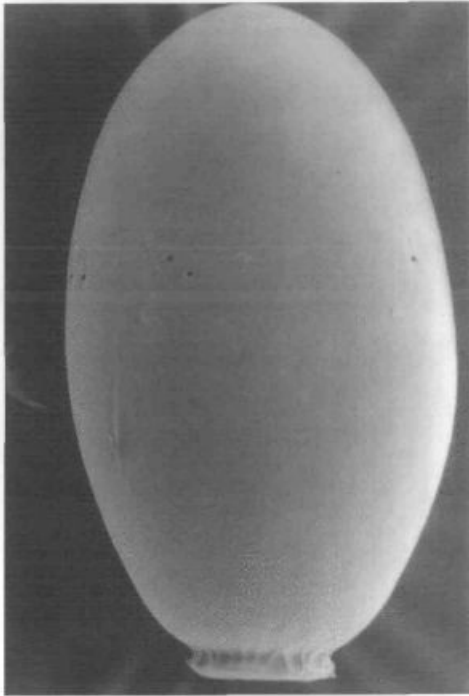
The *Perla grandis* Group
***Perla grandis* RAMBUR, 1842**
Figs. 31-33

Egg.- Length 0.42-0.47 mm, width 0.25-0.30 mm. Collar short, about 0.02 mm long and about 0.09 mm wide. Circumference of collar with about 24 irregularly spaced vertical ribs extending from rim onto shoulders of egg body and forming irregularly shaped, somewhat trapezoidal cells around shoulders. Rim very slightly flanged and subtly incised, but these visible only in polar aspect. Chorion texture granular in appearance with fine detail showing irregular short vermiform surface processes and very fine surface pitting over entire surface. Micropyles with moderately large funnel like orifices surrounded by smooth low rims; micropylar row set about 0.15-0.16 mm from pole.

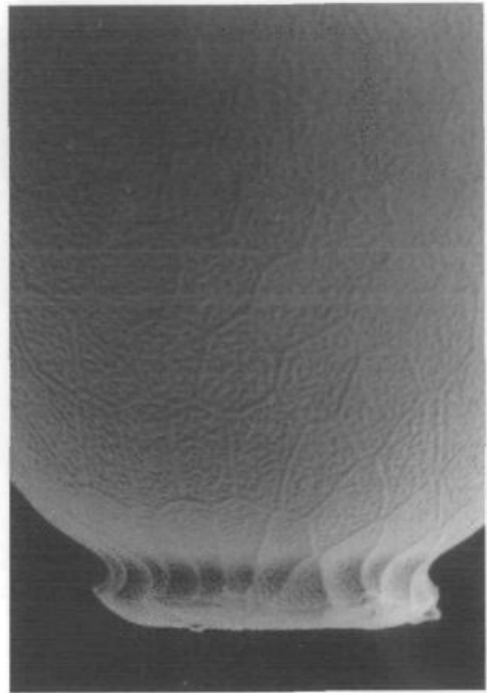
SEM Specimen Data.- Austria, no other data (NMP). Poland, Zakopane, 14 July 1985, S.W. Szczytko (SWS). Slovenia, Lepena, Bovec, 25 May 1983, I. Sivec (SMNH). Switzerland, Valai, Col de Bretolet, August 1963 (MZ).

Distribution.- Reported from the Sierra Nevada of Spain to Belgium and southeastern Poland in the north, through the Italian Peninsula to Sicily and as far east as the Carpathian Mountains in Ukraine and Roumania and south as far as Croatia. We have confirmed specimens from Austria, Czech Republic, Italy, Poland, Serbia, Slovakia, Slovenia, Spain, Morocco and Switzerland.

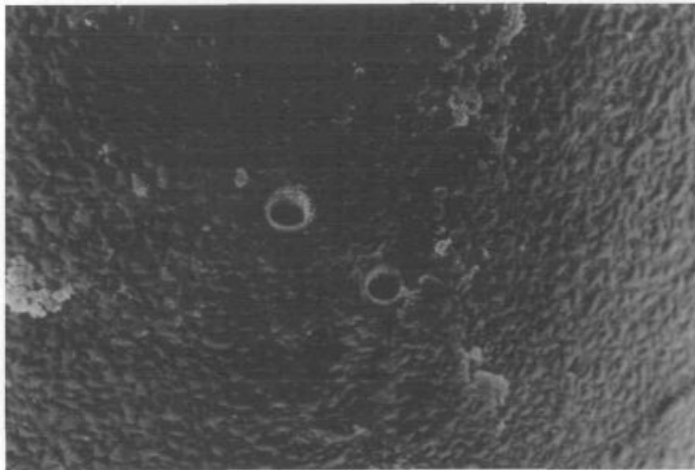
Comments.- Earlier authors such as KLAPÁLEK (1923), DESPAX (1951), ILLIES (1955) and AUBERT (1959) rather consistently used the name *Perla maxima* (SCOPOLI) for this species, however, *P. maxima*, through action of the ICZN "relative precedence" procedure has been placed as a synonym of *P. marginata* (PANZER). CONSIGLIO (1967a) first proposed the suppression of *P. maxima* and also applied the name, *P. grandis* to this species in CONSIGLIO (1967b).



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Figs. 31-33: SEM photomicrographs of eggs: *Perla grandis* RAMBUR [Switzerland]: Egg lateral, 210x (31); collar end, 500x (32); detail of chorion and micropyles, 1040x (33).

The *Perla horvati* Group
Perla horvati, sp. nov.
Figs. 34-36

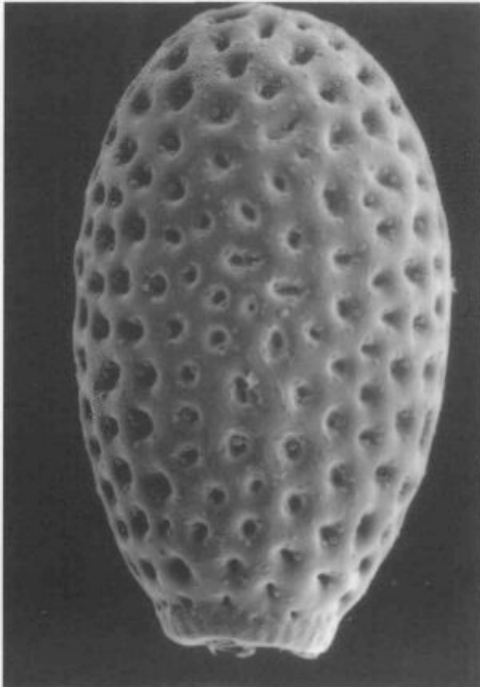
Types.- holotype, male: Turkey, r. Aksu, Tamdere, Kümbet, Sehitler Gec, 1550 m, 26.-27.6.1995, leg. Horvat. Paratypes: 33 males, 42 females, same data (Type material is deposited in Slovenian Museum of Natural History, Ljubljana, Slovenia).

Male.- Length of fore wings 22 mm

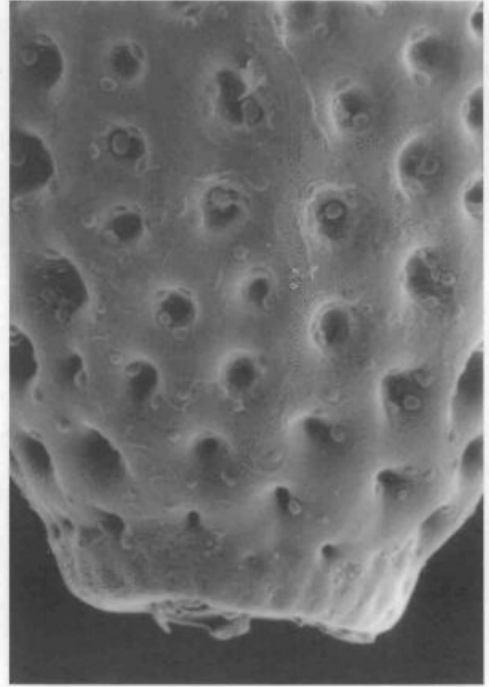
Female.- Length of fore wings 28 mm

Egg.- Length 0.59 mm, width 0.35 mm. Collar short, about 0.02-0.03 mm long and 0.17 mm wide. Circumference of collar without discernable ribs or follicle cell impressions; rim smooth and without flange or incisions. Chorion coarsely pitted; pits irregularly oval or round in shape, relatively large (ca. 0.017-0.029 mm diameter) and deep; surface between pits smooth; equatorial section with about 10-12 pit rows in lateral aspect. Micropyles set in pits about 0.249 mm from pole; orifices slightly raised with thin rims.

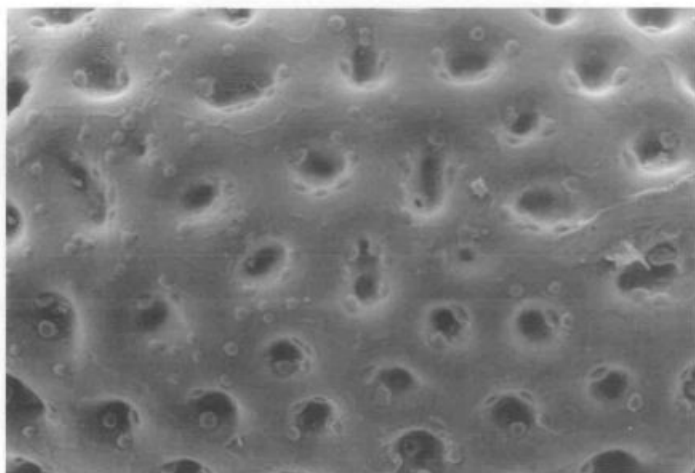
Etymology.- The patronym honors our friend and colleague, B. Horvat, curator at the Slovenian Museum of Natural History, and collector of the type series.



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Figs. 34-36: SEM photomicrographs of eggs: *Perla horvati* sp. nov. SIVEC&STARK [Turkey]: Egg lateral, 170x (34); collar end, 350x (35); detail of chorion and micropyles, 360x (36).

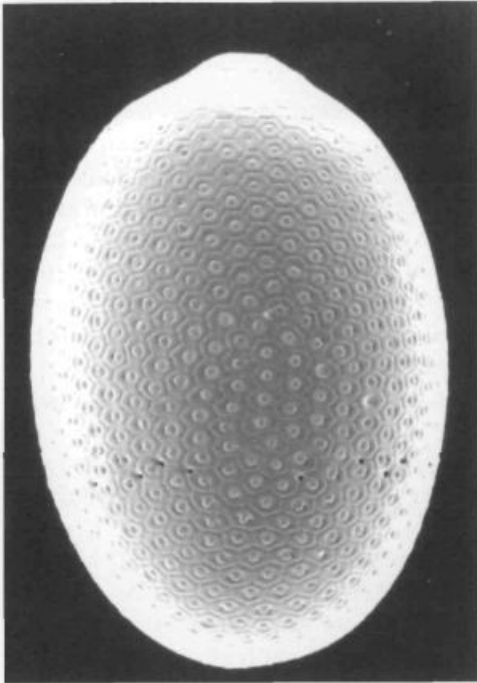
The *Perla marginata* Group
Perla marginata (PANZER, 1799)
 Figs. 37-39

Egg.- Length 0.41-0.46 mm, width 0.29-0.30 mm. Egg collar hardly produced, essentially a sessile opening surrounded by smooth terminus; basal width of terminus about 0.06-0.08 mm. Chorion covered throughout with prominent follicle cell impressions; hexagonal cells fairly uniform but cell widths ranging from 0.018-0.023 mm; cells tightly packed but separated from adjacent ones by narrow, shallow sulci; cell floors with a central depression containing usually a single minute pore; depressions house a single globular mushroom body whose stalk attaches to chorion through cell pore. Micropylar row set about 0.13-0.16 mm from pole; orifices without rims, set along intracellular borders at irregular points.

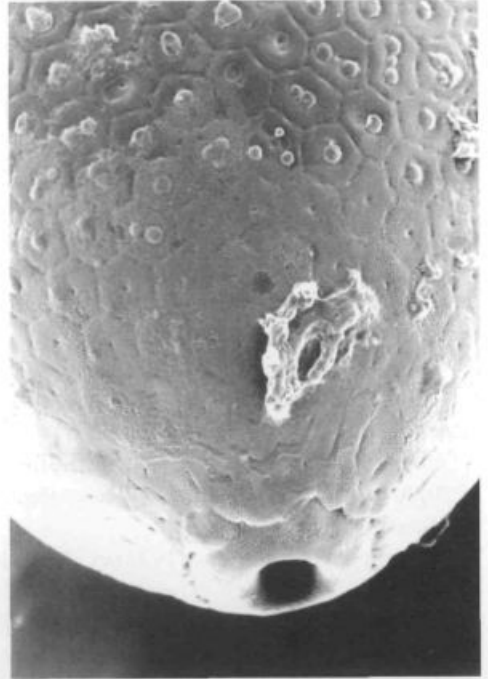
SEM Specimen Data.- Germany, Eder Bergland n. Marburg, 9 June 1990, P. Zwick (LFS). Germany, Hammersbach, 5 June 1988, P. Zwick (LFS). Germany, Harz, Hinter Eberssberg, 12 June 1969, Tobias (LFS). Slovenia, Divje jezero, 8 June 1979, I. Sivec (SMNH). Slovenija, Mala Voda, Sevnik, 24 May 1990, B. Horvat (SMNH). Slovenia, Slatna, Grgar, 19 May 1993, I. Sivec (SMNH).

Distribution.- Known from western Europe ranging from Spain to Holland east to Italy and western Poland. Earlier records from North Africa, Iran and the southern Balkans apparently pertain to *P. pallida*. We have confirmed specimens from Austria, Czech Republic, Germany, Italy, Poland, Slovakia, Slovenia and Spain.

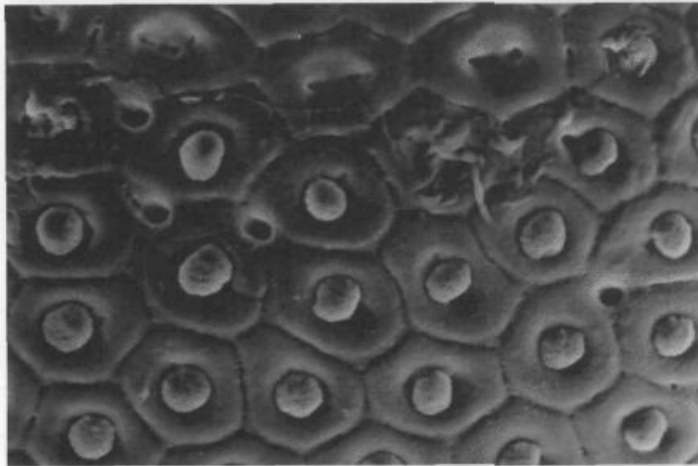
Comments.- Eggs of this species are recognized on the basis of the extremely reduced collar. In other respects the eggs are quite similar to those of *P. madritensis* RAMBUR and to the *P. pallida* complex.



37



38



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Figs. 37-39: SEM photomicrographs of eggs: *Perla marginata* (PANZER) [Slovenia]: Egg lateral, 240x (37); collar end, 520x (38); detail of chorion and micropyles, 1000x (39).

Perla madritensis RAMBUR, 1842

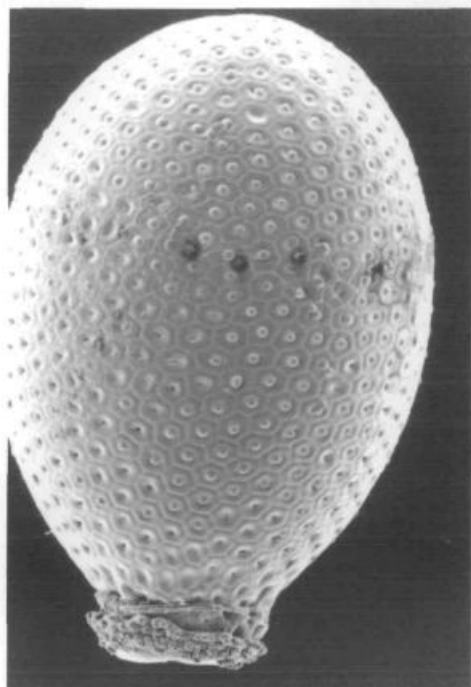
Figs. 40-42

Egg.- Length 0.42-0.45 mm, width 0.29-0.30 mm. Collar short, about 0.04 mm long, not distinctly offset from egg body and narrowed from basal width of about 0.13 mm to rim width of about 0.09 mm; rim relatively smooth but, at least in some specimens, with indistinct follicle cell impressions continuous from rim to egg body. Chorion covered throughout with prominent follicle cell impressions; hexagonal cells fairly uniform but with cell widths ranging from 0.016-0.020 mm; cells separated from adjacent ones by narrow sulci, and cell floors containing a central depression and one or two minute pores; each cell depression houses a single globular mushroom body whose stalk attaches to the chorion through the cell pores. Micropylar row set about 0.15 - 0.17 mm from pole; orifices without rims, set along intracellular borders at irregular points.

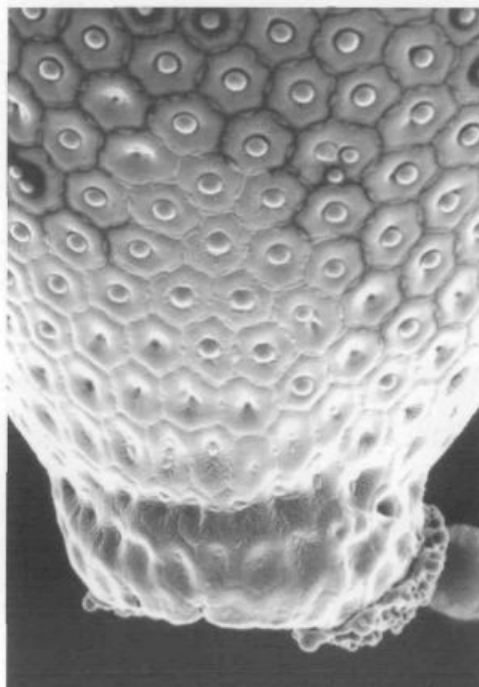
SEM Specimen Data.- Portugal, Terras de Pontesa da Figulira, 3 June 1972 (LFS). Spain, Gosende, 6 June 1982, A. Coruna (LFS).

Distribution.- Reported from the basins of the Tego and Douro Rivers (BERTHELEMY & TERRA 1980) in the northern half of the Iberian Peninsula. We have confirmed specimens from Portugal and Spain.

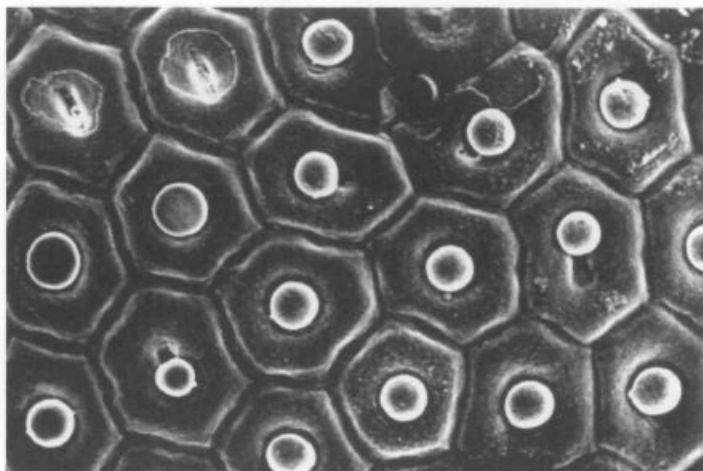
Comments.- KLAPÁLEK (1923) evidently had the holotype of this species from the "vicinity of Madrid" in his possession at one time but we have not located the specimen and its existence has apparently not been documented since that time. For much of the last century the species was regarded as a synonym of *P. marginata* but AUBERT (1963) recognized it as a subspecies of *P. marginata* and BERTHELEMY & TERRA (1980) considered it a valid species at least partially on the basis of egg morphology. More recently, MEMBIELA (1990) supported this position by showing the drumming signals of *P. madritensis* are distinct from those of *P. marginata*.



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Figs. 40-42: SEM photomicrographs of eggs: *Perla madritensis* RAMBUR [Spain]: Egg lateral, 240x (40); collar end, 600x (41); detail of chorion and micropyle, 1220x (42).

***Perla pallida* GUERIN, 1838**

Figs. 43-63

Egg.- Length 0.43-0.47 mm, width 0.27-0.30. Collar short, about 0.02-0.03 mm long and about 0.09-0.12 mm wide; collar form variable but often, but not always, with the rim flanged and distinctly wider across the rim than the neck; sides of collar with ornamentation varying from irregular rows of pits to regular follicle cell impressions. Chorion covered throughout with prominent follicle cell impressions; hexagonal cells fairly uniform but cell widths ranging from about 0.015-0.024 mm; cells typically separated from adjacent ones by narrow sulci but in some specimens these are reduced to a series of pits leaving incomplete sulci for cell impressions near collar; cell floors contain a central depression and one or two minute pores; each cell depression houses usually one, but up to three mushroom bodies. Micropylar row set about 0.15-0.22 mm from pole; orifices without rims, set along intracellular borders at irregular points.

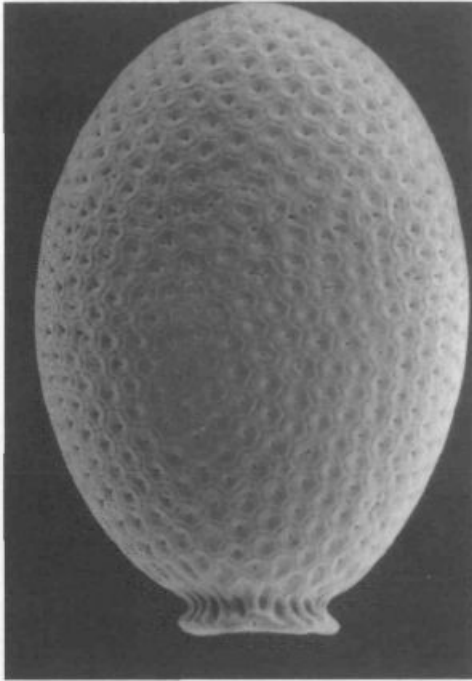
SEM Specimen Data.- Type 1 Egg.- Armenia, Sevan Basin, Argicki, 13 June 1961 (ZISP). Caucasus, A. Kownacki, no additional data (LFS). Turkey, Macka, Trabzon, B. Horvat (SMNH). Turkey, Kastanoan, Azdanaj, 21 June 1996, B. Horvat (SMNH). Turkey, Anatolia, no additional data (LFS). Turkey, Anatolia, Anat Bor Umg., Savi Gol, 7 August 1978 (LFS). Type 2 Egg.- Bulgaria, 29 July 1969, D. Braasch (BPS). Bulgaria, Pirin, 3 June 1964, D. Braasch. Macedonia, T.M. Stirevo Voda, 15 April 1999, B. Horvat (SMNH). Macedonia, Pesočani, 11 June 1979, P. Ikononov (NMS). Macedonia, 20 July 1977, I. Sivec (SMNH). Slovenia, Gabrje, Žerovnik, 28 June 1995, I. Sivec (SMNH). Slovenia, Bistrica, nad Selnico, 6 June 1983 (SMNH). Type 3 Egg.- Bulgaria, Stranca Gebirge, 15-19 June 1980, H. Malicky (LFS). Greece, Mega Peristeri, 22 May

1988, I. Sivec, S. Uchida (SMHN). Greece, River Thiamis, Soulopoula, 21 May 1988, I. Sivec, S. Uchida (SMNH). Montenegro, Durmitor Mountain, 15 June 1983, C. Krušnik (SMNH). Morocco, Moyen Atlas, del'Oued, Oum River, 4 May 1960, J. Aubert (MZ). Type 4 Egg. - Greece, Klepa, 25 June 1990. I. Sivec (SMNH).

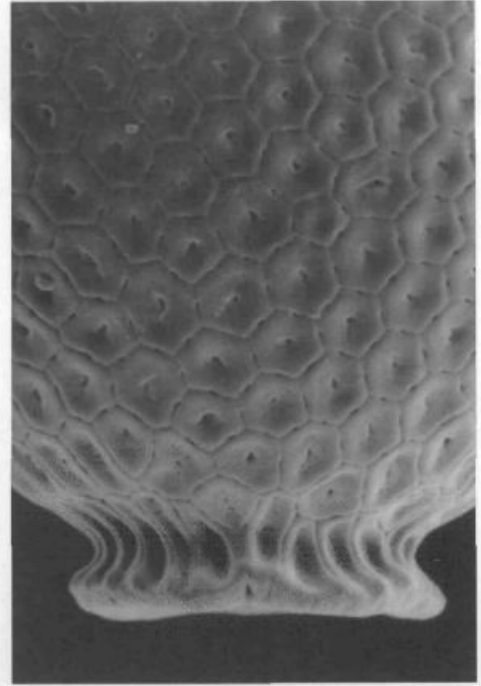
Distribution.- This species complex is reported from central Europe to the Caucasus. We have confirmed specimens from Armenia, Austria, Bosnia, Bulgaria, the Caucasus, Greece, Macedonia, Montenegro, Morocco, Slovakia, Slovenia and Turkey.

Comments.- *Perla pallida* may be a complex of three or more species or subspecies. The original type of *P. pallida* (now lost) was from the Caucasus and all egg samples we observed from the Caucasus, Turkey and Armenia had very similar egg collars of Type 1, with the rim flanged, incised and distinctly wider than the neck. Sides of these collars have prominent, continuous ribs extending from the shoulders to the rim. Type 2 egg collars occur on all samples examined from Slovenia and Macedonia and some from Bulgaria. These eggs have the collar about the same diameter (or slightly narrower) at the rim than the base so there is no constricted neck. Irregular thick ribs extend from the cell impression meshwork of the egg body to the rim and these are defined by a series of conspicuous pits arranged in two or three irregular tiers. Type 3 collars are slightly shorter than those of Type 1 or 2 and there is a very slight constriction in the neck region and a slight expansion of the rim. Meshwork on the sides of the collar consists of narrow poorly defined ribs separated by a low sulcus. Type 3 collars occur on specimens from Greece, Montenegro, Morocco, Bulgaria and from two samples labeled only "Yugoslavia". One additional egg sample which we tentatively place in this complex appears much more distinct and is referred to as Type 4. Cell impressions above and below the equatorial micropyles of this egg are outlined by a series of minute pores and faint lines which develop into a series of parallel lines of pits near the collar. This egg sample comes from two females captured in central Greece.

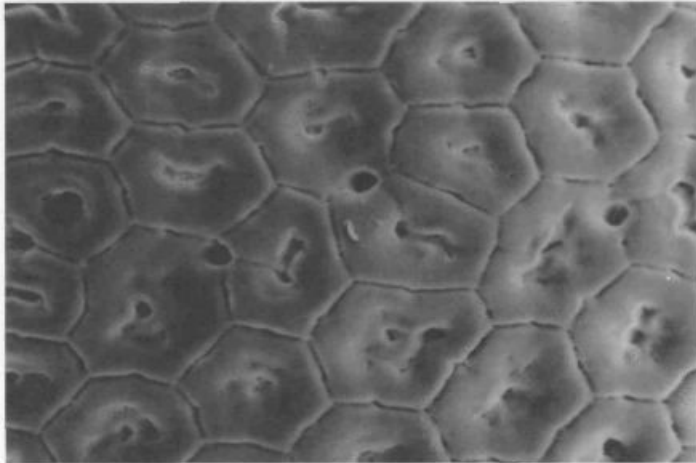
Our egg data suggests *P. pallida* is a complex in need of comprehensive review. A larger sample of material inclusive of the entire range is needed and careful study of types of two current synonyms *P. dacica* KLAPÁLEK and *P. bureschi* SCHOENEMUND must be included.



43

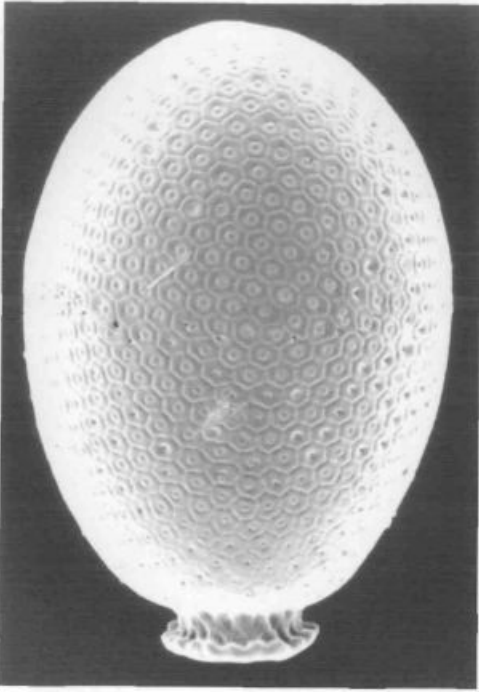


44

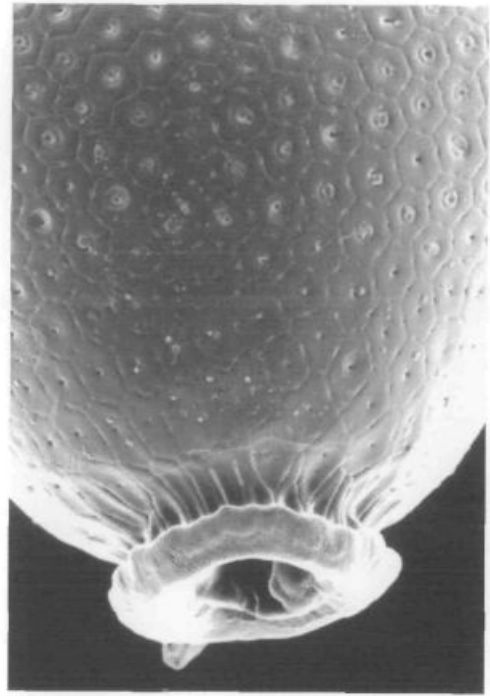


45

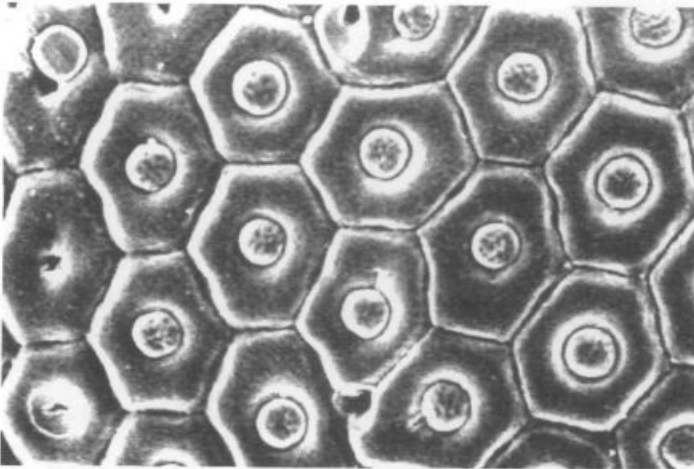
Figs. 43-45: SEM photomicrographs of eggs: *Perla pallida* GUERIN, Type 1 [Armenia]: Egg lateral, 250x (43); collar end, 570x (44); detail of chorion and micropyles, 1000x (45).



46

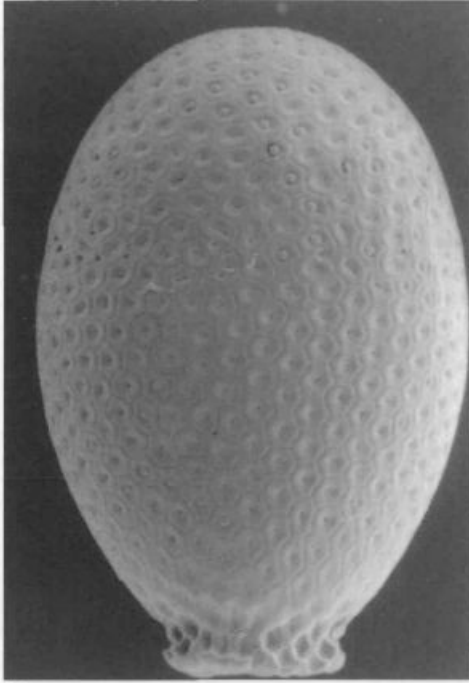


47

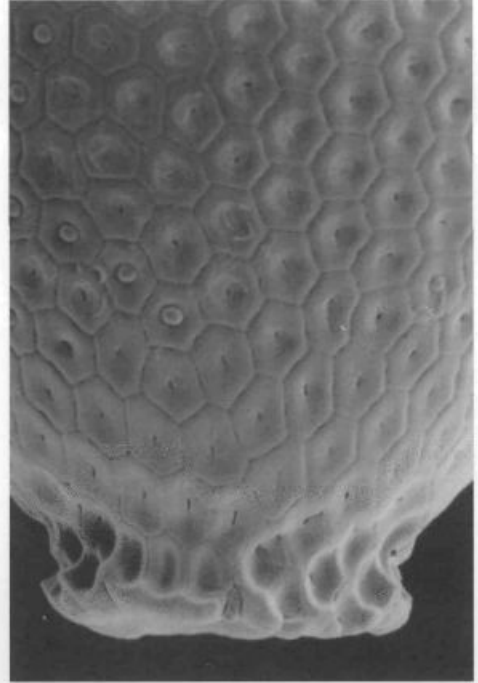


48

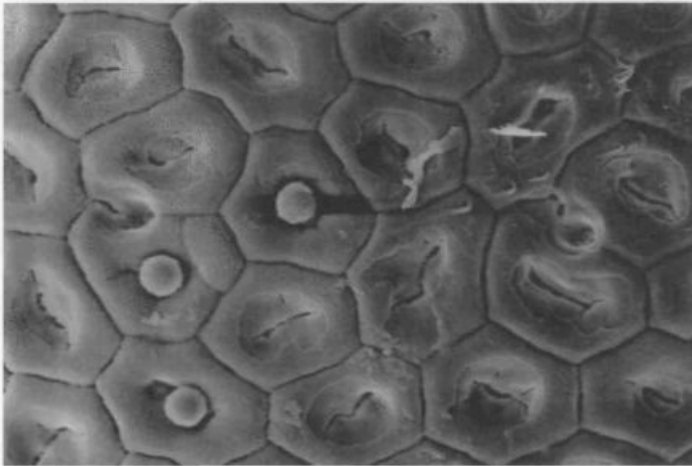
Figs. 46-48: SEM photomicrographs of eggs: *Perla pallida* GUERIN, Type 1 [Turkey]: Egg lateral, 230x (46); collar end, 600x (47); detail of chorion and micropyle, 1210x (48).



49

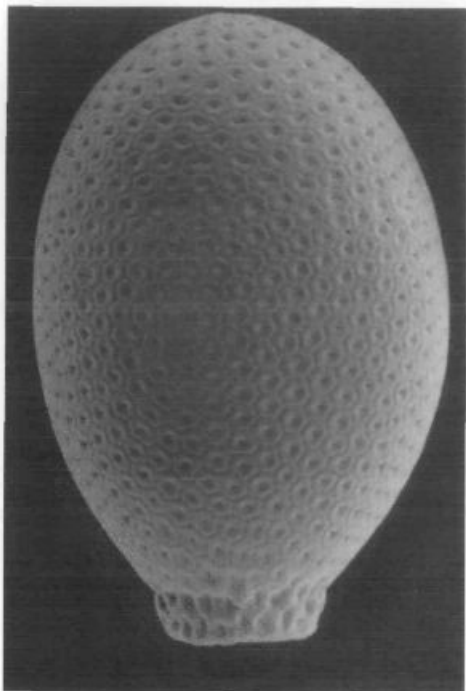


50

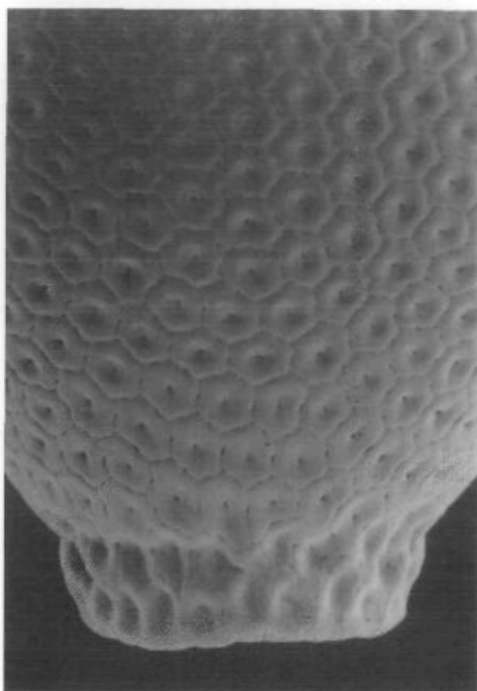


51

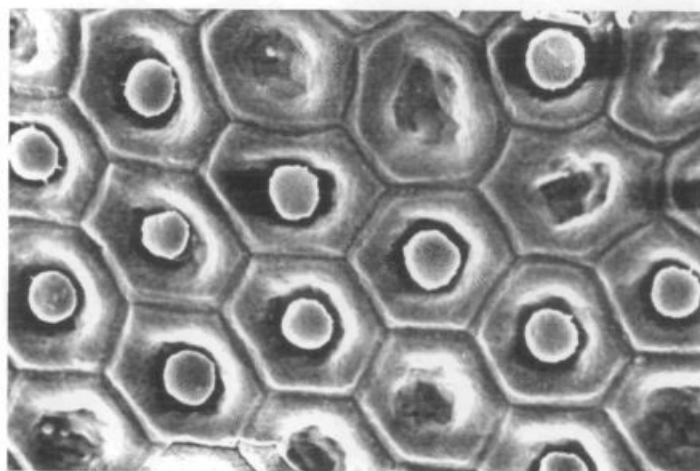
Figs. 49-51: SEM photomicrographs of eggs: *Perla pallida* GUERIN, Type 2 [Bulgaria]: Egg lateral, 240x (49); collar end, 500x (50); detail of chorion and micropyles, 1010x (51).



52

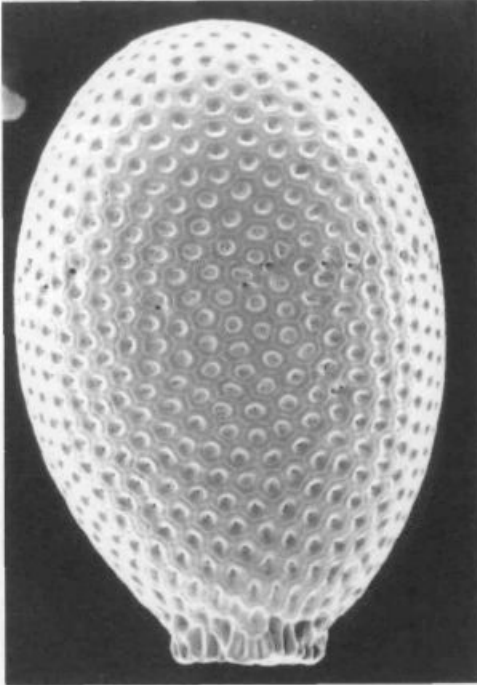


53

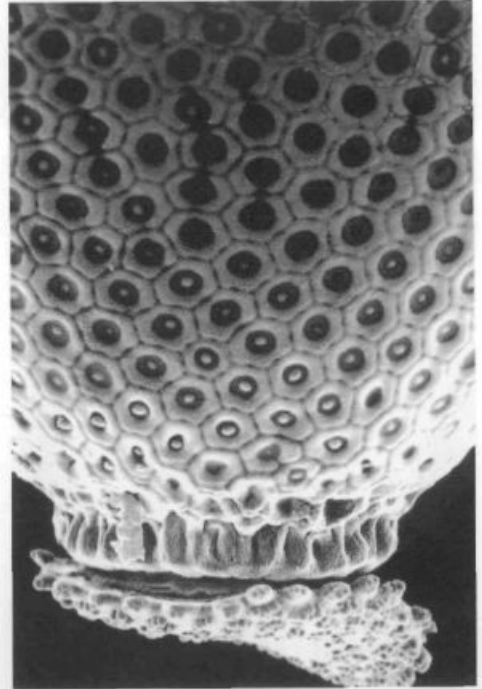


54

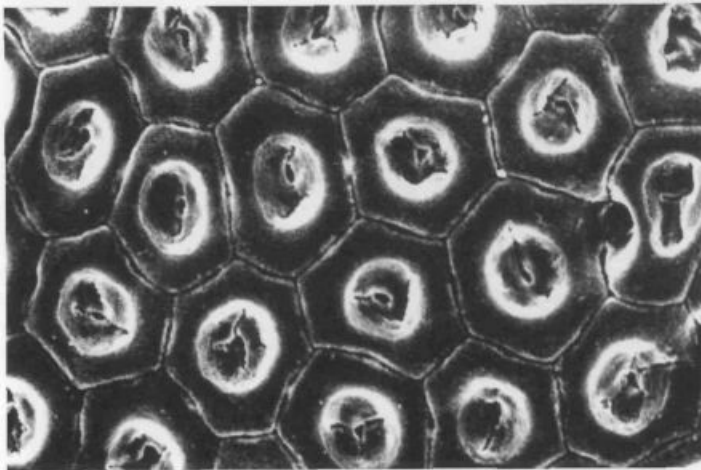
Figs. 52-54: SEM photomicrographs of eggs: *Perla pallida* GUERIN, Type 2 [Macedonia]: Egg lateral, 240x (52); collar end, 500x (53); detail of chorion, 1210x (45).



55

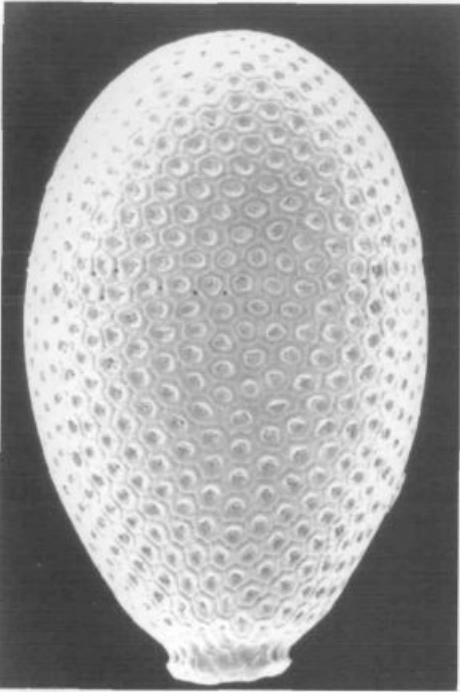


56

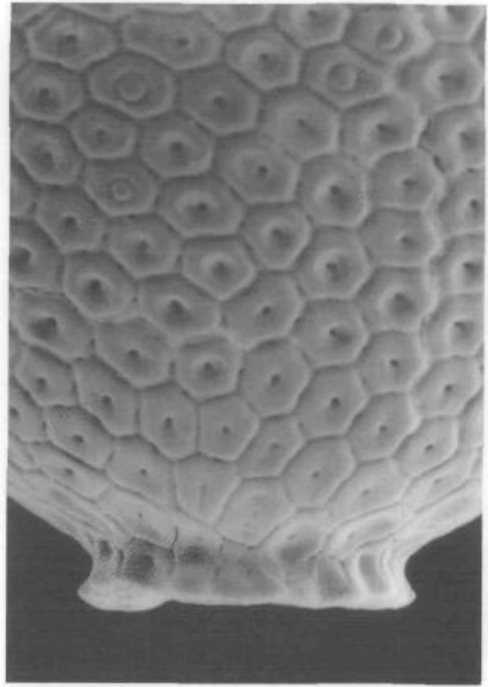


57

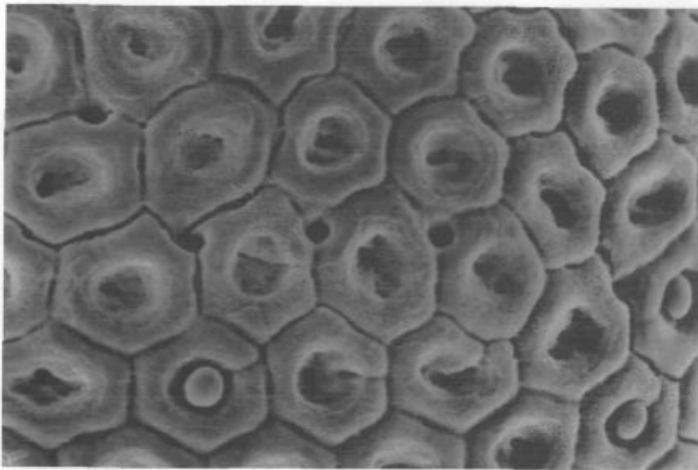
Figs. 55-57: SEM photomicrographs of eggs: *Perla pallida* GUERIN, Type 2 [Slovenia]: Egg lateral, 240x (55); collar end, 470x (56); detail of chorion and micropyle, 1210x (57).



58

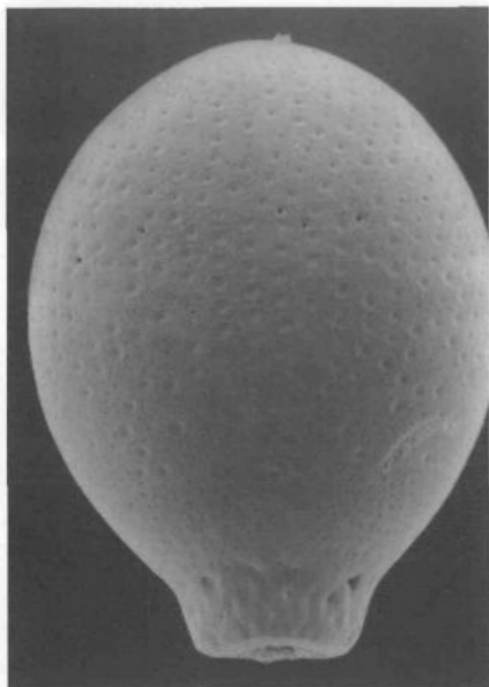


59

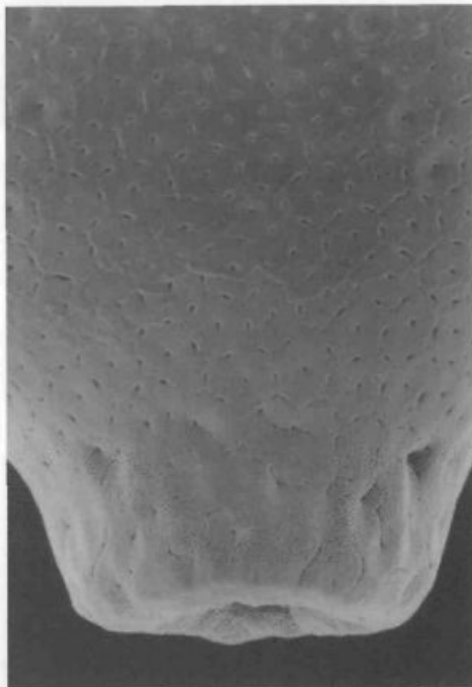


60

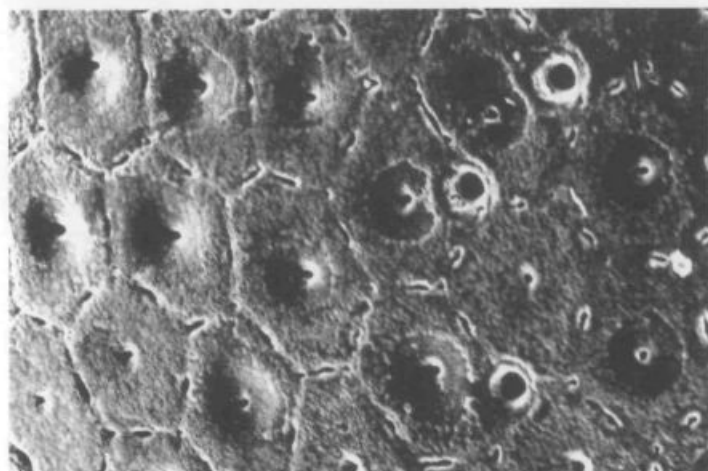
Figs. 58-60: SEM photomicrographs of eggs: *Perla pallida* GUERIN, Type 3 [Greece]: Egg lateral, 240x (58); collar end, 630x (59); detail of chorion and micropyles, 1010x (60).



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Figs. 61-63: SEM photomicrographs of eggs: *Perla pallida* GUERIN, Type 4 [Greece]: Egg lateral, 220x (61); collar end, 500x (62); detail of chorion and micropyles, 1210x (63).

Povzetek

Predstavniki rodu *Perla* sodijo med največje evropske vrbnice. *Perla* je najstarejše rodovno ime med vrbnicami in pod tem imenom so bile opisane številne vrste. V katalogu ILLIESA (1966) za ta rod zasledimo kar 293 imen vrst, ki večinoma sodijo med vprašljive vrste. SIVEC in ostali (1988) so rod *Perla* omejili le na Evropo in nekatere sosednje dežele, tako da se je število vrst znotraj rodu znižalo na 8. Študij precej obsežnega materiala v preteklem desetletju je pokazal, da je taksonomija tega rodu še vedno zelo nejasna.

V tem delu predstavljamo sistematski pregled posameznih vrst rodu *Perla* na podlagi študije strukture površine jajc posameznih vrst z elektronskim rastrskim mikroskopom. Ugotovili smo 12 vrst, ki jih uvrščamo v šest skupin vrst. *Perla horvati* in *Perla zwicki* iz Turčije sta za znanost novi vrsti. *Perla abbreviata* in *Perla persica* sta sinonima vrste *Perla caucasica*.

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