

A boreal ostracod assemblage from the Callovian of the Łuków area, Poland

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Excellently preserved ostracods from large blocks of the late Callovian (*Quenstedtoceras lamberti* Zone) black clays occurring within glacial drift near Łuków, eastern Poland, are described. Unlike coeval faunas from other localities in Poland, the Łuków ammonite assemblage exhibits boreal affinities. The ostracod fauna broadly resembles those of the British Isles and northwestern Germany, there are also some similarities to Central Russia and northwestern Poland. Seventeen ostracod species are reported, and *Schuleridea* (*Eoschuleridea*) *lukoviensis* sp. n. is proposed. The ostracod assemblage is dominated by large number of specimens of *Nophrecythere* and *Schuleridea* (*Eoschuleridea*). The ostracods are of late Callovian age as indicated by the presence of *Nophrecythere triebeli*, *Progonocythere callovica* and advanced evolutionary forms of *Nophrecythere intermedia* and *Terquemula lutzei*. The most probable source of the Łuków clay blocks seems to be from the bed of the Baltic Sea north of Gdańsk.

Key words: Ostracoda, Jurassic, Callovian, taxonomy, zoogeography, Poland.

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Introduction

The Łuków locality of black Callovian clays is famous with respect to its excellently preserved neotonic molluscs, represented by ammonites with aragonitic pearly conch walls and empty phragmocones preserved in limestone concretions (Makowski 1952, 1962; Kulicki 1974, 1979; Brand 1986; Dzik 1990) and jaws (Lehmann 1972; Dzik 1986), bellerophonite rostra (Bandel & Kulicki 1988), arm hooks (Kulicki & Szaniawski 1972), as well as rare nautiloids (Makowski 1952; Dzik 1984). A diverse benthic assemblage is associated with the nautiloids comprising inadequately described bivalves (Makowski 1952; Pugaczewska 1986), gastropods (Makowski 1952), brachiopods and crinoids, but also polychaete jaws (Szaniawski 1974) and rhabdopleurid pterobranchs (Kulicki 1969). The microfossil assemblage is dominated by benthic foraminifera, only partly described by

Makowski (1952), Pazdro (1969) and Jendryka-Fuglewicz (1975). Dinoflagellate cysts have been identified in the concretions (Górka 1970).

In contrast to the abundant macrofauna recorded in the limestone concretions, the clay itself is rather poor in microfossils. Nevertheless, by washing uncemented surfaces of concretions and clay samples from shallow boreholes, a reasonable collection of ostracod carapaces and isolated valves has been assembled and described in the present paper. On the surface of the ornamented shells of the ostracods, various calcareous nannofossils have been found. According to Dr. Paul Bown (personal communication 1999) most of the coccoliths belong to the long-ranging species *Watznaueria britannica* (Stradner, 1963), *Watznaueria barnesae* (Black in Black & Barnes, 1959), *Zeugrhabdotus* sp., *Stradnerlithus* sp., and *Biscutum* sp.

Late Callovian deposits of Poland are represented by strata of sandy or carbonate facies, almost completely without ostracods, an exception is the northwestern Poland, where the strata are developed in mudstone-clay facies with numerous ostracods, however, they still require detail study (see Bielecka *et al.* 1980, 1988).

The ostracod material studied is deposited in the Institute of Paleobiology, Polish Academy of Sciences, in Warsaw (abbreviated ZPAL).

Geological and stratigraphical setting

Very large glacially transported blocks of soft rocks of various ages are common in the glacial drift of northern Poland. In the Polish literature the term 'kra' (used also for ice-cakes) is applied to them owing to their usual shape and glacial origin. Several such blocks of Callovian black clays are known to occur in Łapiguz and Gołaszyn (51°57'18"N, 22°23'21"E) near Łuków, eastern Poland, explored for centuries for brick production (Jahn 1949; Morawski 1954; Kosmulska 1973; Mizerski & Szamałek 1985). The erratic in the Gołaszyn area is the largest in the region of Łuków, its body is about 1500 m long, 500 m wide, and up to 26 m thick. In some places Callovian rocks are intercalated with Quaternary ones, which appears to suggest transport in a partially frozen state and under conditions of marked stress (Mizerski & Szamałek 1985). In the Łapiguz area there are three separate blocks of these Callovian shales. The largest one is 600 m long, 590 m wide and with maximum thickness 10.5 m. The smaller block is 200 m long and 140 m wide and the smallest one 80 m long and 60 m wide (Morawski 1954).

Although some isolated finds of ammonites of early and middle Callovian age are reported from the Łuków area (Makowski 1952) the famous Łuków concretions invariably contain conchs of *Quenstedtoceras*, diagnostic of late Callovian age. *Quenstedtoceras henrici* Douville, 1912 and *Q. carinatum* (Eichwald, 1865) dominate the ammonite assemblage, *Kosmoceras spinosum* (Sowerby, 1826) being much less common, while other ammonite species occur only rarely (Dzik 1990). These concretions thus represent the *Q. henrici* Subzone of the *Q. lamberti* Zone of late Callovian age.

The Łuków clays are completely foreign to the area. The autochthonous Callovian rocks reached by deep boreholes in the Łuków area were deposited in carbonate facies (Dayczak-Calikowska & Kopik 1976). Black clays of coeval age are known from Lithuania, Gdańsk Pomerania and Scania (Grigelis & Norling 1999). The geographically

closest outcrops of the late Callovian in Lithuania (classic locality Papilė) are traditionally believed to represent the source area of the Łuków clays. However, *Quenstedtoceras* which dominates the Łuków ammonite assemblage is very rare in Lithuania and clay deposits there are of lesser (2 m) thickness (Rotkyté 1987; Grigelis & Norling 1999) than the Łuków block. A quite different interpretation for the origin of the Łuków clays was suggested by Reymont (1971) who reported a finding by an amateur collector of a Łuków concretion in Scania. This appears to be in conflict with the absence of Łuków concretions in glacial deposits of northwestern Poland where Callovian erratics represent generally sandy facies, known also from boreholes in western Pomerania. The most probable source of the Łuków clay blocks seems to be from the bed of the Baltic Sea north of Gdańsk, where the late Callovian black clays reach a thickness of several metres. The Łuków clay erratics have been transported for some 200–300 km and show similar lithological and palaeontological affinities with the Jurassic units of the east Baltic coast of Poland (Dayczak-Calikowska & Kopik 1976: pp. 332–334).

Material

The ostracod material described in this paper was obtained from samples collected by palaeontologists working in the Łuków area during the years 1970–1980; the brick-pit has recently been abandoned. The Ostracoda were washed out from the clays using hot water. The specimens are well preserved, mostly as disarticulated valves.

Systematic descriptions

Subclass Ostracoda Latreille, 1802

Order Podocopida Müller, 1894

Suborder Platycopina Sars, 1866

Family Cytherellidae Sars, 1866

Genus *Cytherella* Jones, 1849

Type species: *Cytherina ovata* Roemer, 1840.

Cytherella recta Sharapova, 1939

Fig. 1A–F.

Cytherella ovalis Terquem var. *recta* Sharapova, 1939: p. 34, pl. 4: 45, 46.

Cytherella recta Sharapova, 1939; Lubimova 1955: p. 105, pl. 12: 3.

Cytherella recta Sharapova, 1939; Kilenyi 1969: p. 115, pl. 23: 1–5.

Cytherella recta Sharapova, 1939; Brand 1990: p. 145, pl. 1: 8.

Material. — 50 valves and three carapaces.

Description. — Carapace sub-elliptical in lateral outline. Dorsal margin slightly convex and almost subparallel with ventral margin. Greatest height slightly behind mid-length. Greatest width in female carapaces in posterior part; males almost uniformly convex. Greatest length at mid-height. Right valve larger than left valve which it overlaps around all margins. Antero- and posterodorsal slope and anterior and posterior margins almost equally rounded. Shell surface generally smooth, with very small tubercles developed close to and parallel with posterior margin (Fig. 1A). Adductorial depression absent.

Holosolenic contact groove well developed. Adductor muscle field consists of two rows of elongate spots (Fig. 1E). Females with poorly developed limen and swollen posterior part of carapace.

Remarks. — According to Kilenyi (1978), *C. recta* is a junior synonym of *Cytherella fullonica* Jones & Sherborn, 1888, but in the opinion of the present authors, they differ in the absence of an adductorial depression in *C. recta* and in the almost equally rounded antero- and posterodorsal slope. Also greatest height is more posteriorly protruded in *C. recta*.

Occurrence. — Late Bathonian of northwestern Germany; Kimmeridgian of Great Britain; early and middle Volgian of Middle Volga and Syrt area, Russia; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Suborder Podocopina Sars, 1866
Superfamily Cypridacea Baird, 1845
Family Paracyprididae Sars, 1923
Genus *Paracypris* Sars, 1866

Type species: *Paracypris polita* Sars, 1866.

***Paracypris?* sp. A *sensu* Whatley (1970)**

Fig. 1G.

Paracypris sp. A.; Whatley 1970: p. 314, pl. 1: 20, 22, 23, 29.

Material. — Two carapaces.

Description. — Carapace elongate-oval in lateral outline, slightly compressed anteriorly. Greatest height at mid-length. Greatest length ventrally of mid-height. Left valve larger than right valve which it overlaps around all margins. Greatest overlap at ventral concavity. Anterior margin rounded, posterior margin pointed below mid-height. Dorsal margin slightly arched. Ventral margin slightly concave anteriorly of mid-length. Surface smooth.

Remarks. — Based on the carapace outline and left valve over right valve overlap the species is placed in *Paracypris* but this assignment is tentative due to the lack of single valves with preserved internal structures. Specimens of *Paracypris* from Łuków are also similar in the lateral outline to *Pontocyprrella aureola* Mandelstam in Lubimova, 1955 from the Middle and late Callovian and early Oxfordian of the Middle Volga area, Russia (Lubimova 1955). It is also similar to *Pontocyprrella suprajurassica* Oertli, 1959 from the Oxfordian of Switzerland (Oertli 1959).

Occurrence. — Callovian to Oxfordian (*E. coronatum* to *Q. mariae* zones) of Scotland and late Callovian (*Q. lamberti* Zone) of southern England; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Superfamily Sigilliecea Mandelstam, 1960
Family Sigillidae Mandelstam, 1960
Genus *Cardobairdia* van den Bold, 1960

Type species: *Cardobairdia ovata* van den Bold, 1960.

***Cardobairdia* sp.**

Fig. 1H.

Krausella sp. A; Whatley 1970: p. 316, pl. 2: 1, 2, 5, 6.

Material. — Two carapaces.

Description. — Carapace elongate-oval in lateral outline. Anterior margin rounded, posterior pointed in right valve, rounded in left valve. Left valve larger than right valve with continuous marginal overlap. Dorsal margin arched, ventral gently convex. Surface smooth.

Remarks. — This species is similar to *Cardobairdia argoviensis* (Oertli, 1959) from the early Oxfordian of Switzerland (Oertli 1959) and the middle and late Oxfordian of Poland (Bielecka *et al.*

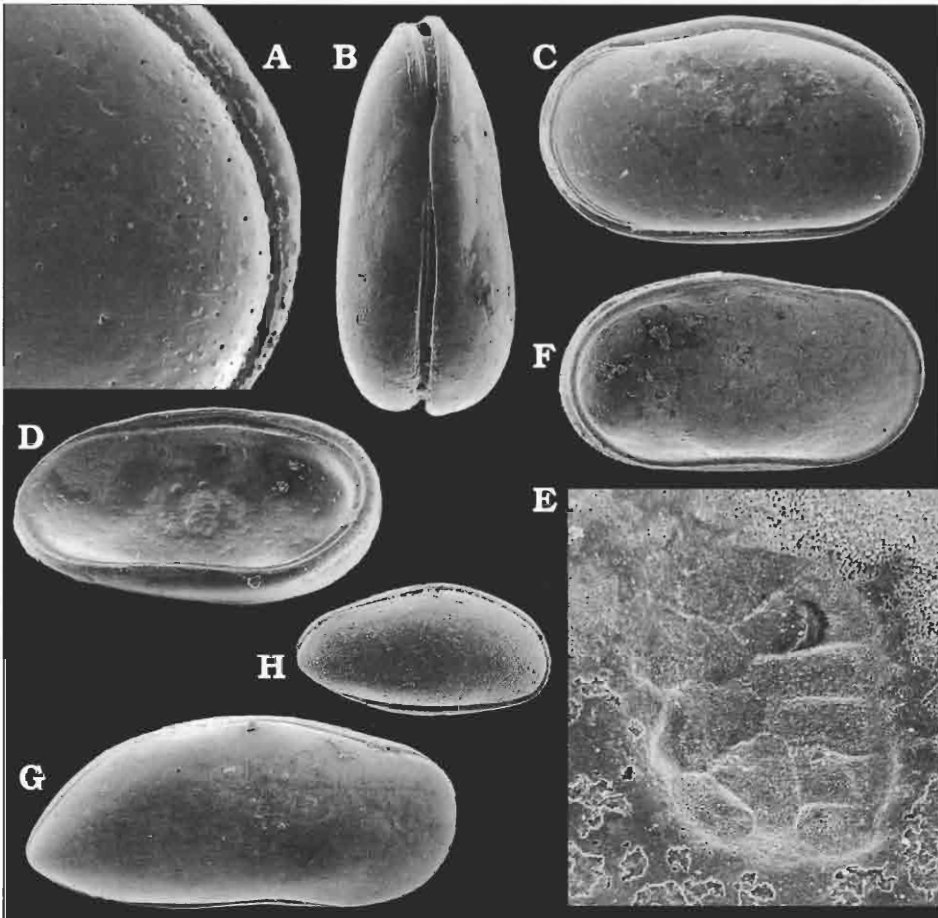


Fig. 1. A–F. *Cytherella recta* Sharapova, 1939. Females. A. Detail of posterior end of carapace. B, C. Carapace in dorsal and right lateral views. A–C. ZPAL O.32/1. D, E. RV in oblique internal view and detail of adductor muscle scar; ZPAL O.32/2. F. LV in internal view; ZPAL O.32/3. G. *Paracypris?* sp. Carapace in right lateral view; ZPAL O.32/4. H. *Cardobairdia* sp. Carapace in right lateral view; ZPAL O.32/5. All $\times 100$ except for A which is $\times 300$ and E which is $\times 500$.

1980, 1988) but differs in having a less rectangular lateral outline. It is similar in lateral outline to *Cardobairdia inflata* Szczechura & Błaszyk, 1968 from the Bathonian of Central Poland (Szczechura & Błaszyk 1968; Bielecka *et al.* 1980, 1988).

Occurrence. — Middle Callovian to late Oxfordian (*E. coronatum* to *P. cautisnigrae* zones) of Scotland and England; late Callovian (*Q. lamberti* Zone) of Luków, eastern Poland.

Superfamily Cytheracea Baird, 1850

Family Cytherideidae Sars, 1925

Subfamily Cytherideinae Sars, 1925

Genus *Glabbellacythere* Wienholz, 1967

Type species: *Glabbellacythere nuda* Wienholz, 1967.

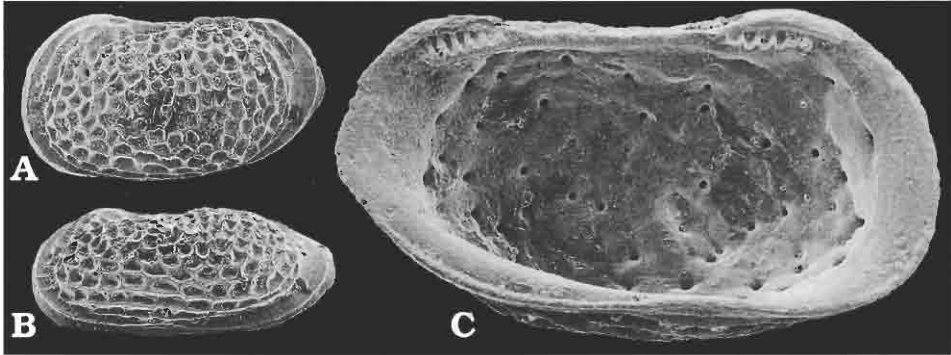


Fig. 2. A–C. *Glabellacythere reticulata* Whatley, 1970. A, B. LV in lateral and oblique views; $\times 100$. C. LV in internal view; $\times 200$. A–C. ZPAL O.32/6.

Glabellacythere reticulata Whatley, 1970

Fig. 2A–C.

Ostracod No. 138 Brand in Brand & Fahrion 1962: p. 153, pl. 21: 37–38.

Glabellacythere reticulata Whatley, 1970: p. 321, pl. 4: 7–15, pl. 5: 1–6.

Glabellacythere reticulata Whatley, 1970; Kilenyi 1978: pl. 7: 9–12.

Glabellacythere reticulata Whatley, 1970; Bodergat 1997: p. 220.

Material. — Two valves.

Description. — Carapace subrectangular in lateral outline. Cardinal angles rounded. Greatest length slightly above mid-height. Greatest height at anterior cardinal angle. Anterior margin broadly rounded, posterior bluntly rounded in shape and smaller, both marginally compressed. Left valve larger than right valve. Dorsal margin slightly concave medianly. Ventral margin with slight median concavity. Lateral surface coarsely reticulate. Eye node small. Avestibulate. Inner lamella of medium width. Marginal pore canals six anteriorly, three posteriorly. Hinge antimerodont. Six anterior and seven posterior sockets and median bar with poorly preserved denticulation in left valve. Muscle scars poorly visible.

Remarks. — Only presumed female valves are present in the material from Łuków.

Occurrence. — Late Callovian and early Oxfordian (*E. coronatum* – *C. cordatum* zones) of southern England and Scotland; Middle Callovian (*K. jason* Zone) of northwestern Germany; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Subfamily Schulerideinae Mandelstam, 1959

Genus *Schuleridea* Swartz & Swain, 1946

Subgenus *Schuleridea* (*Eoschuleridea*) Bate, 1967

Type species: *Schuleridea* (*Eoschuleridea*) *bathonica* Bate, 1967.

Schuleridea (*Eoschuleridea*) *lukoviensis* sp. n.

Fig. 3A–N.

Holotype: ZPAL O.32/7 (Fig. 3A).

Type horizon: Middle Jurassic, late Callovian, *Q. lamberti* Zone.

Type locality: Łuków, eastern Poland.

Derivation of the name: From the type locality.

Diagnosis. — *Schuleridea* (*Eoschuleridea*) *lukoviensis* sp. n. differs from other species of the genus in having micropunctate lateral surface, pronounced left/right valve overlap and strong sexual dimorphism.

Material. — 150 valves and six carapaces.

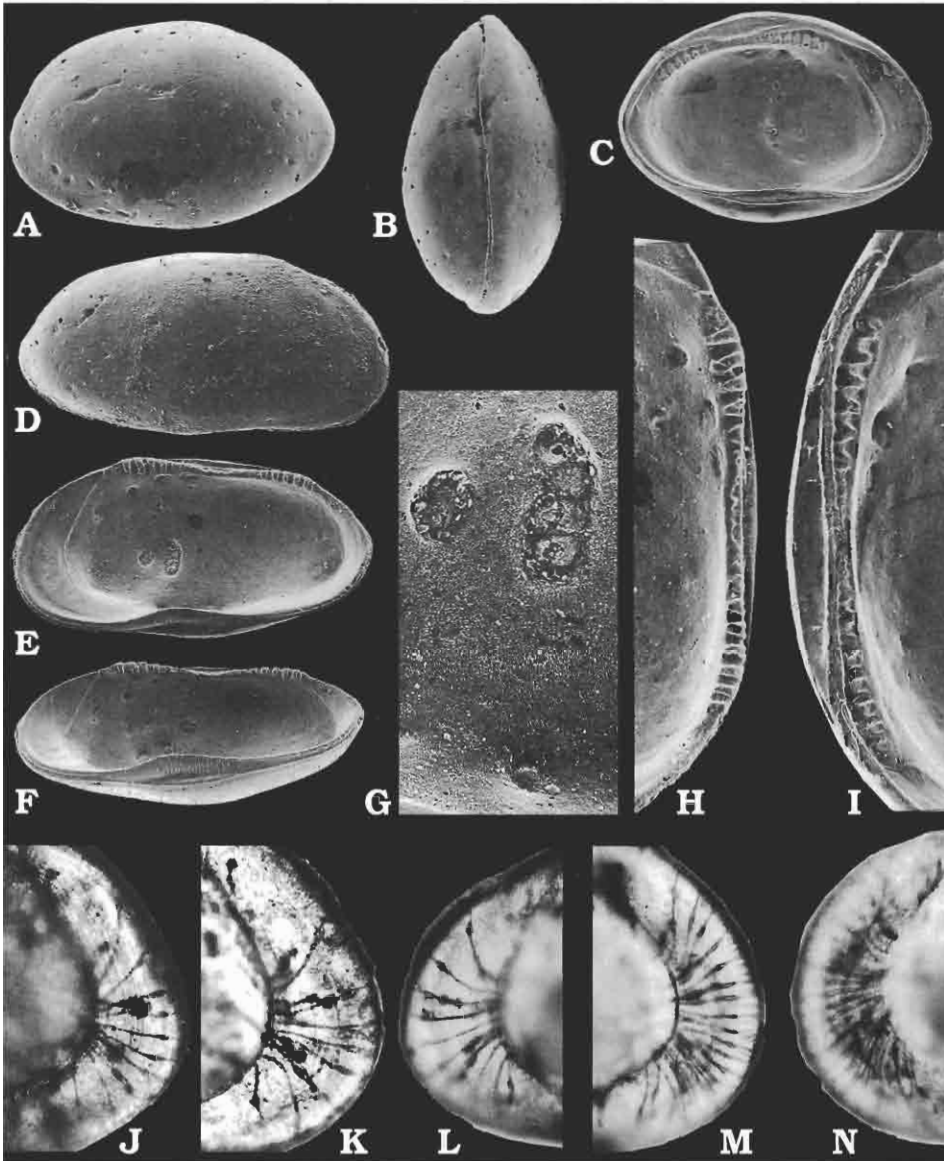


Fig. 3. A–N. *Schuleridea (Eoschuleridea) lukoviensis* sp. n. A. Holotype. Female LV in lateral view; ZPAL O.32/7; $\times 100$. B. Female carapace in ventral view; ZPAL O.32/8; $\times 100$. C. Female LV in internal view; ZPAL O.32/9; $\times 100$. D. Male RV in lateral view; ZPAL O.32/10; $\times 100$. E, F. Male LV in internal view; $\times 100$. G. Central muscle scars; $\times 500$. H. Hinge structure of RV; $\times 200$. E–H. ZPAL O.32/11. I. Hinge structure in LV; ZPAL O.32/9; $\times 200$. J–N. Anterior marginal pore canals in transmitted light. J. Female LV; ZPAL O.32/12. K. Male LV; ZPAL O.32/13. L. Male RV; ZPAL O.32/14. M. Female LV; ZPAL O.32/15. N. Male RV; ZPAL O.32/16. J–M $\times 155$.

Description. — Female carapace subovate in lateral outline, males more elongate and proportionally less high. Greatest length at mid-height. Greatest height at mid-length. Anterior margin broadly rounded in both dimorphs. Posterior margin narrowly rounded in left valves, more narrowly in right

valves. Dorsal margin gently convex in female carapaces, almost straight in males. Ventral margin slightly convex medianly in females and almost straight in males. Cardinal angles rounded. Lateral surface sparsely micropunctate. Larger left valve overlaps right valve all around. Inner lamella wide. Avestibulate. Hinge palaeomerodont. Left valve with six posterior, elongate terminal sockets and very short, finely locellate median groove. Accommodation groove well developed (Fig. 3I). Right valve with six anterior and seven posterior teeth connected by short, very finely denticulate ridge (Fig. 3H). Muscle scars a subvertical row of four small adductors, proportionally larger ovale frontal scar, poorly visible upper mandibular scar and small lower mandibular scar (Fig. 3G). Anterior marginal pore canals arranged in fan-like fashion at mid-height; 12 to 22 anteriorly (Fig. 3J–N), and four to nine posteriorly.

Remarks. — *Schuleridea* (*Eoschuleridea*) differs from *Schuleridea* (*Schuleridea*) in having a reduced number (18–30) of anterior marginal pore canals (Bate 1967). In the material from Łuków, there are adult forms (males and females) with seven to nine anterior marginal pore canals anteriorly (Fig. 3J–L) and three to four posteriorly and other forms with 20 to 22 anteriorly (Fig. 3M, N) and eight to nine posteriorly. Nevertheless, these forms correspond with each other in all other respects concerning dimensions and outline of their carapace.

S. (E.) lukoviensis is similar in lateral outline to *Praeschuleridea batei* Whatley, 1970 from the Callovian of Britain but differs in its micropunctate surface and hingement. The female specimens from Łuków are very similar in lateral outline to *Schuleridea* sp. 1 *sensu* Lutze (1960) from the middle Callovian of northwestern Germany (Lutze 1960).

Occurrence. — Late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Subfamily uncertain

Genus *Procytheridea* Peterson, 1954

Type species: *Procytheridea exempla* Peterson, 1954.

Remarks. — Neale (1982) summarised investigations of this genus and concluded that it may be placed in the tribe Procytherideini within the subfamily Schulerideinae. According to Lord (1972) species assigned to the genus belong to several different genera.

'*Procytheridea*' *gublerae* (Bizon, 1958)

Fig. 4A–I.

Progonocythere (?) *gublerae* Bizon, 1958: p. 28, pl. 4: 14–16.

Procytheridea gublerae (Bizon, 1958); Oertli 1959: p. 38, pl. 6: 172–177, pl. 7: 178–180.

Procytheridea gublerae Bizon, 1958; Dépeche 1985: pl. 32: 16–18.

Terquemula gublerae (Bizon, 1958); Rosenfeld *et al.* 1987: p. 261, pl. 6: 4.

Material. — Three valves.

Description. — Carapace subtriangular in lateral view. Greatest length at mid-height. Greatest height at mid-length. Anterior margin rounded. Posterior margin reduced and rounded triangular in shape. Dorsal margin convex. Ventral margin almost straight. Prominent eye node at anterior cardinal angle. Prominent ridge extends from eye node to anteroventral margin, subparallel to anterior margin. Lateral surface with three meandering subhorizontal ribs. Intercostal areas reticulate. Hinge antimerodont. Six anterior and seven posterior elongated teeth in right valve (Fig. 4H), locellate median groove of some width over entire length; well developed accommodation groove in left valve (Fig. 4E). Avestibulate. Inner lamella of moderate width. When well preserved, marginal fringe present along anterior, ventral and posteroventral margins in left valve (Fig. 4C). Marginal pore canals not visible. Muscle scars consist of subvertical row of four adductors, large frontal scar below line with top adductor; small upper mandibular scar below line of lower adductor and lower mandibular scar near ventral margin (Fig. 4D).

Remarks. — According to Rosenfeld *et al.* (1987), the three prominent, broad ribs of this species relate it to the genus *Terquemula* Błaszyk & Malz, 1965, they did not, however, discuss its internal structures.

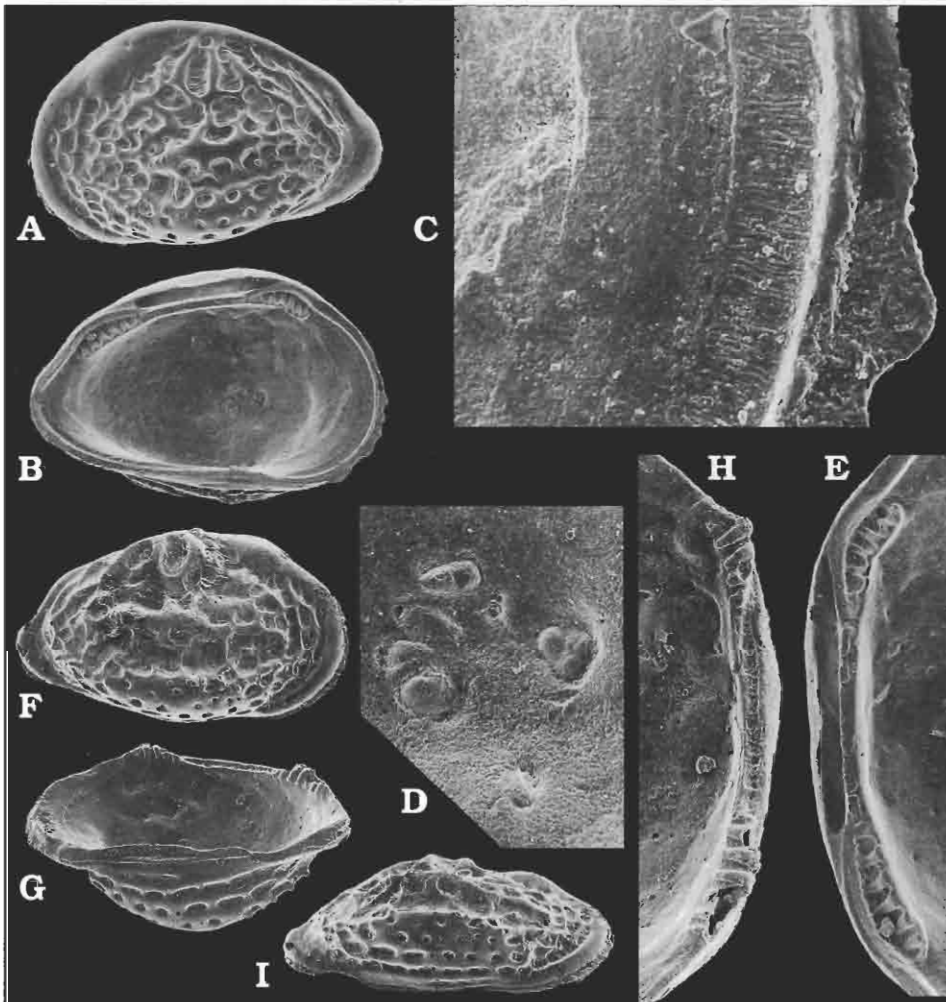


Fig. 4. A–I. '*Procytheridea*' *gublerae* (Bizon, 1958). A, B. LV in lateral and internal views; $\times 100$. C. Detail of marginal area; $\times 1000$. D. Central muscle scars; $\times 500$. E. Hinge structure of LV; $\times 200$. A–E. ZPAL O.32/17. F, G. RV in lateral and oblique internal views; $\times 100$. H. Hinge structure of RV; $\times 200$. F–H. ZPAL O.32/18. I. RV in oblique ventral view; ZPAL O.32/19; $\times 100$.

Occurrence. — Late Callovian and Oxfordian (*P. athleta* – *E. bimammatum* zones) of the Paris Basin, France; Callovian and early Oxfordian of Egypt; Oxfordian of Switzerland; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Family Protocytheridae Lubimova, 1955

Subfamily Pleurocytherinae Mandelstam, 1960

Genus *Pleurocythere* Triebel, 1951

Subgenus *Pleurocythere* (*Sabacythere*) Wienholz, 1967

Type species: *Pleurocythere* (*Sabacythere*) *arcuata* Wienholz, 1967.

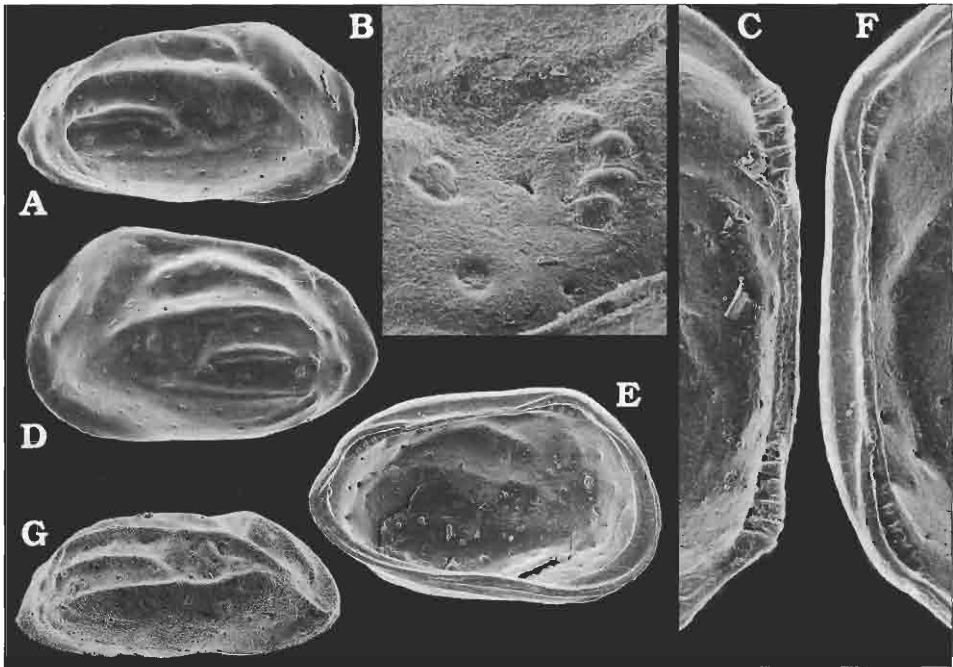


Fig. 5. A–G. *Pleurocythere (Sabacythere) arcuata* Wienholz, 1967. A. RV in lateral view; $\times 100$. B. Central muscle scars; $\times 500$. C. Hinge structure of RV; $\times 200$. A–C. ZPAL O.32/20. D, E. LV in lateral and internal views; $\times 100$. F. Hinge structure of LV; $\times 200$. D–F. ZPAL O.32/21. G. RV in oblique ventral view; ZPAL O.32/22; $\times 100$.

Pleurocythere (Sabacythere) arcuata Wienholz, 1967

Fig. 5A–G.

Pleurocythere (Sabacythere) arcuata Wienholz, 1967: p. 34, pl. 4: 42–44.

Pleurocythere (Sabacythere) arcuata Wienholz, 1967; Bodergat 1997: p. 220.

Material. — 18 valves.

Description. — Carapace subrectangular in lateral view. Greatest length almost at mid-height. Greatest height at anterior cardinal angle. Dorsal margin straight, slightly sloping downwards towards posterior. Ventral margin inclined to posterior, slightly concave medianly. Anterior margin broadly rounded, posterior margin reduced and rounded subtriangular in shape. Eye node ovate. Four longitudinal ribs extend across lateral surface. Median rib longest, reaching anteroventral part of margin. A short ridge extends from eye node almost to anteroventral margin. Intercostal areas smooth. Hinge antimerodont. Five anterior and six posterior, elongate, dorsally bifid terminal teeth in right valve, median groove finely locellate (Fig. 5C). Corresponding structures present in left valve (Fig. 5F). Inner lamella of moderate width. Avestibulate. Muscle scars consist of subvertical row of four ovate adductors, ovate frontal scar, small and round upper mandibular scar, and small lower mandibular scar near to ventral margin (Fig. 5B). Marginal pore canals not visible.

Remarks. — Specimens determined by Gerasimov *et al.* (1996) as *Pleurocythere rubra* (Mandelstam in Lubimova, 1955) from the Callovian of Central Russia are very similar to *P. (S.) arcuata*. The holotype of *P. rubra* illustrated by Lubimova (1955: pl. 8:6) differs in its somewhat different pattern of ribs on the lateral surface, the lower rib in *P. (S.) arcuata* joins the dorsal rib and extends almost to the anterior margin.

Occurrence. — Late Callovian (*P. athleta* – *Q. lamberti* zones) of northwestern Germany and France; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

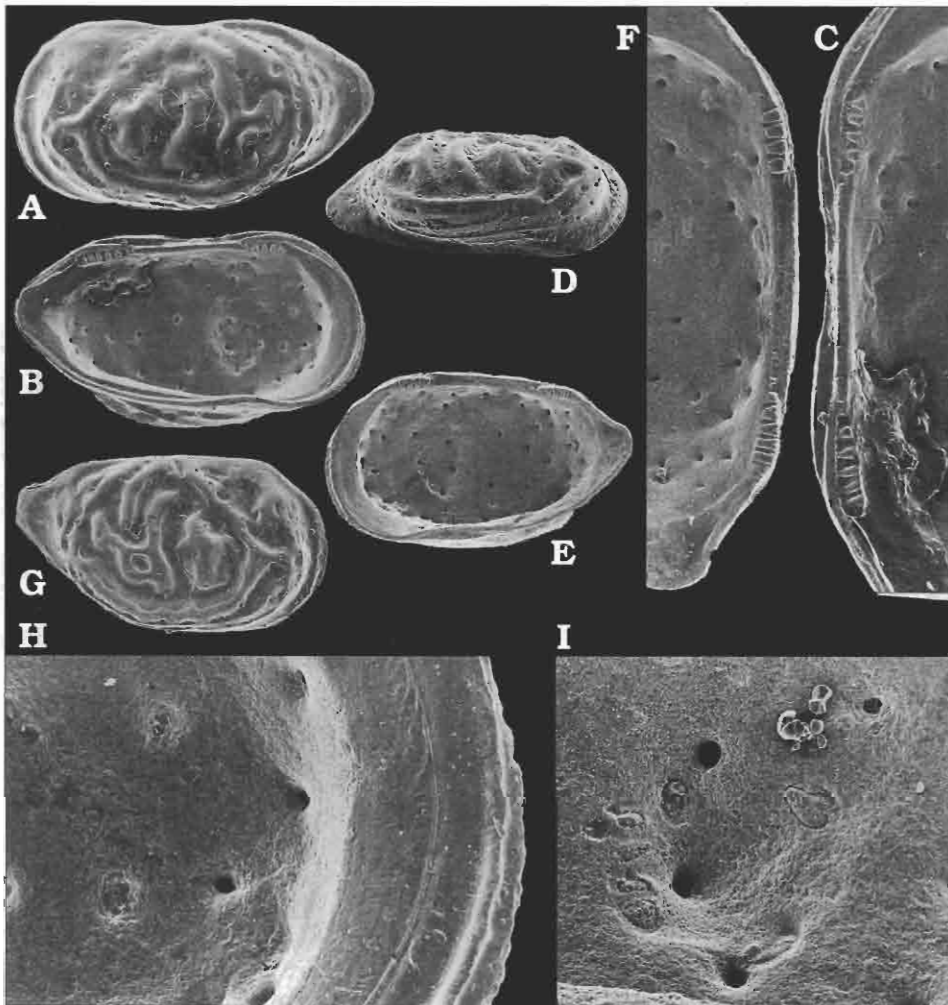


Fig. 6. A–I. *Pseudohutsonia hebridica* Whatley, 1970. A, B. Male LV in lateral and internal views; $\times 100$. C. Hinge structure of LV; $\times 200$. A–C. H. ZPAL O.32/23. D. Female RV in oblique ventral view; ZPAL O.32/24; $\times 100$. E, F. RV in internal view; $\times 100$ and hinge structure; $\times 200$; ZPAL O.32/25. G. Female RV in lateral view; ZPAL O.32/26; $\times 100$. H. Detail of marginal area of B; $\times 500$. I. Central muscle scars of LV; ZPAL O.32/27; $\times 500$.

Subfamily Kirtonellinae Bate, 1963

Genus *Pseudohutsonia* Wienholz, 1967

Type species: *Pseudohutsonia tuberosa* Wienholz, 1967.

Remarks. — According to Whatley (1970), and the present authors, *Balowella* Wienholz, 1967 is a junior synonym of *Pseudohutsonia*. However Brand (1990) regards it as a distinct genus.

Pseudohutsonia hebridica Whatley, 1970

Fig. 6A–I.

Ostracode Nr. 12. Lutze 1960: p. 435, pl. 38: 9.

Pseudohudsonia hebridica Whatley, 1970: p. 349, pl. 15: 5–10, 12–14, 16, 18.

Balowella attendens (Lubimova, 1955); Wienholz 1967: p. 37, pl. 4: 49–50, pl. 5: 53–56.
Pseudohudsonia hebridica Whatley, 1970; Kileny 1978: p. 288, pl. 13: 9, 10.
 non *Protocythere attendens* Lubimova, 1955: p. 74, pl. 9: 2.

Material. — 17 valves.

Description. — Carapace subrectangular in lateral outline. Dorsal margin straight in right valve, slightly concave in left valve. Ventral margin almost straight and overhung by ventrolateral ridge. Greatest length above mid-height. Greatest height at mid-length. Anterior margin broadly rounded, posterior margin rounded subtriangular with apex above mid-height, marginal zones compressed. Left valve larger than right valve. Lateral surface with series of ribs radiating from just below dorsal margin. A strong smooth rib extends ventrally from anterior cardinal angle, curving posteriorly and extending over ventrolateral surface. Large median tubercle occurs between ribs. Four ribs subparallel to ventral margin occur between main rib and ventral margin. Eye node indistinct. Hinge antimerodont. Five anterior and seven posterior terminal teeth in right valve, median groove finely locellate (Fig. 6F). Corresponding structures present in left valve (Fig. 6C). Avestibulate. Inner lamella of moderate width, narrowest posteriorly (Fig. 6H). Muscle scar pattern consists of vertical row of four adductors, elongate frontal scar slightly above line of top adductor, elongate mandibular scar below line of lower adductor (Fig. 6I). Five anterior and three posterior straight marginal pore canal present. Males more elongate than females.

Remarks. — This species is very similar to *Pseudohudsonia attendens* (Lubimova, 1955) but differs in its better defined ribs. Specimens described by Wienholz (1967) as *Balowella attendens* are in the opinion of the present writers conspecific with *P. hebridica*. Specimens designated by Gerasimov *et al.* (1996) as *Balowella attendens* from the Callovian of Central Russia, possess clearly developed ribs, but differ from *P. hebridica* in their different rib pattern, and intercostal reticulation.

Occurrence. — Late Callovian and early Oxfordian (*Q. lamberti* – *C. cordatum* zones) of Scotland and northwestern Germany; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Family Progonocytheridae Sylvester-Bradley, 1948

Remarks. — Whatley & Ballent (1996) partly revised this family, which according to them comprises only genera with entomodont/lobodont hinges. Accordingly the family should be divided into the Progonocytherinae, comprising subovate to subtriangular genera with a convex dorsal margin and more or less ventro-lateral tumidity, and another subfamily (not yet named) which will embrace subrectangular to subquadrate genera, with entomodont hinge, and ovate, crescentric or heart shaped frontal scars and straight marginal pore canals.

Subfamily Progonocytherinae Sylvester-Bradley, 1948

Genus *Progonocythere* Sylvester-Bradley, 1948

Type species: *Progonocythere stilla* Sylvester-Bradley, 1948.

Progonocythere callovica Wienholz, 1967

Fig. 7A–G.

Progonocythere callovica Wienholz, 1967: p. 24, pl. 1: 1–4.

Progonocythere callovica Wienholz, 1967; Whatley & Ballent 1996: p. 926

Progonocythere callovica Wienholz, 1967; Bodergat 1997: p. 220.

Material. — 60 valves and one carapace.

Description. — Subrectangular in lateral view. Left valve larger than right. Greatest length slightly above mid-height. Greatest height at anterior cardinal angle. Anterior margin broadly rounded with narrow compressed marginal zone. Posterior margin rounded triangular in shape. Dorsal margin straight. Cardinal angles rounded. Ventral margin medianly concave and overhung by ventrolateral swelling. Ventral surface with narrow ventrolateral rib developed in posteroventral and ventral parts, with two less distinct ribs close to and subparallel to ventral margin (Fig. 7F). Eye node poorly developed. Lateral surface weakly pitted.

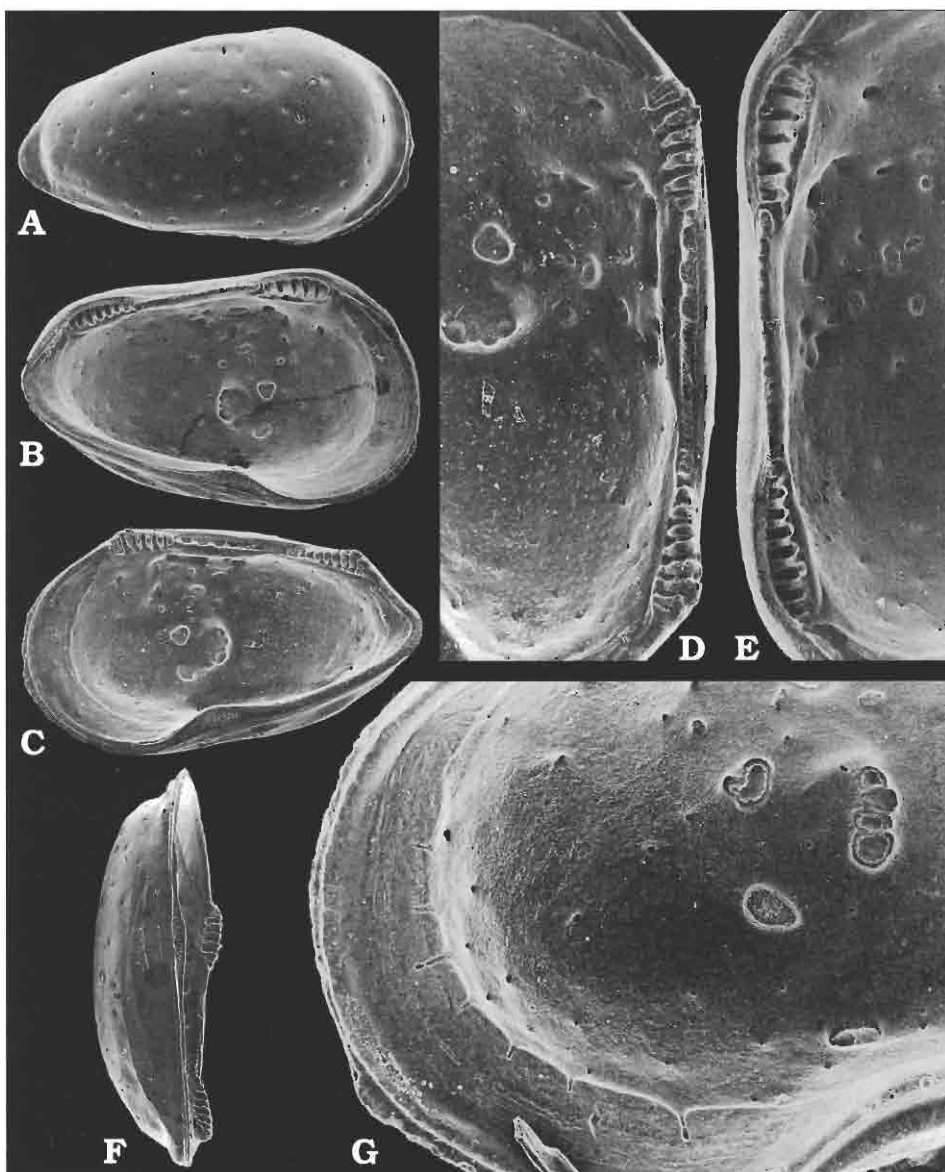


Fig. 7. A–G. *Progonocythere callovica* Wienholz, 1967. A. RV in lateral view; ZPAL O.32/28; $\times 100$. B. LV in internal view; ZPAL O.32/29; $\times 100$. C. RV in internal view; ZPAL O.32/30; $\times 100$. D. Hinge structure of C; $\times 200$. E. Hinge structure of B; $\times 200$. F. RV in ventral view; ZPAL O.32/31; $\times 100$. G. Anterior end and muscle scars of RV; ZPAL O.32/32; $\times 300$.

Hinge entomodont. Seven anterior and seven to eight posterior terminal teeth in right valve, median element with five to six distinct loculi in anteromedian part and narrow posterior groove with seven to eight paired locellae (Fig. 7C, D). Left hinge with anterior and posterior loculate sockets, median bar with anterior part dentate and posterior denticulate (Fig. 7B, E). Avestibulate. Inner lamella of moderate width, narrowest posteriorly. Central muscle scars consist of subvertical row of four adductors, heart shape frontal scar, elongate-oval upper mandibular scar and elongate lower

mandibular scar (Fig. 7G). Six to seven straight marginal pore canals anteriorly and three posteriorly. Sexual dimorphism indistinct.

Remarks. — This species is very similar in its lateral outline to *Progonocythere polonica* Błaszyk, 1959 from the Bathonian of Central Poland, but differs in weaker ornament.

Occurrence. — Late Callovian (*P. athleta* Zone) of northwestern Germany; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Subfamily Neurocytherinae Gründel, 1975

Remarks. — Whatley (1970) placed species of the 'cruciata-group' in the subgenus *Lophocythere* (*Neurocythere*), which Malz (1975) regarded as a junior synonym of *Terquemula* Błaszyk & Malz, 1965. For species of the 'cruciata-group' Malz (1975) created a new genus *Crucicythere*. Ware & Whatley (1980) regarded *Neurocythere* as a genus separate from *Terquemula*. For 'cruciate' and 'flexicostate' species of *Neurocythere*, Gründel (1975) created a new subgenus *Nophrecythere*. This taxon has subsequently been elevated to generic rank by Kilenyi (1978). *Nophrecythere* has the priority by three months over *Crucicythere*.

Genus *Nophrecythere* Gründel, 1975

Type species: *Lophocythere cruciata* Triebel, 1951.

Remarks. — In the present authors opinion the differences between the stratigraphical subspecies of *Nophrecythere cruciata*, especially *N. cruciata cruciata* – *N. cruciata triebeli* and *N. cruciata cruciata* – *N. cruciata intermedia* are sufficient to recognize them as separate species.

Nophrecythere triebeli (Lutze, 1960)

Fig. 8A–I.

Lophocythere cruciata triebeli Lutze, 1960: p. 424, pl. 35:1–4, 6.

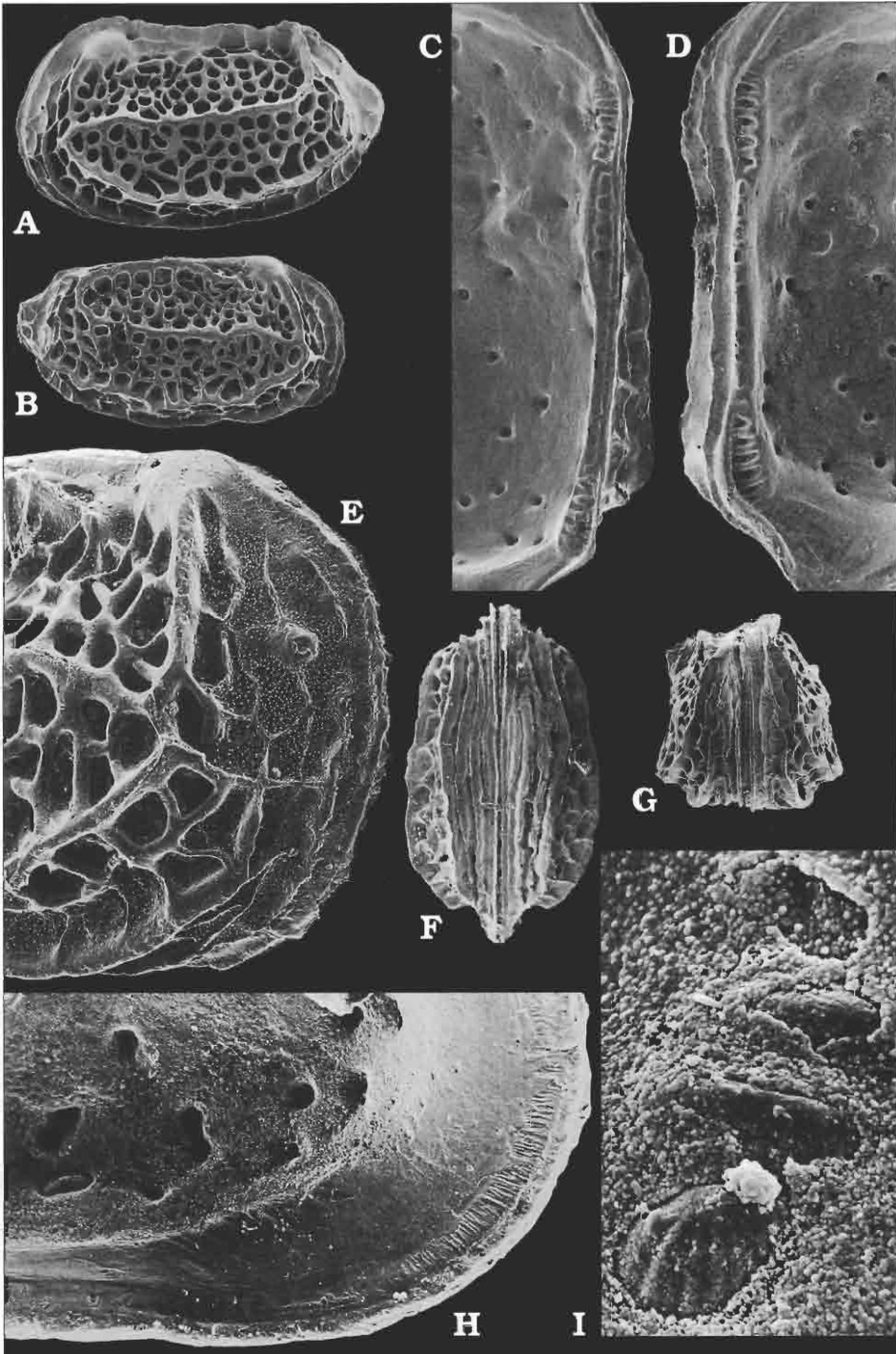
Lophocythere cruciata triebeli Lutze, 1960; Wienholz 1967: pl. 5: 61.

Material. — 110 valves and six carapaces.

Description. — Carapace subrectangular in lateral outline. Left valve larger than right. Anterior margin rounded; posterior margin rounded triangular with apex above mid-height. Dorsal margin straight. Ventral margin convex. Greatest length at mid-height. Greatest height at anterior cardinal corner. Eye node well developed. Ornamentation consists of smooth ribs with intercostal reticulation. Dorsal rib starts near anterior cardinal corner, extends posteriorly then turns downwards to join median rib. Median rib extends to anterior end and joins anterior and ventrolateral ribs. Short anterior rib extends from eye node and joins median rib at mid-height. Ventrolateral rib extending to posteroventral part. Ventral rib extends from anteroventral to posteroventral part. Complex of thin anastomosing ribs occurs anteromedianly. Muscle scars can be seen to interfere with pattern of reticulation. Avestibulate. Inner lamella of moderate width. Marginal fringe present along anterior, anteroventral and posteroventral margins in left valve (Fig. 8H). Central muscle scars consist of row of four adductors (Fig. 8I), oval frontal scar, elongate upper mandibular scar, and elongate lower mandibular scar situated near ventral margin. Hinge entomodont. Six anterior and six to seven posterior terminal teeth in right valve, teeth dorsally bifid; loculate median groove expanded anteriorly with thickened lower lip; posterior locellae in median groove are paired (Fig. 8C). Corresponding structures present in left valve (Fig. 8D). Seven straight anterior marginal pore canals and three posterior present. Sexual dimorphism distinct, males more elongate than females.

Remarks. — This species differs from other species of the 'cruciata' group in its different rib pattern especially in the anterior part of the carapace. *N. cruciata cruciata* illustrated by Brand & Fahrion (1962, pl. 21: 29) from the Callovian of NW Germany and that illustrated by Wienholz (1967) are

Fig. 8. A–I. *Nophrecythere triebeli* (Lutze, 1960). A. LV in lateral view; ZPAL O.32/33; × 100. B. RV in lateral view; ZPAL O.32/34; × 100. C. Hinge structure of B; × 200. D. Hinge structure of LV; ZPAL O.32/35; × 200. E. Anterior end of RV; ZPAL O.32/36; × 300. F. Carapace in ventral view; ZPAL O.32/37; × 100.



G. Carapace in anterior view; ZPAL O.32/38; $\times 100$. **H.** Anterior part of LV showing lower mandibular scar and fringed marginal area; ZPAL O.32/39; $\times 400$. **I.** Adductor muscle scars of B; ZPAL O.32/34; $\times 2000$.

similar to *N. triebeli* but differ in the presence of two small ribs reaching the anterior margin. *N. cruciata cruciata* (Triebel, 1951) from the early Callovian of Germany, illustrated by Malz (1975) is similar to *N. triebeli* in the absence of the short anterior ribs. *N. cruciata triebeli* from the early Oxfordian of Poland, illustrated by Bielecka *et al.* (1980, 1988) is very poorly preserved with the rib pattern not discernable.

Occurrence. — Late Callovian (*Q. lamberti* Zone) of northwestern Germany; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Nophrecythere intermedia (Lutze, 1960)

Fig. 9A–H.

Lophocythere cruciata intermedia Lutze, 1960: p. 423, pl. 34: 5, 6.

Lophocythere (Neurocythere) cruciata intermedia Lutze, 1960; Whatley 1970: p. 338, pl. 10: 6, 7, 9–21, pl. 11: 1, 4.

Nophrecythere cruciata intermedia (Lutze, 1960); Kilenyi 1978: pl. 11: 9–12.

Lophocythere cruciata intermedia Lutze, 1960; Herngreen *et al.* 1984: pl. 3: 1–5.

Nophrecythere cruciata (Triebel, 1951); Dépeche 1985: pl. 32: 20.

Lophocythere cruciata intermedia Lutze, 1960; Bielecka *et al.* 1980: p. 234, pl. 67: 1.

Lophocythere cruciata intermedia Lutze, 1960; Bielecka *et al.* 1988: p. 171, pl. 67: 1.

Material. — 70 valves and two carapaces.

Description. — Carapace subrectangular in lateral view, highest at anterior cardinal angle. Left valve slightly larger than right valve. Greatest length near mid-height, greatest height at anterior cardinal angle. Anterior margin broadly and obliquely rounded, posterior margin protruded posteriorly. Dorsal margin concave in left valve with moderately raised anterior cardinal angle, straight in right valve. Ventral margin sinuous to slightly convex in left valve, sinuous in right valve. Anterior margin obliquely rounded; posterior margin angular/subtriangular. Prominent ovate eye node at anterior cardinal angle. Hinge ears in left valve well developed. A prominent dorsal rib starts near eye node, extends subparallel to dorsal margin, turns to posterior end and then downwards to join median rib. Median rib reaches anterior margin. In anterior part of carapace, short rib starts at eye node, extends subparallel to anterior margin and joins median and ventrolateral ribs at mid-height. Close to ventral margin, but below ventrolateral rib, three ventral ribs occur. One of these ribs reaches anterior margin. Two vertical ribs connect dorsal and median ribs posterodorsally (Fig. 9G). Surface between ribs with moderately large, deep, cellate fossae. Avestibulate. Inner lamella of moderate width. Marginal fringe present along anterior, anteroventral and posteroventral margins of left valve (Fig. 9F). Hinge entomodont. Six anterior and seven posterior terminal teeth in right valve, loculate median groove anteriorly expanded with thickened lower lip, posterior locellae in median groove are paired (Fig. 9C). Corresponding structures present in left valve (Fig. 9D). Central muscle scars consist of four elongate adductors in a vertical row, ovate frontal scar, elongate upper and lower mandibular scars (Fig. 9C, H). Six to seven straight marginal pore canals are present in anterior part and three in posterior. Dimorphism not clear.

Remarks. — In the early evolutionary form of *N. intermedia* from the middle Callovian, the vertical ridges are poorly developed. However, in the anterior part of the carapace the median and ventral rib reach the margin as in later forms. Specimens from the late Callovian of Łuków have better developed vertical ribs than those in *N. intermedia* from the middle Callovian of northwestern Germany (Lutze 1960). *N. catephracta* (Mandelstam in Lubimova 1955) from the Callovian of the Middle Volga and Syrt area (Lubimova 1955) and Central Russia (Gerasimov *et al.* 1996: pl. 5: 1–4) also differs from late evolutionary forms of *N. intermedia* in having poorly developed vertical ribs. *N. catephracta* is more similar to *N. cruciata* and is very similar to *N. cruciata intermedia*, as illustrated by Herngreen *et al.* (1984: pl. 3: 1–5) from the middle Callovian of the eastern Netherlands. *N. cruciata intermedia* illustrated from the Callovian of Westfalen (Kaefer *et al.* 1978, p. 63, pl. 9: 5) also differs in having poorly developed vertical ribs dorsally. Specimens of *N. intermedia* from Łuków are very similar to those from the *Q. lamberti* Zone of Scotland (Whatley 1970, Kilenyi

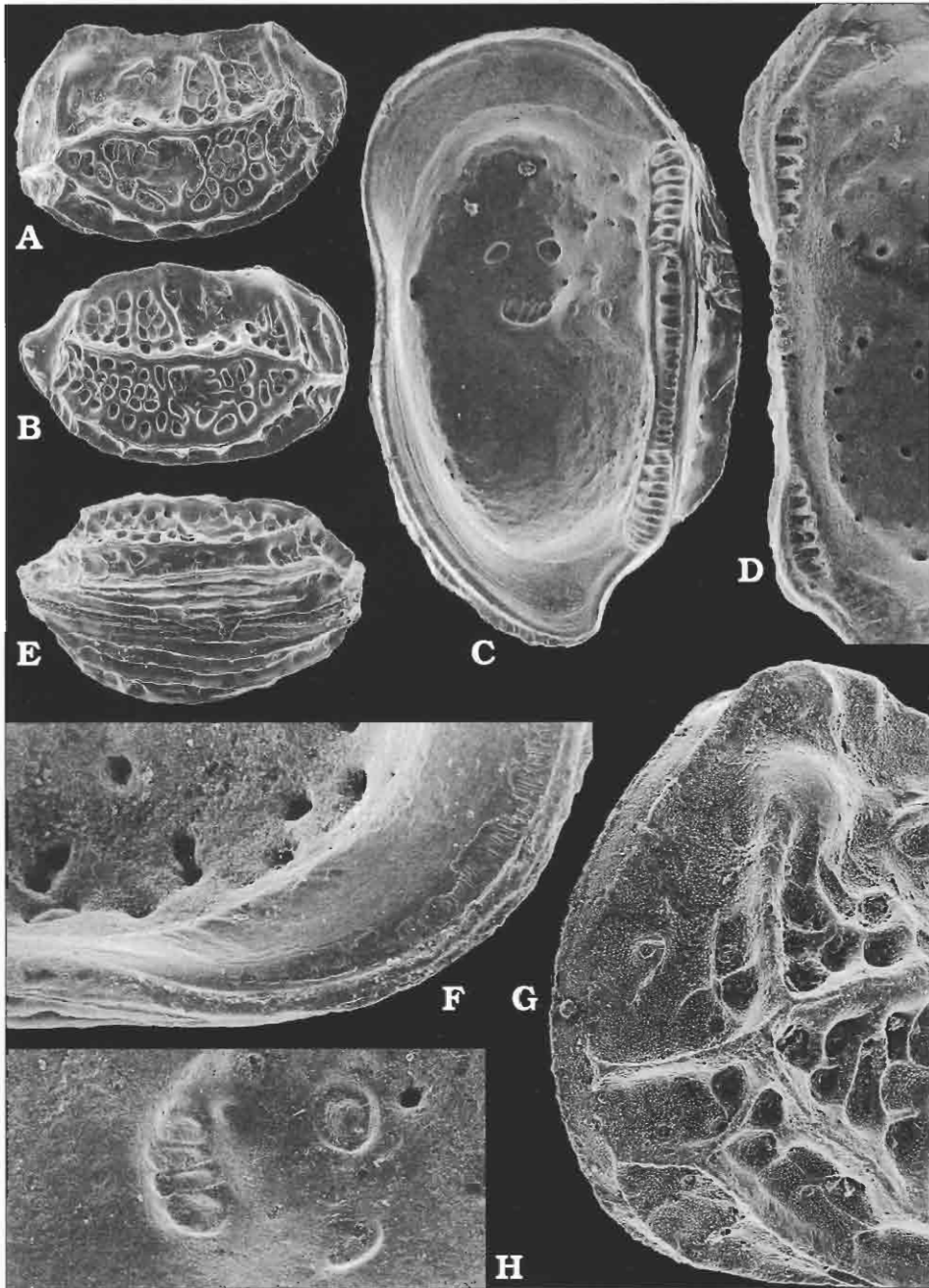


Fig. 9. **A–H.** *Nophrecythere intermedia* (Lutze, 1960). **A.** LV in lateral view; ZPAL O.32/35; $\times 100$. **B.** RV in lateral view; ZPAL O.32/36; $\times 100$. **C.** RV in internal view; ZPAL O.32/36; $\times 200$. **D.** Hinge structure of LV; ZPAL O.32/37; $\times 200$. **E.** Carapace in oblique ventral view; ZPAL O.32/38; $\times 100$. **F.** Anterior end of LV showing lower mandibular scar and fringed marginal area; ZPAL O.32/39; $\times 400$. **G.** Anterior part of LV in lateral view; ZPAL O.32/40; $\times 300$. **H.** Central muscle scars; ZPAL O.32/35; $\times 500$.

1978). In *N. cruciata franconica* (Triebel, 1951) from the *K. jason* Zone of Germany, one vertical rib in the posterodorsal part is also visible (Triebel 1951: pl. 49: 58).

Occurrence. — Middle and late Callovian of northwestern Germany; middle Callovian of the eastern Netherlands; middle and late Callovian and early Oxfordian (*E. coronatum* – *C. cordatum* zones) of Scotland and England; late Callovian of the Paris Basin, France; late Callovian of northwestern Poland and late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Genus *Lophocythere* Sylvester-Bradley, 1948

Type species: *Cytheridea ostreata* Jones & Sherborn, 1888.

Lophocythere karpinskyi (Mandelstam in Lubimova, 1955)

Fig. 10A–G.

Protocythere karpinskyi Mandelstam in Lubimova, 1955: p. 71, pl. 8: 5.

Lophocythere scabra bucki Lutze, 1960: p. 430, pl. 37: 1, 2.

Lophocythere scabra bucki Lutze, 1960; Brand & Fahrion 1962: p. 148, pl. 21: 33.

Lophocythere scabra bucki Lutze, 1960; Malz 1962: p. 240, pl. 24: 6c.

Lophocythere scabra bucki Lutze, 1960; Klingler *et al.* 1962: p. 185, pl. 25: 3.

Lophocythere (Lophocythere) scabra bucki Lutze, 1960; Whatley 1970: p. 334, pl. 8: 15–24, pl. 9: 1, 5.

Lophocythere karpinskyi (Mandelstam in Lubimova, 1955); Malz 1975: p. 130, pl. 1: 4, pl. 2: 9, pl. 3: 14–16, pl. 5: 36.

? *Lophocythere scabra bucki* Lutze, 1960; Kaefer *et al.* 1978: p. 62, pl. 9: 4.

Lophocythere scabra bucki Lutze, 1960; Kilenyi 1978: p. 282, pl. 10: 8–11.

Lophocythere karpinskyi Mandelstam in Lubimova, 1955; Hergreen *et al.* 1984: pl. 3: 10.

Lophocythere karpinskyi (Mandelstam, 1955); Bielecka *et al.* 1980: p. 235, pl. 67: 4.

Lophocythere karpinskyi (Mandelstam, 1955); Bielecka *et al.* 1988: p. 171, pl. 67: 4.

Lophocythere karpinskyi (Mandelstam in Lubimova, 1955); Schudack 1994: p. 104, pl. 17: 7, 8.

Lophocythere karpinskyi (Mandelstam, 1949); Gerasimov *et al.* 1996: pl. 5: 9–12.

Lophocythere scabra bucki Lutze, 1960; Bodergat 1997: p. 220.

Material. — 38 valves and three carapaces.

Description. — Carapace subrectangular in lateral view. Male valves being longer and proportionally less high than females. Anterior margin rounded with small tubercles subparallel to margin, posterior margin pointed slightly above mid-height with subparallel small spines. Dorsal margin almost straight. Left valve larger than right. Lateral surface with vertical rows of different kinds of spines and tubercles. Large spine occurs near dorsal margin slightly behind mid-length. Lateroventrally five spatulate tubercles occur. Prominent eye node at anterior cardinal corner. A short rib extends from eye node to mid-height. Avestibulate. Inner lamella of moderate width. Hinge entomodont. Five anterior and six posterior terminal teeth in right valve, loculate median groove anteriorly expanded with thickened lower lip, posterior locellae in median groove are paired (Fig. 10C). Corresponding structures are present in left valve (Fig. 10D). Central muscle scars consist of four adductors in vertical row, ovate frontal scar and elongate upper and lower mandibular scars. Five to six straight anterior marginal pore canals and three posterior.

Remarks. — This species differs from *L. scabra* Triebel, 1951 in possessing a row of spatulate tubercles ventro-laterally instead of a rib. *L. scabra bucki* Lutze, 1960 described from the Callovian and Oxfordian of Westfalen (Kaefer *et al.* 1978: pl. 9: 4), differs from the species in different ornamentation and probably represents a different species.

Occurrence. — Callovian to early Oxfordian (*M. macrocephalus* – *C. cordatum* zones) of Europe; Middle Callovian – early Oxfordian (*E. coronatum* – *C. cordatum* zones) of England and Scotland; Middle Callovian of the eastern Netherlands; Middle Callovian – early Oxfordian of Germany; late Callovian of the Paris Basin, France; early and Middle Callovian – early Oxfordian of the Middle Volga and Syrt area and late Callovian of Central Russia; late Callovian – early Oxfordian of northwestern Poland and late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

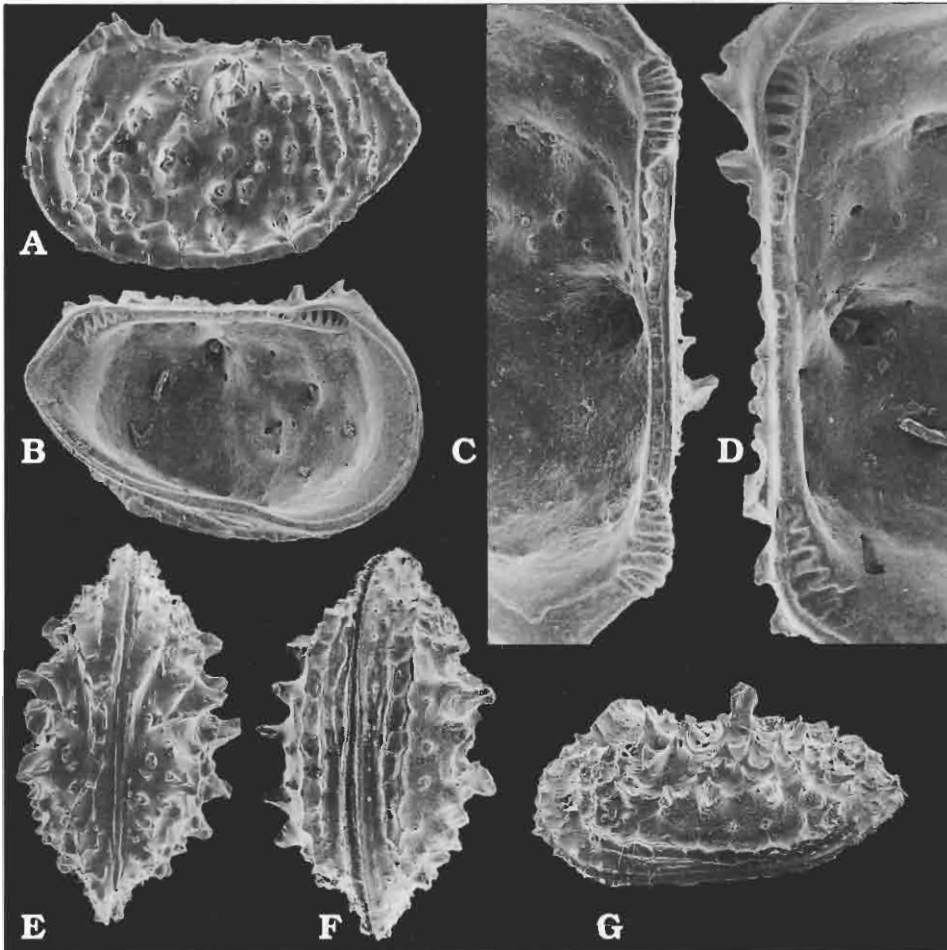


Fig. 10. A–G. *Lophocythere karpinskyi* (Mandelstam in Lubimova, 1955). A, B. LV in lateral and internal view; ZPAL O.32/41; $\times 100$. C. Hinge structure of RV; ZPAL O.32/42; $\times 200$. D. Hinge structure of B; $\times 200$. E, F. Carapace in dorsal and ventral views; ZPAL O.32/43; $\times 100$. G. LV in oblique lateroventral view; ZPAL O.32/44; $\times 100$.

Genus *Terquemula* Blaszyk & Malz, 1965

Type species: *Terquemula parallela* Blaszyk, 1965.

***Terquemula lutzei* (Whatley, 1970)**

Fig. 11A–E.

Lophocythere flexicosta n. subsp. A. Lutze, 1960: p. 428, pl. 36: 2, 3.

Lophocythere flexicosta subsp. A. Lutze, 1960; Oertli 1963: pl. 34: 1, 2; pl. 35: 1.

Lophocythere (Neurocythere) flexicosta lutzei Whatley, 1970: p. 341, pl. 12: 1–12.

Terquemula flexicosta lutzei (Whatley, 1970); Kilenyi 1978: p. 286, pl. 12: 1–4.

Terquemula flexicosta lutzei (Whatley, 1970); Dépeche 1985: pl. 32: 19.

Terquemula flexicosta lutzei (Whatley, 1970); Bodergat 1997: p. 220.

Material. — Six valves.

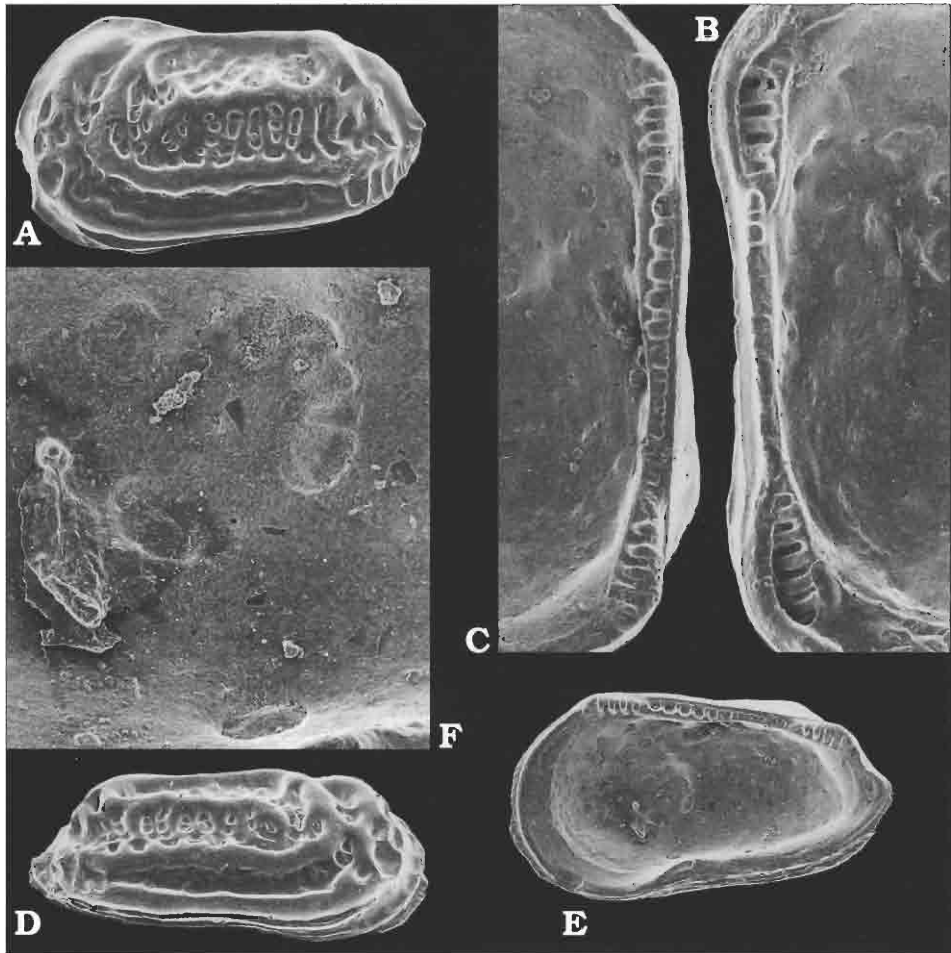


Fig. 11. A–E. *Terquemula lutzei* (Whatley, 1970). A, B. LV in lateral view and details of hinge structure in internal view; ZPAL O.32/45; A $\times 100$, B $\times 200$. C. Hinge structure of RV; $\times 200$. D. RV in oblique ventral view; $\times 100$. E. RV in internal view; $\times 100$. F. Central muscle scars; $\times 500$. C–F. ZPAL O.32/46.

Description. — Carapace elongate, surectangular in lateral view. Greatest length at mid-height, greatest height at anterior cardinal angle. Anterior margin broadly rounded, posterior margin smaller, rounded triangular. Dorsal margin almost straight, ventral margin slightly concave medially. Left valve larger than right. Lateral surface with four broad, smooth rounded longitudinal ribs. Dorsal and lateroventral ribs connected in anterior part of valve. One subvertical rib subparallel to anterior margin, connected with dorsolateral and ventrolateral ribs below mid-height. Intercostal area strongly reticulate. Hinge entomodont. Four anterior and six posterior teeth in right valve, loculate median groove anteriorly expanded with thickened lower lip, posterior locellae in median groove are paired (Fig. 11C). Corresponding structures in left valve (Fig. 11B). Avestibulate. Inner lamella moderately wide. Seven straight marginal pore canals anteriorly and three posteriorly. Central muscle scars consist of four adductors in a subvertical row, oval frontal scar and obliquely elongate upper mandibular scar and small elongate lower mandibular scar situated near ventral margin at line of adductors (Fig. 11F).

Remarks. — *Lophocythere flexicosta* subsp. A Lutze, 1960, illustrated by Brand & Fahrion (1962: pl. 21: 41) from the Callovian (*P. athleta* Zone) of northern Germany and that illustrated by Wienholz

(1967) from the *P. athleta* Zone of Germany, differ from specimens from Łuków and those illustrated by Whatley (1970) and Kilenyi (1978) by their more strongly developed, not rounded crests.

Occurrence. — Middle and late Callovian (*E. coronatum* – *Q. lamberti* zones) of northwestern Germany; Middle and late Callovian of England (*P. athleta* – *Q. lamberti* zones) and Scotland (*E. coronatum* Zone); Callovian of the Paris Basin, France; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Genus *Fuhrbergiella* Brand & Malz, 1962

Subgenus *Fuhrbergiella* (*Praefuhrbergiella*) Brand & Malz, 1962

Type species: *Fuhrbergiella* (*Praefuhrbergiella*) *horrida* Brand & Malz, 1962.

Fuhrbergiella (*Praefuhrbergiella*) *archangelskyi* (Mandelstam in Lubimova, 1955)

Fig. 12A–F.

Palaecocytheridea archangelskyi Mandelstam in Lubimova, 1955: p. 39, pl. 4: 1.

Fuhrbergiella archangelskyi (Mandelstam in Lubimova, 1955); Gerasimov *et al.* 1996: pl. 4: 5–8.

Material. — 11 valves and three carapaces.

Description.— Carapace elongate, subrectangular in lateral view. Left valve larger than right. Greatest length at mid-height. Greatest height at anterior cardinal corner. Anterior margin broadly rounded with small spines. Posterior margin smaller, rounded triangular in shape with narrow compressed marginal zone. Dorsal and ventral margins almost straight. Shallow oblique mid-dorsal depression. Prominent eye node. Lateral surface reticulate with conjunctive spines. Hinge weakly entomodont. Five anterior and seven posterior teeth in right valve. Loculate median groove slightly expanded in anterior part, posterior locellae in median groove are paired (Fig. 12E). Corresponding structures in left valve. Avestibulate. Inner lamella of moderate width. Seven anterior marginal pore canals, three posteriorly. Central muscle scars consist of a vertical row of four adductors; rounded triangulate frontal scar slightly above level of top adductor, large almost circular upper mandibular scar situated in front of and below level of basal adductor, and small elongate lower mandibular scar near ventral margin in line with adductors (Fig. 12F).

Remarks. — *Fuhrbergiella* (*Praefuhrbergiella*) *horrida horrida* Brand & Malz, 1962 described and illustrated by Whatley (1970) from from *M. macrocephalus* – *C. cordatum* Zones of England and Scotland and *F.(P.) horrida horrida* illustrated by Witte & Lissenberg (1994) from the Callovian of Central North Sea Graben are very similar to *F. (P.) archangelskyi* and possibly they are conspecific. Originally, *F. (P.) horrida horrida* was described from the middle Bajocian of northwestern Germany (Brand & Malz 1962) and differs from *F. (P.) archangelskyi* in its larger eye node and in lack of anterior and posterodorsal crests.

Occurrence. — Middle and late Callovian, early Oxfordian of the Middle Volga and Syrt area, Russia; late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Family Bythocytheridae Sars, 1926

Genus *Bythoceratina* Hornibrook, 1952

Subgenus *Bythoceratina* (*Praebythoceratina*) Gründel & Kozur, 1971

Type species: *Monoceratina gracilis* Kozur, 1968.

Bythoceratina (*Praebythoceratina*) *scrobiculata* (Triebel & Bartenstein, 1938)

Fig. 13A–D.

Monoceratina scrobiculata Triebel & Bartenstein, 1938: p. 508, pl. 1: 4a,b; pl. 2: 6.

Bythocythere calloveica Mandelstam in Lubimova, 1955: p. 30, pl. 1: 10.

Monoceratina scrobiculata Triebel & Bartenstein, 1938; Oertli 1959: p. 26, pl. 4: 92–95.

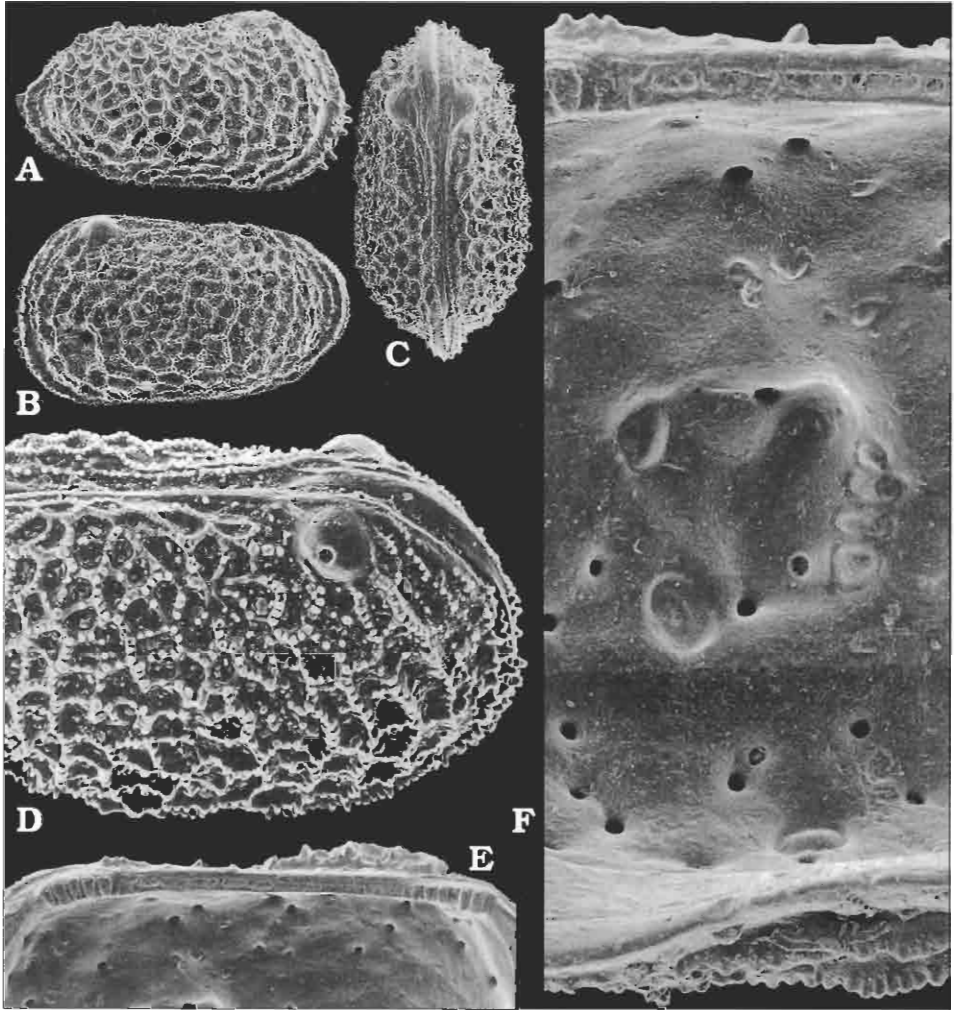


Fig. 12. A–F. *Fuhrbergiella* (*Praefuhrbergiella*) *archangelskyi* (Mandelstam in Lubimova, 1955). A. Carapace in right lateral view; ZPAL O.32/47; $\times 100$. B. LV in lateral view; ZPAL O.32/48; $\times 100$. C, D. Carapace in dorsal and anterior oblique views; ZPAL O.32/49; C $\times 100$, D $\times 200$. E, F. RV in internal view, detail of hinge structure and muscle scars; ZPAL O.32/50; E $\times 200$, F $\times 500$.

Monoceratina cf. *scrobiculata* Triebel & Bartenstein, 1938; Lutze 1960: p.433, pl. 37: 7.

Monoceratina scrobiculata Triebel & Bartenstein, 1938; Fischer 1962: p. 335, pl. 19: 10–12.

Monoceratina scrobiculata Triebel & Bartenstein, 1938; Whatley 1970: p. 318, pl. 3: 2, 5, 6, 10.

Bythoceratina (*Praebythoceratina*) *scrobiculata* (Triebel & Bartenstein, 1938); Gründel & Kozur 1971: p. 924.

Monoceratina cf. *scrobiculata* Triebel & Bartenstein, 1938; Kaefer *et al.* 1978: p. 51, pl. 6: 9.

Monoceratina scrobiculata Triebel & Bartenstein, 1938; Sheppard 1979: p. 113, pl. 114: 1–3, pl. 116: 1–5.

Monoceratina scrobiculata Triebel & Bartenstein, 1938; Bielecka *et al.* 1980: p. 247, pl. 73: 4.

Bythoceratina (*Praebythoceratina*) *scrobiculata* (Triebel & Bartenstein, 1938); Herrig 1981: p. 873, pl. 1: 3, Abb. 2.

Monoceratina scrobiculata Triebel & Bartenstein, 1938; Knitter 1983: p. 219, pl. 36: 2.

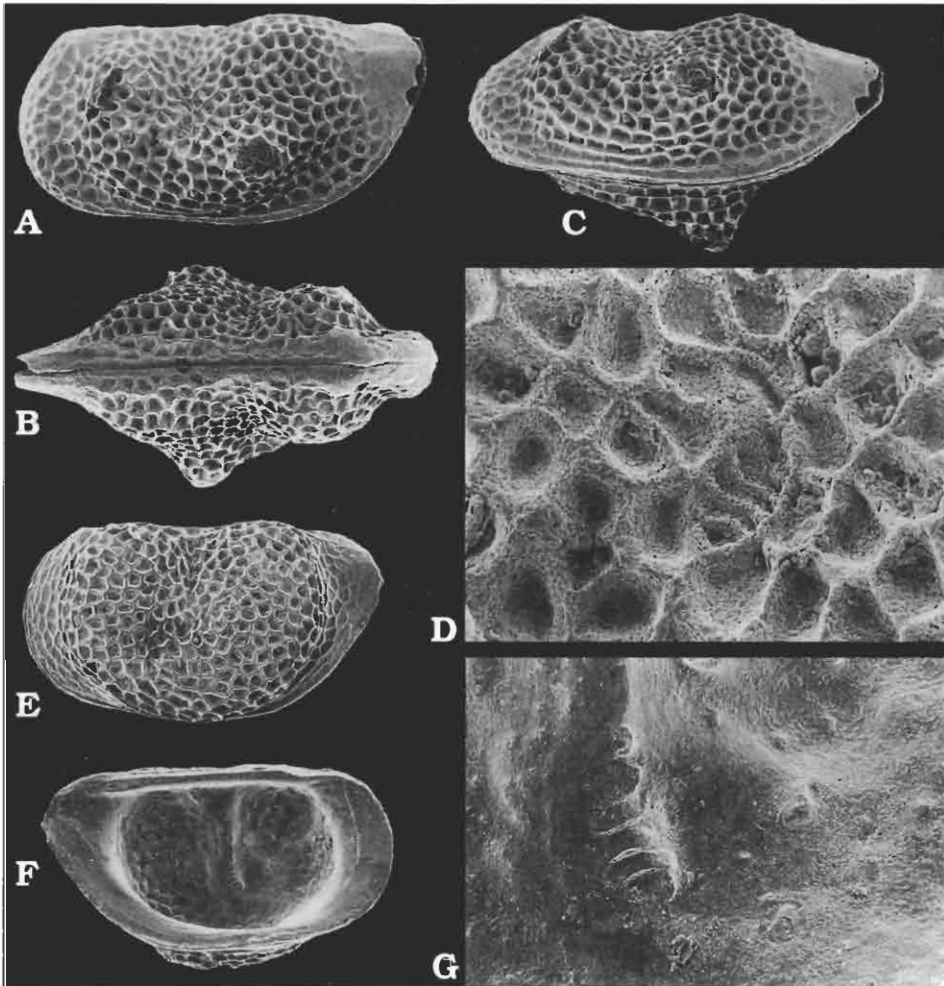


Fig. 13. **A–D.** *Bythoceratina (Praebythoceratina) scrobiculata* (Triebel & Bartenstein, 1938); ZPAL O.32/51. **A–C.** Carapace in left lateral, dorsal and oblique views; $\times 100$. **D.** Detail of lateral surface showing muscle scar interfering with the pattern of reticulation; $\times 500$. **E–G.** *Patellacythere paravulsa* Brand, 1990; ZPAL O.32/52. **E. F.** LV in lateral and internal views; $\times 100$. **G.** Central muscle scars; $\times 500$.

Monoceratina scrobiculata Triebel & Bartenstein, 1938; Herngreen *et al.* 1984: pl. 5: 12.

Monoceratina scrobiculata Triebel & Bartenstein, 1938; Bielecka *et al.* 1988: p. 178, pl. 73: 4.

Bythoceratina (Praebythoceratina) scrobiculata (Triebel & Bartenstein, 1938); Brand 1990: p. 154, pl. 2:10.

Material. — One carapace.

Description. — Carapace elongate, sub-rectangular. Dorsal margin straight, ventral margin almost straight. Anterior margin rounded, posterior truncate. Anterior and posterior part of carapace compressed. Greatest height in line of posteroventral spine. Adductor sulcus shallow, long. Posteroventral spine long. Surface reticulate.

Occurrence. — *M. scrobiculata* ranges from the Lower to Upper Jurassic in Europe: early Bathonian of Normandy; Middle Callovian (*C. coronatum* Zone) to the base of the late Oxfordian (*P. plicatilis* Zone) of England and Scotland; Middle Callovian of the eastern Netherlands; late Callovian to early

Oxfordian of northern France; late Bathonian (*O. aspidoides* Zone) to early Oxfordian (*Q. mariae* Zone) in northwestern Germany; late Liassic and early Aalenian of southern Germany; late Oxfordian of Switzerland; Callovian–Oxfordian of the Middle Volga and Syrt area, Russia; late Bathonian – early Oxfordian of northwestern Poland and late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Genus *Patellacythere* Gründel & Kozur, 1972

Type species: *Monoceratina williamsi* Stephenson, 1946.

Patellacythere paravulsa Brand, 1990

Fig. 13E–G.

Monoceratina vulsa (Jones & Sherborn, 1888); Triebel & Bartenstein 1938: p. 516, pl. 17: 18a, b.

Monoceratina cf. *vulsa* (Jones & Sherborn, 1888); Lutze 1960: p. 433, pl. 37: 5.

Monoceratina vulsa (Jones & Sherborn, 1888); Bielecka *et al.* 1980: p. 248, pl. 73: 5.

Patellacythere vulsa (Jones & Sherborn, 1888); Dépeche 1985: pl. 31: 15.

Monoceratina vulsa (Jones & Sherborn, 1888); Bielecka *et al.* 1988: p. 178, pl. 73: 5.

Patellacythere paravulsa paravulsa Brand, 1990: p. 155, pl. 2: 12–15.

non *Cytheridea vulsa* Jones & Sherborn, 1888: p. 263, pl. 2: 4.

Material. — One valve.

Description. — Carapace subrectangular in lateral outline. Greatest length above mid-height. Greatest height at mid-length. Dorsal margin straight. Ventral margin almost straight, subparallel to dorsal margin. Anterior margin rounded. Posterior margin subtriangular, rounded. Caudal process laterally compressed. Dorsal margin strongly compressed. Ornamentation as coarse closely arranged reticulation. Inner lamella of moderate width. Muscle scars as row of five elongate adductors with small frontal and mandibular scars (Fig. 13G).

Remarks. — *M. cf. vulsa* (Jones & Sherborn 1888) described from Late Jurassic of Westfalen (Kaefer *et al.* 1978: pl. 7: 2), differs from Łuków specimen in the more elongate carapace. The species described by Lubimova (1955) as *Bythocythere aliena* Lubimova, 1955 from the early Volgian of the Middle Volga area, Russia, is very similar in lateral outline and ornamentation, but differs in its reticulate margins. Specimen from Łuków are more similar to *P. paravulsa paravulsa* than to *P. paravulsa tenuis* Brand, 1990.

Occurrence. — Late Bathonian and Middle Callovian of northwestern Germany; early Callovian of the Paris Basin; Middle and late Kuiavian, Callovian and early Oxfordian of northwestern Poland, late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Order Cladocopida Sars, 1866

Suborder Cladocopina Sars, 1866

Superfamily Polycopacea Sars, 1866

Family Polycopidae Sars, 1866

Genus *Polycope* Sars, 1866

Type species: *Polycope orbicularis* Sars, 1866.

Polycope sp.

Fig. 14A–H.

Material. — Two carapaces and two valves.

Description. — Carapace small, almost circular in lateral view. Hinge margin short and straight. Greatest length at mid-height. Greatest height slightly behind mid-length. Greatest width median. Anterior and posterior margin broadly rounded. Ventral margin regularly rounded, dorsal margin slightly obtuse. Anterior and posterior cardinal angles obtuse. Rostral incisure absent. Muscle scar pattern consists of three large scars forming together compact subtriangular area (Fig. 14F). Hinge consists of a short bar in right valve and an indistinct groove in left valve. Infold structure narrow.

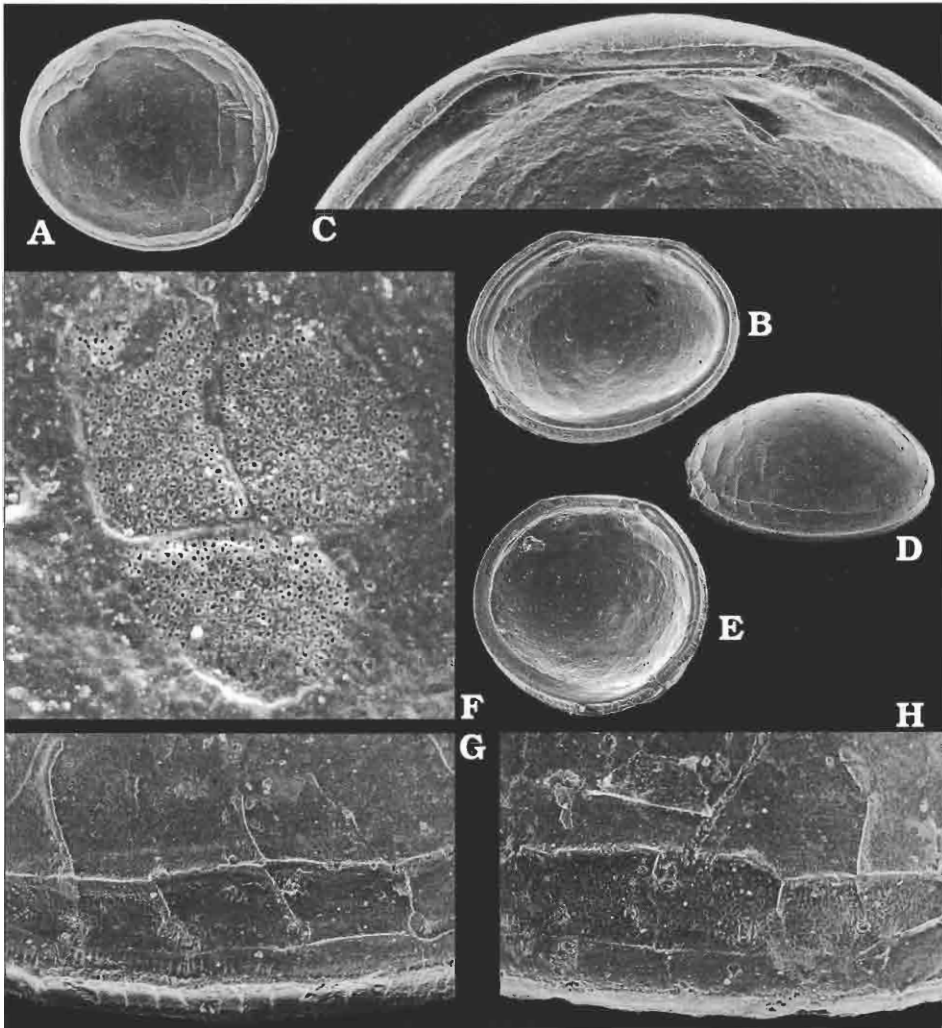


Fig. 14. A–H. *Polycope* sp. A–C. LV in lateral view, internal view and detail of hinge structure; ZPAL O.32/53; A, B $\times 100$, C $\times 300$. D. RV in oblique lateral view; ZPAL O.32/54; $\times 100$. E. Same in internal view. F. Same with detail of muscle scar; $\times 1400$. G. Same with detail of ventral marginal area; $\times 500$. H. Detail of ventral marginal area of A; $\times 500$.

Surface centrally smooth. Marginal area with fine marginally subparallel striae, interconnected by secondary striae to form rhombic reticulation.

Remarks. — The material probably represents a new species but more material is needed to confirm this.

Occurrence. — Late Callovian (*Q. lamberti* Zone) of Łuków, eastern Poland.

Zoogeographical and palaeoecological interpretation

There is a general agreement to subdivide European Jurassic seas into two faunal realms, defined by ammonites (Hallam 1975), the Boreal and the Tethyan. In more

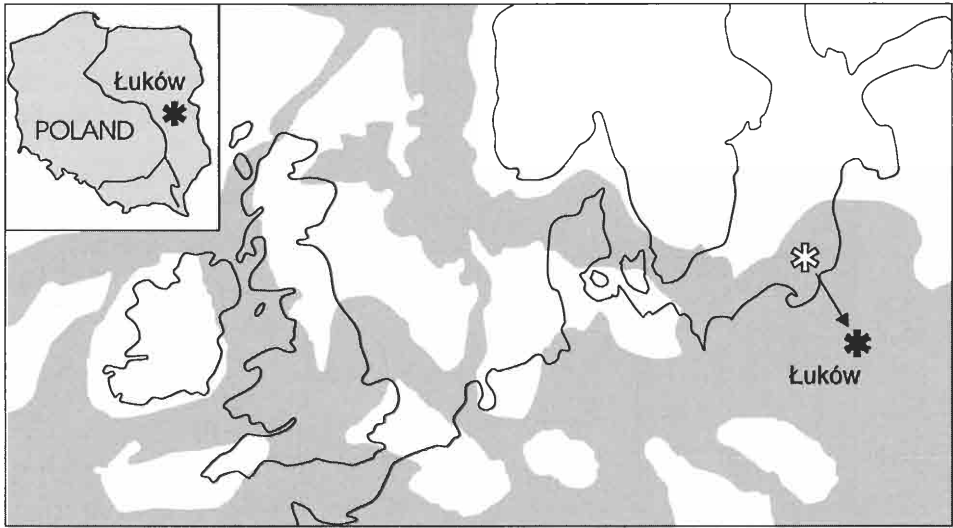


Fig. 15. Palaeobiogeographic map of the Callovian, after Ziegler (1990) showing the probable source area (indicated with hollow asterisk) of the Łuków clay blocks. The sea is shaded.

general terms, three realms from north to south are recognized; the Boreal, the Laurasian Tethyan and the Gondwanan Realm, that correspond to climatic belts (Wu & Tong 1994).

The exact cause of this provincialism remains an enigma, although different palaeoenvironmental and facies controls have been suggested (see Hallam 1975, 1994 for detailed discussion). During the late Callovian and early Oxfordian, the boundary between the Boreal and Tethyan realms fluctuated due to the world-wide transgression (Haq *et al.* 1987). Although the boundary between these two realms is gradational and the exact nature of the barrier between them is uncertain, the faunas of the two realms retained their distinctive provincial characteristics (Hallam 1975; Brand 1986).

In northwestern Europe, the marine ostracod fauna had a relatively uniform composition in the Callovian. The highest degree of similarity recognised is between the Scottish, southern English, NW German and the Łuków faunas. Apparently, the studied sediments were deposited in a region through which a free communication between the seas of northeastern and northwestern Europe was possible (Fig. 15). During the existence of this seaway, faunal migration was not completely unhindered. Environmental factors, such as temperature gradients are postulated to have restricted faunal communication.

Brand (1986) performed mineralogical and microstructural analyses of *Quenstedtoceras* conchs from Łuków. The shell material appears to have been deposited in seawater of salinity about 33‰ and a range of about 32–35‰. Other data, such as Mn and Fe, imply that the oxygen level of the seawater was normal. The palaeotemperature, using $\delta^{18}\text{O}$ values with a salinity correction, was calculated to be some 11.0–14.5°C with an average water temperature of about 12.5°C. According to Brand (1986) all of these environmental factors, in addition to others, probably account for the faunal separation of the boreal and tethyan realms.

The late Callovian is represented in Poland by sandy or carbonate facies, almost completely devoid of ostracods (Bielecka *et al.* 1988). The northwestern part of Po-

land is an exception, where coeval strata are developed in mudstone-clay facies with abundant and diverse ostracods: *Nophrecythere* (*N. triebeli*, *N. intermedia*), *Lophocythere karpinskyi*, *Terquemula lutzei*, *Fastigatocythere* (*F.*) *interrupta*, *Bythoceratina* (*P.*) *scrobiculata*, *Progonocythere callovica*, and *Pseudohutsonia hebridica* being similar to those from the fauna of Łuków.

The Callovian ostracod fauna from the southern Baltic Sea and neighbouring regions remains poorly known.

At Łuków, of 17 identified species, three are relatively abundant: *Nophrecythere triebeli*, *Nophrecythere intermedia* and *Schuleridea* (*Eoschuleridea*) *lukoviensis*. The ostracods are of late Callovian age because of the presence of *N. triebeli*, *P. callovica*, and advanced evolutionary forms of *N. intermedia* and *T. lutzei*.

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Kelowejski borealny zespół małżoraczków z glacialnych kier okolic Łukowa

EWA OLEMPSKA i JANUSZ BŁASZYK

Streszczenie

Kelowejskie kry glacialne z okolic Łukowa są słynne z wyjątkowo pięknie zachowanych amonitów o aragonitowych ściankach muszli i pustych fragmokonach (Makowski 1952, 1962; Kulicki 1974, 1979; Dzik 1990) oraz wielu innych grup skamieniałości o niespotykanym stanie zachowania. Makrofauna ta zachowana jest w wapiennych konkrecjach występujących wśród czarnych ilów.

W ilach z obrzeża konkrecji oraz w próbkach ilów pobranych z płytkich wierceń (Mizerski & Szamałek 1985), stwierdzono występowanie zespołu małżoraczków liczącego 17 gatunków należących do 16 rodzajów. Utworzono jeden nowy gatunek *Schuleridea (Eoschuleridea) lukoviensis*. Zespół ten potwierdzający późno kelowejski wiek osadów z których zbudowane są kry łukowskie (poziom *Quenstedtoceras lamberti*) wykazuje duże podobieństwo do późnokelowejskich zespołów małżoraczkowych z północno-zachodnich Niemiec i Wielkiej Brytanii, w mniejszym stopniu do zespołów małżoraczkowych keloweju Centralnej Rosji i północno-zachodniej Polski. Obszarem źródłowym dla kier łukowskich było prawdopodobnie dno Bałtyku na północ od Gdańska.

Skorupki małżoraczków cechują się wyjątkowo dobrym stanem zachowania, pozwalającym na obserwacje wielu cech morfologicznych dotychczas słabo poznanych u kelowejskich małżoraczków z innych obszarów Europy. Zespół małżoraczków z kier łukowskich zdominowany jest przez okazy gatunków rodzaju *Nopherythere* i *Schuleridea (Eoschuleridea)*.