POLISH POLAR RESEARCH	10	1	47—55	1989

Andrzej GAŹDZICKI

Institute of Paleobiology
Polish Academy of Sciences
Żwirki i Wigury 93
02-089 Warszawa, POLAND

Planktonic foraminifera from the Oligocene Polonez Cove Formation of King George Island, West Antarctica

ABSTRACT: Planktonic foraminifera of the genera *Chiloguembelina* Loeblich and Tappan, *Globigerina* d'Orbigny, and *Globorotalia* Cushman are reported from glacio-marine sediments of the Low Head Member (Polonez Cove Formation, Oligocene) of King George Island (South Shetland Islands), West Antarctica. The foraminifer assemblage comprises two stratigraphically important species: *Globigerina angiporoides* Hornibrook and *Chiloguembelina cubensis* (Palmer), which indicate the Upper Eocene — Lower Oligocene age. Taking into account specific composition, this planktonic assemblage may tentatively be correlated with the *Globigerina angiporoides* Zone of New Zealand, Australia, South Pacific and South Atlantic, which belongs to the Lower Oligocene (*see* Jenkins 1985).

Key words: Antarctica, Tertiary (Paleogene), micropaleontology (Foraminifera), biostratigraphy.

Introduction

The planktonic foraminifer assemblages recorded in the Upper Paleogene of the Southern Hemisphere in areas south of latitude 30° S mainly comprise individuals of the families Globigerinidae Carpenter *et al.* and Globorotaliidae Cushman (*cf.* Jenkins 1985). These foraminifera have been used to erect local zonations (Jenkins 1966, 1971; Lindsay 1969; Ludbrook and Lindsay 1969) and they may also be of prime importance in regional biostratigraphic correlations and paleobiogeographic reconstructions (Kaneps 1975; Krasheninnikov and Basov 1983, 1986; Jenkins 1985).

This paper presents the record of stratigraphically important planktonic foraminifera in glacio-marine sediments of the *Chlamys*-bearing conglomerate (= *Pecten* Conglomerate of Barton 1965, Low Head Member of Birkenmajer 1980) on King George Island, West Antarctica.

The investigated foraminifera are housed in the Institute of Paleobiology of the Polish Academy of Sciences in Warsaw, Poland (abbreviated as ZPAL).

Geological setting

The Oligocene Polonez Cove Formation (up to 90 m thick) consists of glacially-controlled sediments formed during Antarctic continental glaciation named the Polonez Glaciation (Birkenmajer 1980, 1982, 1987; Birkenmajer and Gaździcki 1986; Birkenmajer *et al.* 1987; *see also* Porębski and Gradziński 1987).

The studied planktonic foraminifera are derived from glacio-marine strata of the *Chlamys*-bearing Low Head Member (over 15 m thick), best exposed in the lower part of a steep cliff-face near Low Head (Figs 1–2), *see also* Gaździcki and Pugaczewska (1984; Pl. 2. Figs 1–2). The *Chlamys* coquinas, which are common here (Fig. 3) are rich in fossils and contain mixed biota

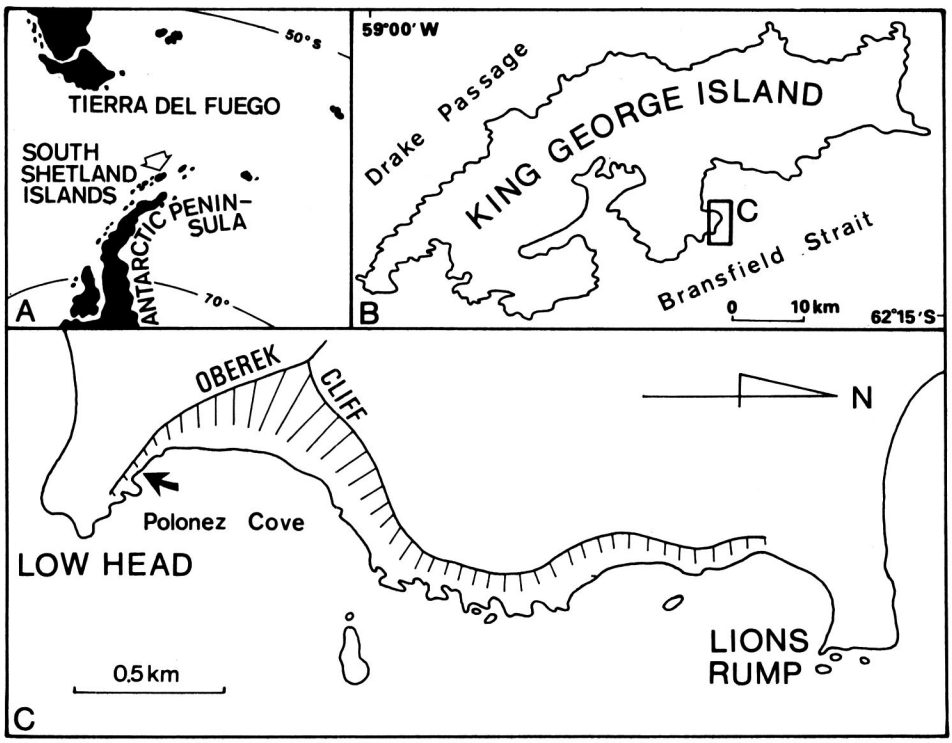


Fig. 1. Map showing position of King George Island (arrowed) in the South Shetland Islands (A) and location of the Low Head — Lions Rump area (B and C). The arrow (C) indicates the locality of the *Chlamys* coquinoid strata (profile I) in which the studied planktonic foraminifera have been found (*cf.* Fig. 2)

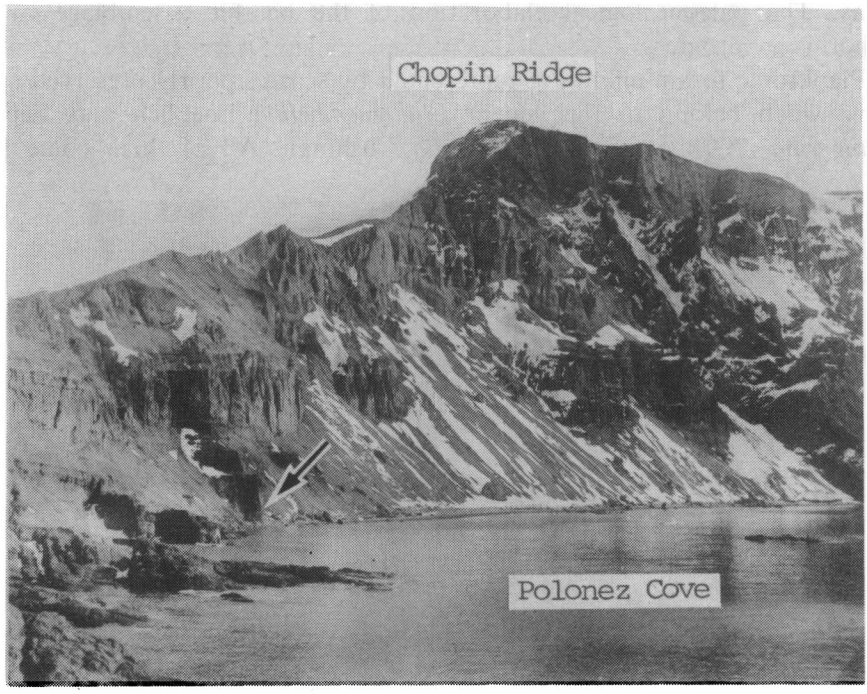


Fig. 2. Exposure of glacio-marine sediments of the Polonez Cove Formation (lower part of the cliff) as seen from Low Head. The arrow indicates the locality of the *Chlamys*--bearing strata (profile I *in* Gaździcki and Pugaczewska 1984) of the Low Head Member
Photo by A. Gaździcki, 1981

(calcareous nannofossils, centric diatoms, chrysomonad cysts, benthic and planktonic foraminifera, worms, bryozoans, brachiopods, bivalves, gastropods, ostracods, crinoids, ophiuroids and echinoids) of shallow- to deep-marine environments (Gaździcki 1984, Gaździcki and Pugaczewska 1984, Bitner and Pisera 1984, Jesionek-Szymańska 1984, Gaździcka and Gaździcki 1985, Błaszyk 1987).

Planktonic foraminifera are rather rare here, being mainly known along with nannofossils from the *Chlamys*-bearing strata (Fig. 3), *see also* Gaździcka and Gaździcki (1985).

Foraminifera

Foraminifera found in the *Chlamys*-bearing conglomerate (= Low Head Member) of the Polonez Cove Formation include both benthic and planktonic forms. Benthic assemblage is fairly rich and comprises chiefly representatives of the families Miliolidae Ehrenberg, Nodosariidae Ehrenberg, Glandulinidae Reuss, Cibicidae Cushman, Cassidulinidae d'Orbigny and Elphidiidae Gal-

loway. The paleontological elaboration of the benthic assemblage by the author is in progress.

Planktonic foraminifera are represented by scarce, poorly preserved specimens which belong to the genera *Chiloguembelina* Loeblich and Tappan, *Globigerina* d'Orbigny and *Globorotalia* Cushman. All of them come from

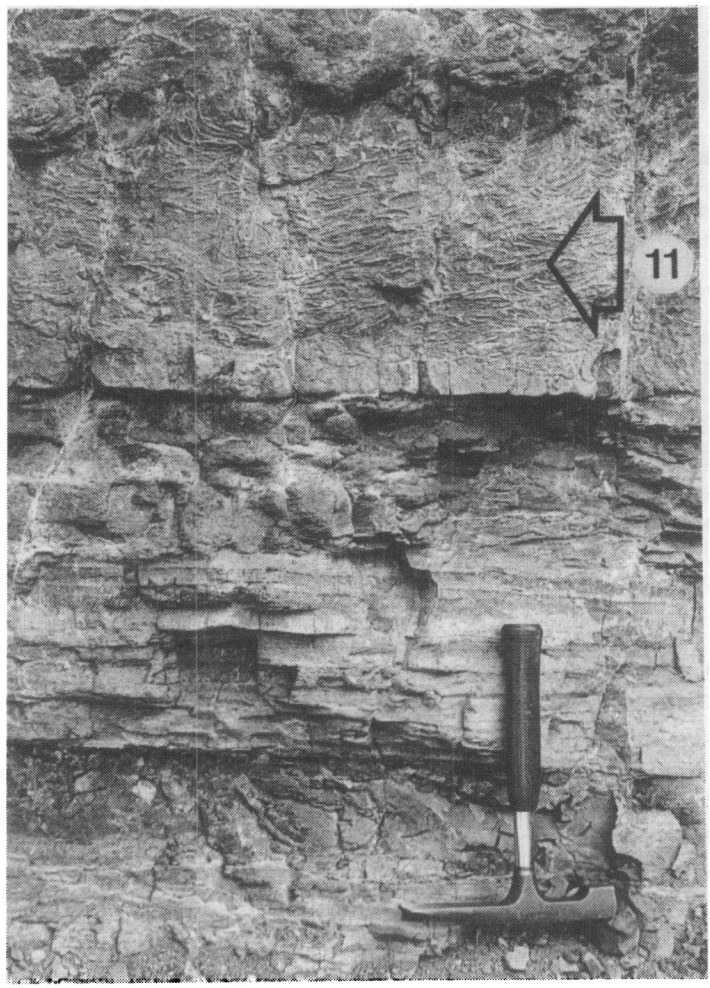


Fig. 3. Upper part of the photograph shows *Chlamys* tempestite bed (11) in which the assemblage of planktonic foraminifera has been found
Photo by A. Gaździcki, 1981

the sample I/11 taken directly above the base of the *Chlamys* tempestite bed (Fig. 3). The maceration of about 10 kg rocks of the *Chlamys* coquina in Glauber salt gave 13 planktonic foraminifer specimens. The following taxa have been identified:

Globigerina angiporoides (six specimens) – Pl. 1, Figs 1–2
Chiloguembelina cubensis (five specimens) – Pl. 2, Figs 1–3
Globorotalia sp. (two specimens)

The low diversity of the planktonic assemblage probably reflects original faunal composition. The recognized foraminifera are characterized by rather fragile tests. The last chambers are usually broken off (Pls 1–2), which may have been caused by post-mortem transportation from deeper part of sedimentary basin to nearshore areas during storm-generated energy events (*cf.* Gaździcki 1984).

Age of the planktonic foraminifer assemblage

Co-occurrence of the species *Globigerina angiporoides* and *Chiloguembelina cubensis* indicates the Upper Eocene – Lower Oligocene age (Jenkins 1985, Fig. 5; *see also* chapter on systematic paleontology). However, the available abundance distribution data show that the cool-water species *G. angiporoides* is the most common form in lower Oligocene sequences from the high latitudes (Kaneps 1975; Krasheninnikov and Basov 1983, 1986; Stott *pers. comm.*) and may also indicate cooling episodes (*cf.* Keller 1983).

The recognized assemblage is characterized by the presence of *G. angiporoides*, *Ch. cubensis* and the complete lack of *G. minima*, which is regarded as the ancestral form of *G. angiporoides*. The transitional forms from *G. minima* to *G. angiporoides* are also missing here. Therefore, the studied planktonic foraminifer assemblage from the *Chlamys*-bearing conglomerate of King George Island may be tentatively correlated with the Lower Oligocene *Globigerina angiporoides* Zone of New Zealand, Australia, South Pacific and South Atlantic (*cf.* Jenkins 1966, 1985; Lindsay 1969; Ludbrook and Lindsay 1969; Krasheninnikov and Basov 1983, 1986).

This age is in accordance with the recent result of $^{87}Sr/^{86}Sr$ isotope ratio of the stromatolite from the studied sequence, which shows that the *Chlamys*-bearing conglomerate of King George Island (and the Polonez Glaciation as well) is older than 35 Ma (Barrera and Gaździcki *in prep.*, *see* Gaździcki 1989).

Systematic paleontology

Family **Globigerinidae** Carpenter, Parker and Jones, 1862
Subfamily Globigerininae Carpenter, Parker and Jones, 1862

Genus *Globigerina* d'Orbigny, 1826
Globigerina angiporoides Hornibrook, 1965
(Pl. 1, Figs 1–2)

1965. *Globigerina angiporoides* n. sp.; Hornibrook, p. 835, Figs 1 a–i, 2.
1975. *Globigerina angiporoides* Hornibrook; Kaneps, p. 574, Pl. 1, Figs 1–6.
1983. *Globigerina angiporoides angiporoides* Hornibrook; Krasheninnikov and Basov, p. 838, Pl. 3, Figs 1–4.

Material. — Six specimens. ZPAL F. XXXIV/1—6.
Dimensions of the test (in microns): diameter – 200–300.
Remarks. – A rather small, compact test of this species consists of four spherical chambers increasing in size in the last whorl. Test surface is ornamented with subhexagonal pores (Pl. 1, Figs 1–2). Although the test presented on Pl. 1, Fig. 1 shows a broken final chamber, the chamber arrangement and nature of its ultrastructure are clearly of the *G. angiporoides* type, as described by Hornibrook (1965) from the uppermost Eocene – Lower Oligocene of New Zealand. It should be noted that its ancestor, *G. minima* Jenkins, is smaller and has smoother wall (*cf.* Jenkins 1985).

Occurrence. – In the Polonez Cove Formation: Low Head Member (profile I, layer 11).
This species ranges from the Upper Eocene to Lower Oligocene, and its ancestor (*G. minima*) – from the Middle to Upper Eocene (Jenkins 1966, 1985; Stainforth *et al.* 1975). The *G. angiporoides* was recorded from Antarctic deep-sea sediments (DSDP) Leg 28 Sites 267 and 274 from the Upper Eocene-Oligocene (Kaneps 1975); and from the Upper Eocene–Lower Oligocene of the Falkland Plateau and Argentine Basin (DSDP) Leg 71 Sites 511 and 513 (Krasheninnikov and Basov 1983).

Family **Heterohelicidae** Cushman, 1927
Subfamily Heterohelicinae Cushman, 1927
Genus *Chiloguembelina* Loeblich and Tappan, 1956
Chiloguembelina cubensis (Palmer, 1934)
(Pl. 2, Figs 1–2)

1934. *Guembelina cubensis* n. sp.; Palmer, p. 74, Figs 1–6.
1957. *Chiloguembelina cubensis* (Palmer); Beckmann, p. 89, Fig. 14 (5–8).
1985. *Streptochilus cubensis* (Palmer); Poore and Gosnell, p. 3, Pl. 2, Figs 1—13.

Material. — Five poorly preserved specimens. ZPAL F. XXXIV/7—11.
Dimensions of the test (in microns): length – 140–190.
Remarks. – The small, triangular shape of the test with biserially arranged subglobular chambers and finely striated surface of the wall matches

description of the type of this species by Palmer (1934) *see also* Beckmann (1957) and Blow (1979). The studied specimens with broken final chambers are rather broad, compact and distinctly striated (Pl. 2, Figs 1–2). Wall surface is similar to that of *Ch. cubensis* (*Streptochilus cubensis*) presented by Poore and Gosnell (1985; Pl. 2, Fig. 6) from the Lower Oligocene samples from Deep Sea Drilling Project, Site 366 (Atlantic Ocean). Heavily calcified specimens develop very prominent ridges (*cf.* Poore and Gosnell, 1985) which give a striated appearance of the test (*see*: Pl. 2, Figs 1–3).

Occurrence. – In the Polonez Cove Formation: Low Head Member (profile I, layer 11).

This geographically widely distributed species ranges through the Middle Eocene to Upper Oligocene (Jenkins 1985). The *Ch. cubensis* was recorded from Antarctic deep-sea sediments (DSDP) Leg 28 Site 267 in the Upper Eocene (Kaneps 1975); and from the Upper Eocene-Lower Oligocene of the Falkland Plateau and Argentine Basin (DSDP) Leg 71 Sites 511 and 513 (Krasheninnikov and Basov 1983).

Acknowledgements. — Field work in Antarctica was supported by the Polish Academy of Sciences (Research-Project MR.I.29 – CPBP 03.03.). The SEM photomicrographs were taken at the Institute of Paleontology (Erlangen during the author's stay on a fellowship granted by the Alexander von Humboldt Foundation (Bonn), and at the Alfred-Wegener-Institute for Polar and Marine Research (Bremerhaven). Dr. Jean-Pierre Beckmann (ETH Zürich) and Dr. Lowell D. Stott (University of California, Santa Barbara) offered helpful comments.

References

Barton C. M. 1965. The geology of the South Shetland Islands. III. The stratigraphy of King George Island. — Sci. Repts Brit. Antarc. Surv., 44: 1–33.

Beckmann J. P. 1957. *Chiloguembelina* Loeblich and Tappan and related foraminifera from the Lower Tertiary of Trinidad. B. W. I. — U. S. National Museum Bull., 215: 83–95.

Birkenmajer K. 1980. Discovery of Pliocene glaciation on King George Island, South Shetland Islands (West Antarctica). — Bull. Acad. Pol. Sci., Terre, 27: 59–67.

Birkenmajer K. 1982. Pliocene tillite-bearing succession on King George Island (South Shetland Islands, West Antarctica). — Stud. Geol. Polonica, 74: 7–72.

Birkenmajer K. 1987. Oligocene-Miocene glacio-marine sequences of King George Island (South Shetland Islands), Antarctica. *In*: A. Gaździcki (ed.), Palaeont. Results Polish Antarctic Expeds. I. — Palaeont. Polonica, 49: 9–36.

Birkenmajer K. and Gaździcki A. 1986. Oligocene age of the *Pecten* Conglomerate of King George Island, West Antarctica. — Bull. Pol. Ac. Sci.: Earth Sc., 34: 219–226.

Birkenmajer K., Gaździcki A., Gradziński R., Kreuzer H., Porębski S. J. and Tokarski A. K. 1987. Origin and age of pectenid-bearing conglomerate (Tertiary) on King George Island, West Antarctica. — 5th Int. Symp. Antarctic Earth Sci., Cambridge, August 1987 (abstracts), 17.

Bitner M. A. and Pisera A. 1984. Brachiopods from "*Pecten* Conglomerate" (Polonez Cove Formation, Pliocene) of King George Island (South Shetland Islands, Antarctica). — Stud. Geol. Polonica, 79: 121—124.

Blow W. H. 1979. The Cainozoic Globigerinida. — E. J. Brill, Leiden, 1413 pp.

Błaszyk J. 1987. Ostracods from the Oligocene Polonez Cove Formation of King George Island, West Antarctica. *In*: A. Gaździcki (ed.) Palaeont. Results Polish Antarctic Expeds. I. — Palaeont. Polonica, 49: 63—81.

Gaździcka E. and Gaździcki A. 1985. Oligocene coccoliths of the *Pecten* Conglomerate, West Antarctica. — N. Jb. Geol. Paläont. Mh., 12: 727—735.

Gaździcki A. 1984. The *Chlamys* coquinas in glacio-marine sediments (Pliocene) of King George Island, West Antarctica. — Facies, 10: 145—152.

Gaździcki A. 1989. Age of the *Chlamys*-bearing conglomerate (Paleogene) from King George Island in the light of micropaleontological data. — Int. Workshop on Antarctic Geochronology, München, April 26—29, 1989 (abstracts), 16.

Gaździcki A. and Pugaczewska H. 1984. Biota of the "*Pecten* Conglomerate" (Polonez Cove Formation, Pliocene) of King George Island (South Shetland Islands, Antarctica). — Studia Geol. Polonica, 79: 59—120.

Hornibrook N. de B. 1963. *Globigerina angiporoides* n. sp. from the Upper Eocene and Lower Oligocene of New Zealand and the status of *Globigerina angipora* Stache, 1865. — N. Z. J. Geol. Geophys., 8: 834—838.

Jenkins D. G. 1966. Planktonic foraminiferal zones and new taxa from the Danian to Lower Miocene of New Zealand. — N. Z. J. Geol. Geophys., 8: 1088—1126.

Jenkins D. G. 1971. New Zealand Cenozoic planktonic foraminifera. — Palaeont. Bull. N. Z. Geol. Surv., 42: 1—278.

Jenkins D. G. 1985. Southern mid-latitude Paleocene to Holocene planktic foraminifera. *In*: H. A. Bolli, J. B. Saunders and K. Perch-Nielsen (eds), Plankton stratigraphy. — Cambridge Univ. Press, Cambridge-London-New York-New Rochelle-Melbourne-Sydney, 263—282.

Jesionek-Szymańska W. 1984. Echinoid remains from "*Pecten* Conglomerate" (Polonez Cove Formation, Pliocene) of King George Island (South Shetland Islands, Antarctica). — Stud. Geol. Polonica, 79: 73—80.

Kaneps A. G. 1975. Cenozoic planktonic foraminifera from Antarctic deep-sea sediments, Leg 28, DSDP. *In*: D. E. Hayes *et al.*, (eds) Init. Repts. DSDP, 28: 573—583.

Keller G. 1983. Biochronology and paleoclimatic implications of Middle Eocene to Oligocene planktic foraminiferal faunas. — Mar. Micropaleont., 7: 463—486.

Krasheninnikov V. A. and Basov I. A. 1983. Cenozoic planktonic foraminifers of the Falkland Plateau and Argentine Basin, Deep Sea Drilling Project Leg 71. *In*: W. J. Ludwig, V. A., Krasheninnikov V. A. *et al.*, (eds), Init. Repts. DSDP, 71: 821—858.

Krasheninnikov V. A. and Basov I. A. 1986. Late Mesozoic and Cenozoic stratigraphy and geological history of the South Atlantic high latitudes. — Paleogeogr., Palaeoclimat., Palaeoecol., 55: 145—188.

Lindsay J. M. 1969. Cainozoic foraminifera and stratigraphy of the Adelaide Plains sub-basin, South Australia. — Bull. Geol. Surv. South Aust., 42: 1—60.

Ludbrook N. H. and Lindsay J. M. 1969. Tertiary foraminiferal zones in South Australia. — Proc. First Int. Confer. Plankt. Microfossils, Geneva, 2: 366—375.

Palmer D. K. 1934. The foraminiferal genus *Guembelina* in the Tertiary of Cuba. — Mem. Soc. Cubana Hist. Nat., 8: 73—76.

Poore R. Z. and Gosnell L. B. 1985. Apertural features and surface texture of Upper Paleogene biserial planktonic foraminifers: links between *Chiloguembelina* and *Streptochilus*. — J. Foram. Res., 15: 1—5.

Porębski S. J. and Gradziński R. 1987. Depositional history of the Polonez Cove Formation (Oligocene), King George Island, West Antarctica: a record of continental glaciation,

shallow-marine sedimentation and contemporaneous volcanism. — Stud. Geol. Polonica, 93: 7—62.

Stainforth R. M., Lamb J. L. Luterbacher H., Beard J. H. and Jeffords R. M. 1975. Cenozoic planktonic foraminiferal zonation and characteristics of index forms. — Univ. Kansas Paleont. Contr., 62: 1—425.

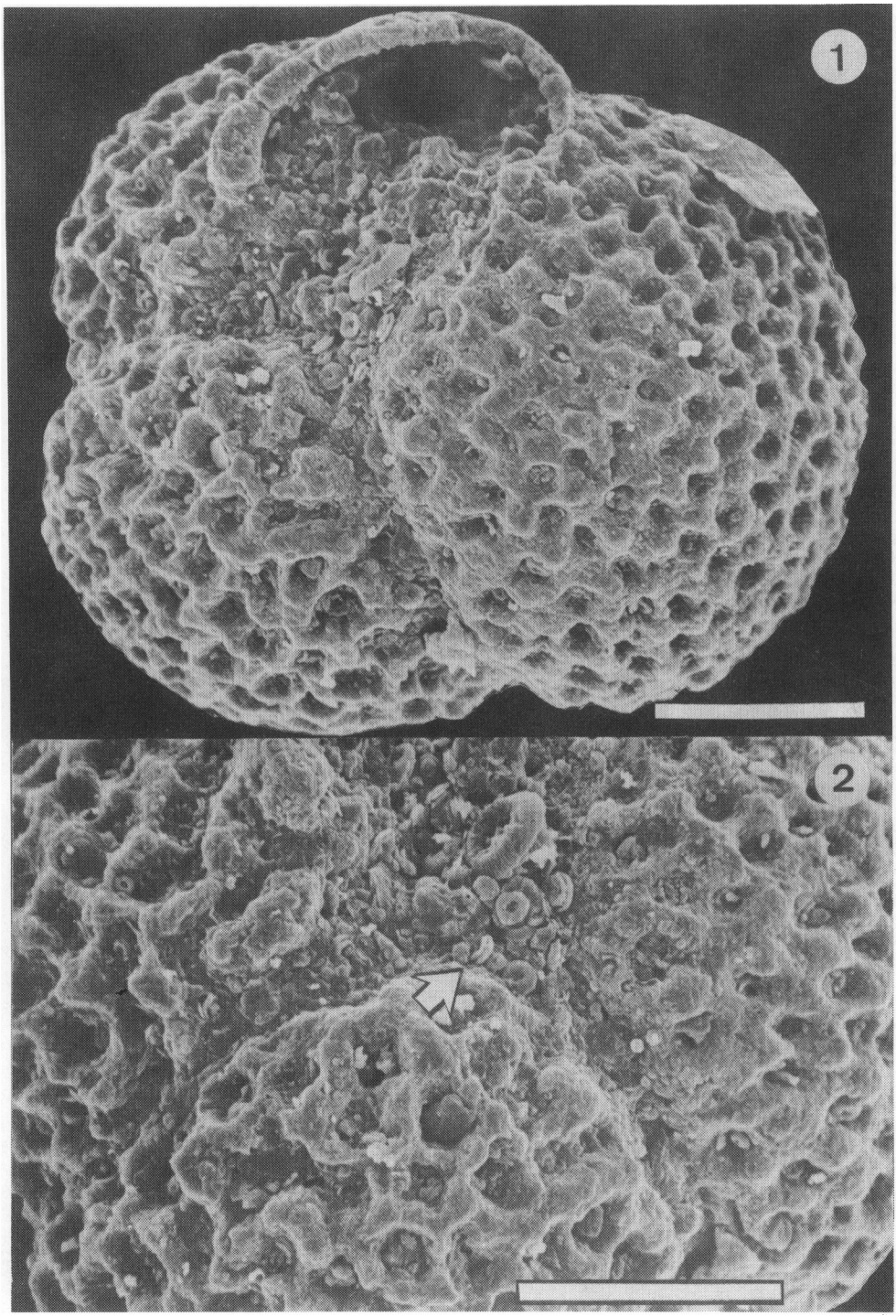
Received October 31, 1988
Revised and accepted November 17, 1988

Streszczenie

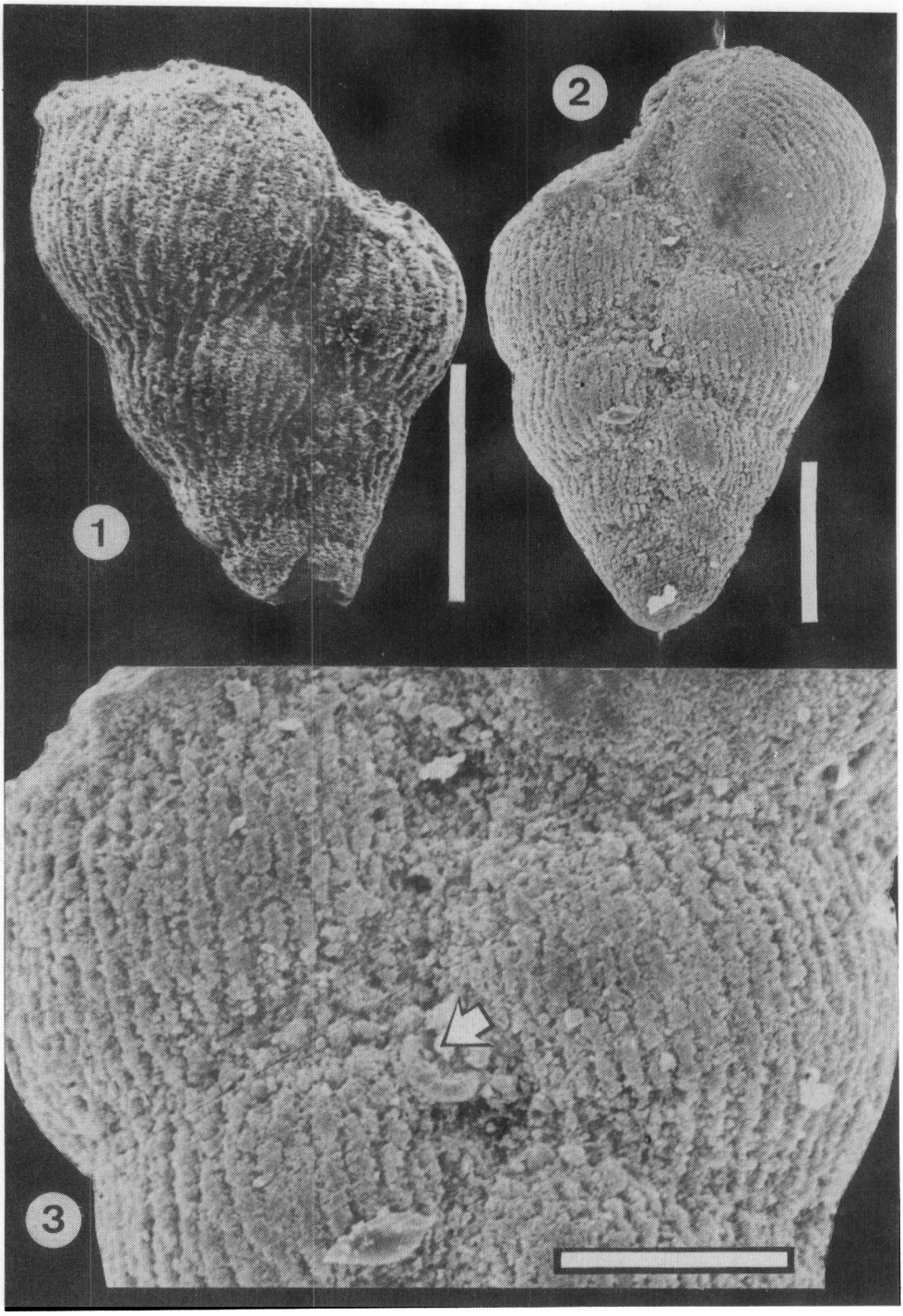
W oligoceńskich utworach morsko-lodowcowych ogniwa Low Head (formacja Polonez Cove) odsłaniających się na Wyspie Króla Jerzego w Antarktyce Zachodniej (fig. 1—3) stwierdzono obecność otwornic planktonowych. Rozpoznany zespół obejmuje taksony: *Globigerina angiporoides* Hornibrook, 1965 (pl. 1) *Chiloguembelina cubensis* (Palmer, 1934) (pl. 2) i *Globorotalia* sp.

Współwystępowanie *G. angiporoides* i *Ch. cubensis* w utworach ogniwa Low Head wskazuje, że powstawały one w górnym eocenie lub dolnym oligocenie. Jednak ponieważ *G. angiporoides* jest szczególnie częsta w sekwencjach skalnych dolnego oligocenu wysokich szerokości geograficznych i jest taksonem wskaźnikowym poziomu ścieśnionego *angiporoides* dolnego oligocenu (*por.* Jenkins 1985) to dolnooligoceński wiek osadów ogniwa Low Head jest najbardziej prawdopodobny.

Praca została wykonana w ramach tematu CPBP 03.03.



1. *Globigerina angiporoides* Hornibrook, 1965; umbilical view
2. The same specimen as Fig. 1. Part of the central area of the test showing ultrastructure and attached coccoliths of the genera *Chiasmolithus* and *Reticulofenestra* (arrowed)
Scale bar = 50 μm
Low Head Member (profile I, layer 11)



1—2. *Chiloguembelina cubensis* (Palmer, 1934), side views. Scale bar = 50 μm
3. The same specimen as Fig. 2. Central part of the test showing details of wall structure and attached coccolith of the genus *Reticulofenestra* (arrowed). Scale bar = 25 μm
Low Head Member (profile I, layer 11)