

***Loculicytheretta morkhoveni* sp. nov. (Ostracoda) from West Africa and its relevance to the history of the Mediterranean Seaway**

LEENDERT J. WITTE

Geological Institute, University of Amsterdam, Nieuwe Prinsengracht 130, 1018 VZ Amsterdam, Netherlands

ABSTRACT — *Loculicytheretta morkhoveni* sp. nov., of which the females have six loculi per valve, was found in Recent beachsand samples from Senegal and The Gambia (West Africa). A displaced specimen of the same species was present in a sample from deeper water off Guinea, where it occurred with *L. aff. L. pavonia* (having four loculi per valve). The presence of the Mediterranean species *L. pavonia* (with three loculi) in deep samples West of Gibraltar is interpreted as a result of transportation by outflowing currents.

The discontinuous distribution pattern of the genus *Loculicytheretta* is tentatively related to a reversal of the flow regime in the Mediterranean basin during the Pliocene.

INTRODUCTION

The genus *Loculicytheretta* Ruggieri, 1954 has received relatively much attention from ostracod workers, not only because of its stratigraphical importance, but also because of its morphological peculiarities. The females are in the possession of posteroventral loculi; this feature is common in Palaeozoic Ostracoda but among the post-Palaeozoic Ostracoda only known to occur in the genera *Loculicytheretta* and *Heptaloculites* Ruggieri, 1963. The true function of these structures is as yet poorly understood, and various hypotheses have been proposed (McKenzie, 1971; Athersuch & Bonaduce, 1976).

Until van Morkhoven's (1962/63) extensive review of post-Palaeozoic ostracods was published, only the type species, *L. pavonia* (Brady, 1866) was known to science. In his treatment of the genus, van Morkhoven reported and illustrated a species from West Africa (The Gambia), quite similar to the type species, but differing in having six instead of three loculi in the female valve. In the present paper, this species is reported from two West African localities, and a formal description is presented.

At this moment a total of 10 species is attributed to the genus *Loculicytheretta* s.s., ranging in age from Miocene to Recent. The morphologically similar genus *Heptaloculites* Ruggieri, 1963 includes 12 species, all of which are of Eocene age. Excellent illustrations of numerous species of both genera were given in Bismuth *et al.* (1978), and the evolution and palaeogeographic distribution was discussed. By these authors, *Heptaloculites* was treated as a junior synonym of *Loculicytheretta* and included in the latter. Carbonel & Colin (1982) demonstrated that the Palaeogene and the Neogene to Recent groups of loculate ostracods, although morphologically similar, belong to separate

phylogenetic lineages, and reintroduced *Heptaloculites* for the Palaeogene species.

This paper forms part of a larger study on West African ostracods. The *Loculicytheretta* material is deposited in the Geological Museum of the University of Amsterdam, collection nos. K 7530 – K 7540 and K 7550 – K 7556.

RESULTS

In three samples from the coast of Senegal and The Gambia, a species of *Loculicytheretta* was found that appeared to be identical to the species van Morkhoven (1962/63) reported from the Subrecent of The Gambia. The samples were taken from the sediment surface at approx. 50cm below the low-tide line, from open beach, high energy environments. A volume of about 100cc, consisting of siliceous fine to medium grained sand, was examined. In all samples, very rich ostracod faunas were found; other constituents were shell debris and benthic foraminifera.

The same *Loculicytheretta* species was found in a sand sample collected at a depth of 133m off the coast of Guinea. This sample was the shallowest out of a series of boxcore grabs collected during Geotropex '83 ("Meteor" expedition no. 65). The single carapace found in this material has a smooth, polished surface, probably resulting from downslope transport.

This sample also yielded another representative of the genus: *L. aff. L. pavonia* (*sensu* Bismuth *et al.*, 1978), which also had a smooth surface and may also be displaced. The latter form closely resembles *Loculicytheretta pavonia* (Brady), but is distinguished by having four loculi, one of which is often poorly developed. Bismuth *et al.* (1978) reported this form from a number of West African localities and a description and

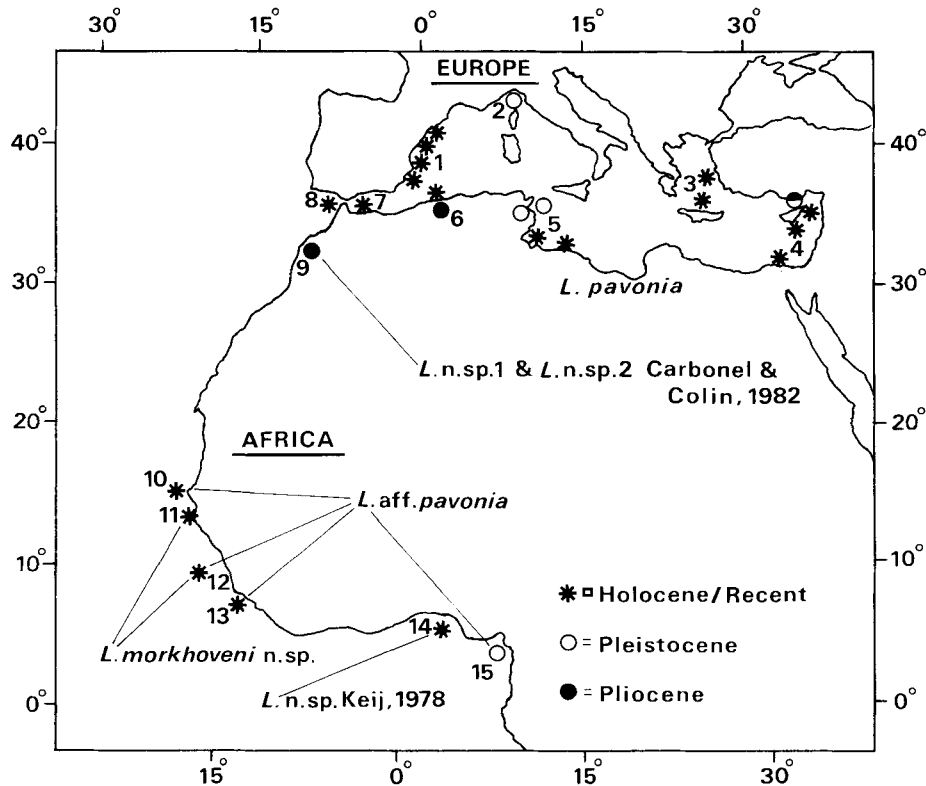


Fig. 1. Distribution of Pliocene to Recent *Loculicytheretta* (based in part on Bismuth *et al.*, 1978).

Loculicytheretta pavonia (Brady, 1866)

1. Spanish coast, Recent: van Morkhoven, 1962/63; McKenzie, 1973; Doruk, 1974; Athersuch & Bonaduce, 1976; Bismuth *et al.*, 1978; Carbonel & Colin, 1982. 2. Ligurian Sea, Pleistocene: Ruggieri, 1954. 3. Aegean Sea, Recent: Brady, 1866; Müller, 1912; Barbeito-Gonzalez, 1971. 4. Eastern Levant, Recent, Plio-Pleistocene: McKenzie, 1973; Doruk, 1974; Athersuch & Bonaduce, 1976; Athersuch, 1979. 5. Tunisian and Libyan coast, Recent, Pleistocene: Bonaduce & Masoli, 1968; Puri *et al.*, 1969; Wouters, 1973; Bonaduce & Pugliese, 1975; Athersuch & Bonaduce, 1976; Bismuth *et al.*, 1978. 6. Algeria, Recent, Pliocene: Yassini, 1979a, 1979b. 7. Alboran Sea, Recent?: Benson & Sylvester-Bradley, 1971. 8. Gulf of Cadiz, Recent?: this paper.

Loculicytheretta sp. 1 and *L. sp. 2* Carbonel & Colin, 1982

9. Morocco (precise location not known), Early Pliocene, Pliocene: Carbonel & Colin, 1982.

Loculicytheretta sp. aff. *L. pavonia* (Brady, 1866)

10. Senegal (off Dakar), Recent: (?Peypouquet, 1977), Bismuth *et al.*, 1978. 12. Guinea, Recent, this paper. 13. Sierra Leone, Recent: Keen, 1972. 15. Nigeria, Recent, Pleistocene: Bismuth *et al.*, 1978.

Loculicytheretta n. sp. Keij, 1978

14. Nigeria, Recent: Bismuth *et al.*, 1978.

Loculicytheretta morkhoveni sp. nov.

11. South Senegal, The Gambia, Recent, Subrecent: van Morkhoven, 1962/63; this paper. 12. Guinea, Recent: this paper.

discussion of its affinities was given. The suggestion was made by these authors that this form, as well as the form with six loculi, are Pleistocene offshoots of ancestral *L. pavonia*.

L. pavonia ranges from Pliocene to Recent and is known from a considerable number of localities in the Mediterranean area (Fig. 1). Benson & Sylvester-Bradley (1971) reported the species from samples collected in the Alboran Sea at depths of 620m and 700m as its westernmost occurrence. A new locality

that can be added to the list is the Gulf of Cadiz (approx. 12km W. of the Strait of Gibraltar), where it was found in three samples collected during a cruise in 1982 with B/O Cornide de Saavedra (Istituto Jaime Almeria, Barcelona).

DISCUSSION

The presence of *L. pavonia* in material from the Gulf of Cadiz is the first report of this species from outside

the Mediterranean. It is, however, obvious that the faunas found in these samples do not represent a biocoenosis. The species was found in three surface samples (upper 2cm), collected at depths of 510m, 836m and 1166m. The mixed origin of the material can be inferred from the presence of ostracod species characteristic of neritic Mediterranean environments (such as *Semicytherura sulcata* (G. W. Müller) and *Cytheretta adriatica* Ruggieri), in combination with other species that are found today only in colder, more northern environments (*Finmarchinella angulata* (Sars), *Cythere lutea* O. F. Müller). Bottom currents through the Strait of Gibraltar will have picked up material moving downslope, and subsequently transported this over the sill into the Atlantic. It cannot be decided whether such a westward transportation, or a reworking of older sediments, or even a combination of both processes can explain the reported occurrences. But one thing that can be safely assumed is that *Loculicytheretta pavonia*, being a typical inhabitant of very shallow water (Bismuth *et al.*, 1978), is not able to survive in deeper waters. The present-day Mediterranean watermass circulation is of an anti-estuarine type; surface currents bring in water from the Atlantic, bottom waters leave along the floor of the Strait of Gibraltar (Fig. 2). Thus, migration of a strictly shallow water genus out of the Mediterranean as a result of a current pattern as it exists today is unlikely. There is, however, evidence that in the Early Pliocene this circulation pattern was reversed, with a wide and deep connection situated approximately where Gibraltar is

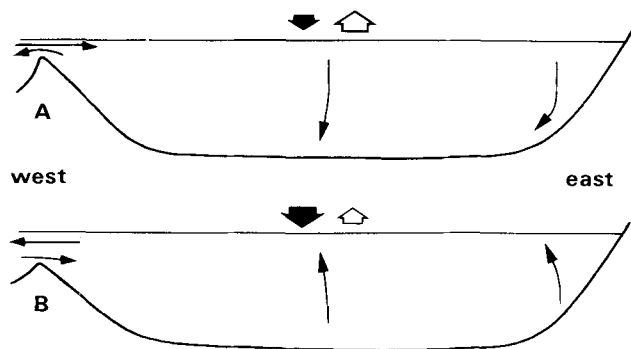


Fig. 2. Mediterranean watermass circulation (after van Harten, 1984). A. Modern type anti-estuarine system: surface currents enter the basin, deep waters leave along the floor of the Strait of Gibraltar. B. Estuarine system, model probably applicable until the Late Pliocene: surface currents are directed towards the Atlantic, deep waters flow over the sill into the basin.

Broad arrows symbolise the balance between evaporation (open arrows) and freshwater input (black arrows).

now, but extending southward into Morocco and northward into southern Spain. During this period, deep water ostracods could invade the Mediterranean (Benson & Sylvester-Bradley, 1971; Benson, 1973, 1976; van Harten, 1984). It is considered that at the same time, facilitated by the outflowing surface currents directed towards the Atlantic, shallow water genera, such as *Loculicytheretta*, could have enlarged their realm to include not only the southern beaches of the Mediterranean, but the adjacent areas in Northwest Africa as well. Subsequent speciation as a result of adaptation to slightly different environments may have given rise to a number of closely related forms, distinguished in particular by the number of loculi.

But where, at the beginning of the Pliocene, did the genus come from? The distribution of the post-Palaeozoic loculate ostracods shows considerable gaps, both in a horizontal and in a vertical sense. A total of 22 species is known (Bismuth *et al.*, 1978); six of these are Pliocene to Recent and found along the coasts of West and Northwest Africa and in the Mediterranean. This is the “*pavonia*” group considered in this paper. A second group, with four species, is restricted to the Miocene of Southwest France, Portugal and North Africa. These two groups together were named group II by Carbonel & Colin (1982) and these authors suggested for this group an origin different from that of yet another, strictly Eocene group, which is found predominantly in North Africa and includes at least 12 species.

Oligocene species of loculate Ostracoda are not known and this is one reason why Carbonel & Colin (1982) make a clear distinction between the Palaeogene and Neogene species. For the Palaeogene species group, they proposed to retain the genus *Heptaloculites* Ruggieri, 1963, whereas the Neogene taxa were allocated to *Loculicytheretta* Ruggieri, 1954.

Another break in the record of *Loculicytheretta* can be found between the Late Miocene and Early Pliocene. Although the record of the genus is continuous, no species is known to be present in both periods. The end of the Miocene is marked in the Mediterranean by the Messinian Salinity Crisis, and it seems probable that the break in the *Loculicytheretta* lineage correlates with this catastrophic event. As suggested by Benson & Sylvester-Bradley (1971) for deep-water ostracods, the development of new faunas, after refilling of the basin, may have started with forms that invaded the basin or survived in isolated areas. Possibly the shallow water species *Loculicytheretta pavonia* evolved from such a Miocene survivor. After the end of the Salinity Crisis, immense areas with a suitable habitat were generated, and a rapid occupation of these areas could be effected, followed by the migration of the genus into the Atlantic. Here, from the ancestral *Loculicytheretta* with three loculi, other

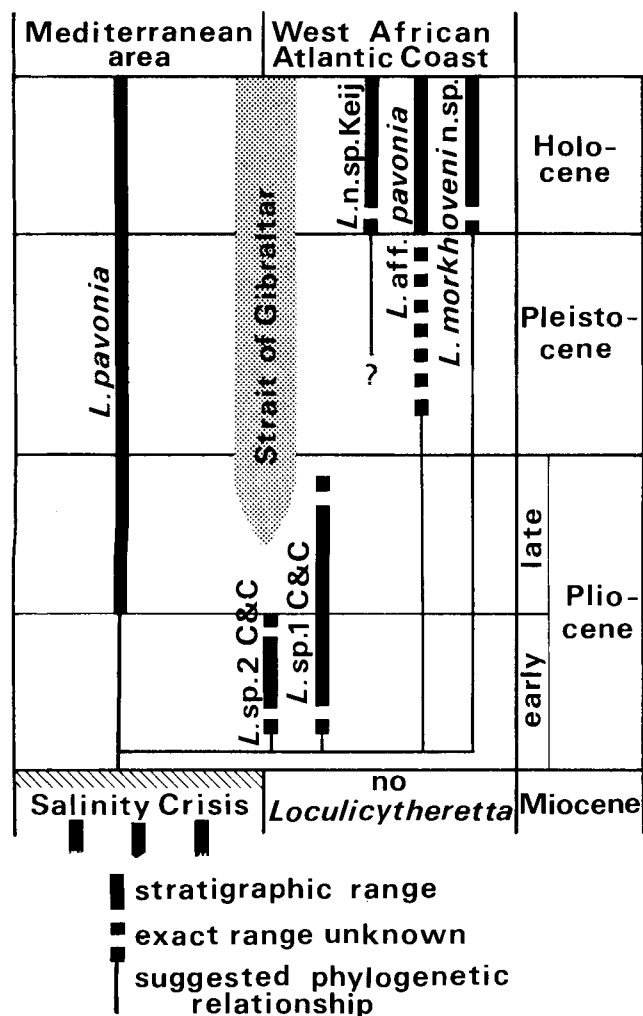


Fig. 3. Schematic representation of the stratigraphic position of post-Miocene *Loculicytheretta* species and the possible phylogenetic relations.

L. pavonia probably descended from one of the Miocene Mediterranean forms that became extinct as a result of the Salinity Crisis. From the African Atlantic coast no Miocene *Loculicytheretta* are known.

Since the Late Pliocene reversal of the current system, the Strait of Gibraltar acts as a barrier to ocean-directed migration of the shallow water inhabitant *L. pavonia*.

taxa evolved, of which most developed more than three loculi (Fig. 3). Pliocene *Loculicytheretta* are known from the Mediterranean (Doruk, 1974; Yassini, 1979b) as well as Morocco (Carbonel & Colin, 1982).

We imagine that when in the Late Pliocene the circulation pattern reversed and the wide and deep connection with the Atlantic was reduced to no more than a narrow strait, a wedge was driven in the until then continuous distribution of the genus around northern Africa. This effect was intensified by the drastic climatic changes that followed and *Loculicytheretta pavonia* became isolated from its Atlantic descendants permanently.

SYSTEMATIC DESCRIPTIONS

Suborder Podocopina Sars, 1866
Superfamily Cytheroidea Baird, 1850
Family Cytherettidae Triebel, 1952
Subfamily Cytherettinae Triebel, 1952
Tribus Loculicytherettini Gründel, 1976
Genus *Loculicytheretta* Ruggieri, 1954

Loculicytheretta pavonia (Brady, 1866)
(Pl. 1, figs. 1, 3)

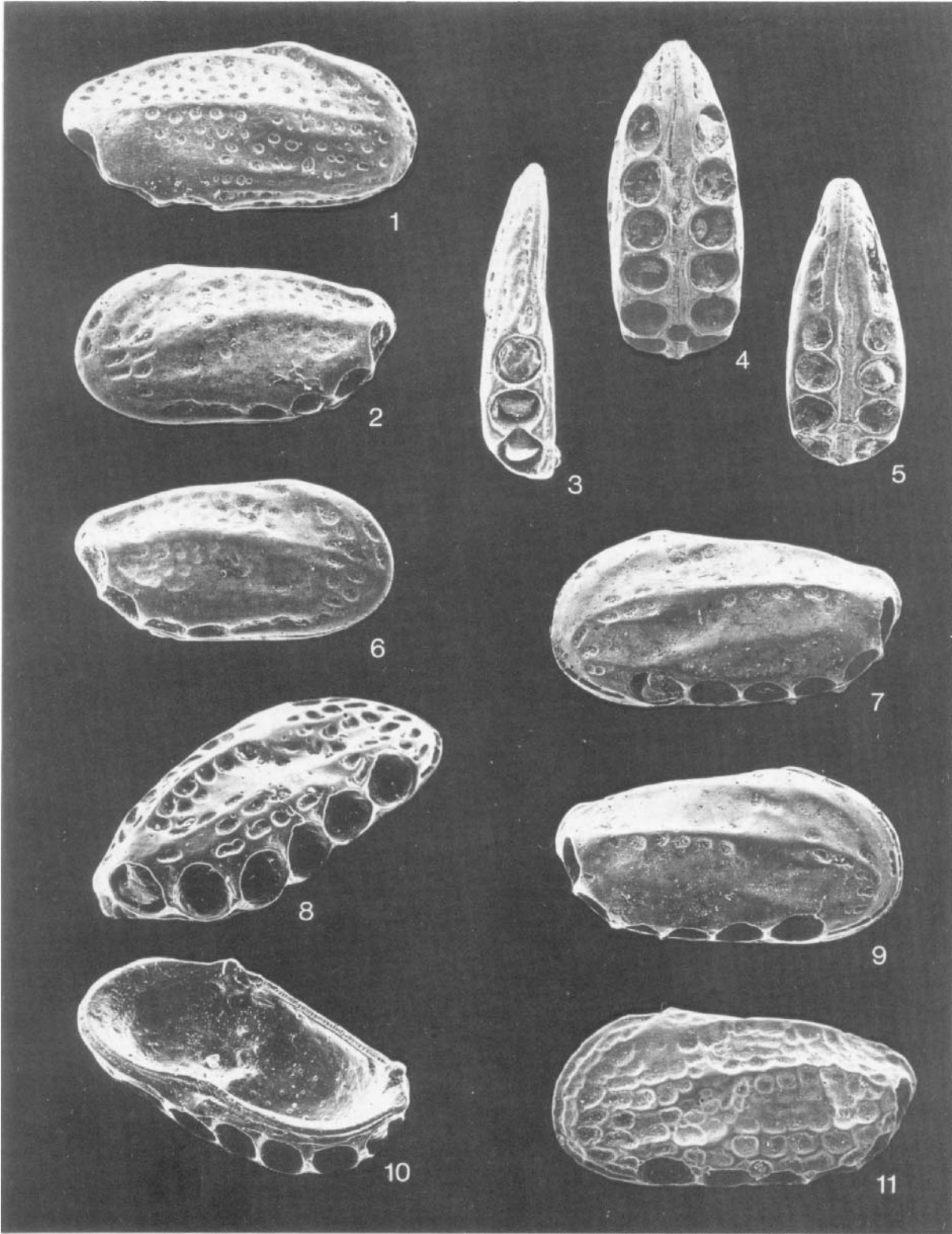
- 1866 *Cythere pavonia* Brady: 378, pl. 61, figs. 2a, b.
1963 *Loculicytheretta pavonia* (Brady); van Morkhoven: 130-134, figs. 194-200, 202.
1974 *Loculicytheretta pavonia* (Brady); Doruk: 237-244.
1976 *Loculicytheretta pavonia* (Brady); Athersuch & Bonaduce: 349-364, pl. 1-3.
1978 *Loculicytheretta pavonia* (Brady); Bismuth, Keij, Oertli and Szczechura: 232, pl. 1, figs. 1-11.
1979 *Loculicytheretta pavonia* (Brady); Yassini (a): 378, pl. 3, figs. 13-15.
1979 *Loculicytheretta pavonia* (Brady); Yassini (b): 97, pl. 2, fig. 15.
1982 *Loculicytheretta pavonia* (Brady); Carbonel & Colin: 440-443, pl. 1, figs. 1-9.

Explanation of Plate 1

Figs. 1, 3. *Loculicytheretta pavonia* (Brady), ♀ RV, K 7552: fig. 1, lateral view (×90); fig. 3, ventral view (×82). Gulf of Cadiz.

Figs. 2, 5, 6. *Loculicytheretta* aff. *L. pavonia* (Brady), ♀ car., K 7555: fig. 2, left lateral view (×90); fig. 5, ventral view (×82); fig. 6, right lateral view (×90). Offshore Guinea.

Figs. 4, 7-11. *Loculicytheretta morkhoveni* sp. nov.: fig. 4, ♀ car. (×82), K 7556, ventral view; fig. 7, ♀ car., K 7556, left lateral view (×90); fig. 8, ♀ RV, K 7530 (Holotype), oblique external view (×95); fig. 9, ♀ car., K 7556, right lateral view (×90); fig. 10, ♀ RV, K 7530 (Holotype), oblique internal view (×90); fig. 11, ♀ LV, K 7539, lateral view (×90). Specimen K 7556, offshore Guinea; specimens K 7530 and K 7539, type locality.



Remarks. The trilobulate species *Loculicytheretta pavonia* is reported from quite a number of Recent localities in the Mediterranean (see Fig. 1 in this paper; Athersuch & Bonaduce, 1976; Bismuth *et al.*, 1978). Doruk (1974) mentioned its presence in the Plio – Pleistocene of Italy and Turkey, and Yassini (1979b) in the Pliocene of Algeria.

The stations in the Gulf of Cadiz where it was found are the following: Station G 127, depth 510m, lat. 36°10,2'N, long. 06°41,9'W (two female valves); Station G 128, depth 836m, lat. 35°57,0'N, long. 07°00,1'W (one male carapace); Station G 129, depth 1166m, lat. 35°50,2'N, long. 07°15,7'W (one male valve).

Dimensions. Length males 0.63-0.66mm, height males 0.30-0.31mm; length females 0.63-0.66mm, height females 0.30-0.32mm.

Loculicytheretta aff. *L. pavonia* (Brady, 1866)
(Pl. 1, figs. 2, 5, 6)

1978 *Loculicytheretta* aff. *pavonia*; Bismuth, Keij, Oertli & Szczechura: 233, pl. 1, figs. 12-22.

Remarks. This form differs from *L. pavonia* mainly in having four rather than three loculi, of which the anterior one, according to Bismuth *et al.* (1978), is sometimes more poorly developed than the other three. *Loculicytheretta* aff. *L. pavonia* was reported from Nigeria (Pleistocene and Recent), Senegal and Sierra Leone (both Recent). The new locality, off the coast of Guinea, lies in the same area: Meteor station 16418-2, depth 133m, lat. 09°53,2'N, long. 16°38,3'W.

Dimensions. Length of figured specimen 0.60mm, height 0.29mm.

Loculicytheretta morkhoveni sp. nov.
(Pl. 1, figs. 4, 7-11; Pl. 2, figs. 1-11)

1962/63 *Loculicytheretta* sp.; van Morkhoven: Pt. 1, 93, Pt. 2, 133, fig. 201.

1978 *Loculicytheretta* n. sp. van Morkhoven; Bismuth, Keij, Oertli & Szczechura: 234, 245, pl. 2, fig. 23.

Derivation of name. After F.P.C.M. van Morkhoven; who reported this species for the first time.

Diagnosis. A *Loculicytheretta* species of which the females have six clearly developed loculi in each valve; three longitudinal ridges are present, the ventral one less pronounced; surface coarsely pitted.

Holotype. A female right valve, no. K 7530, illustrated in Pl. 1, figs. 8, 10 and Pl. 2, figs. 2, 4, 10. [Paratypes: One male carapace, one female carapace, two male valves, two female valves, two juvenile valves, nos. K 7531-K7538].

Material. In three samples, a total of 79 valves and carapaces was found.

Type locality. Beach of Bakau, Cape St. Mary, Republic of The Gambia, lat. 13°28'N, long. 16°47'W. (Sub)recent; no living individuals were collected.

Description. Carapace elongate in lateral outline, dorsal and ventral lines almost straight. Anterior end evenly rounded, posterior end obliquely truncate.

Three longitudinal ridges are present, dorsal one shortest, medium and ventral ones connected near the posterior margin. This feature is especially distinct in males and juveniles, less so in females. Surface covered with numerous pits, arranged in a characteristic pattern of rows. Intensity of the pitting, particularly of the females, variable, as nearly smooth to reticulate surfaces were found.

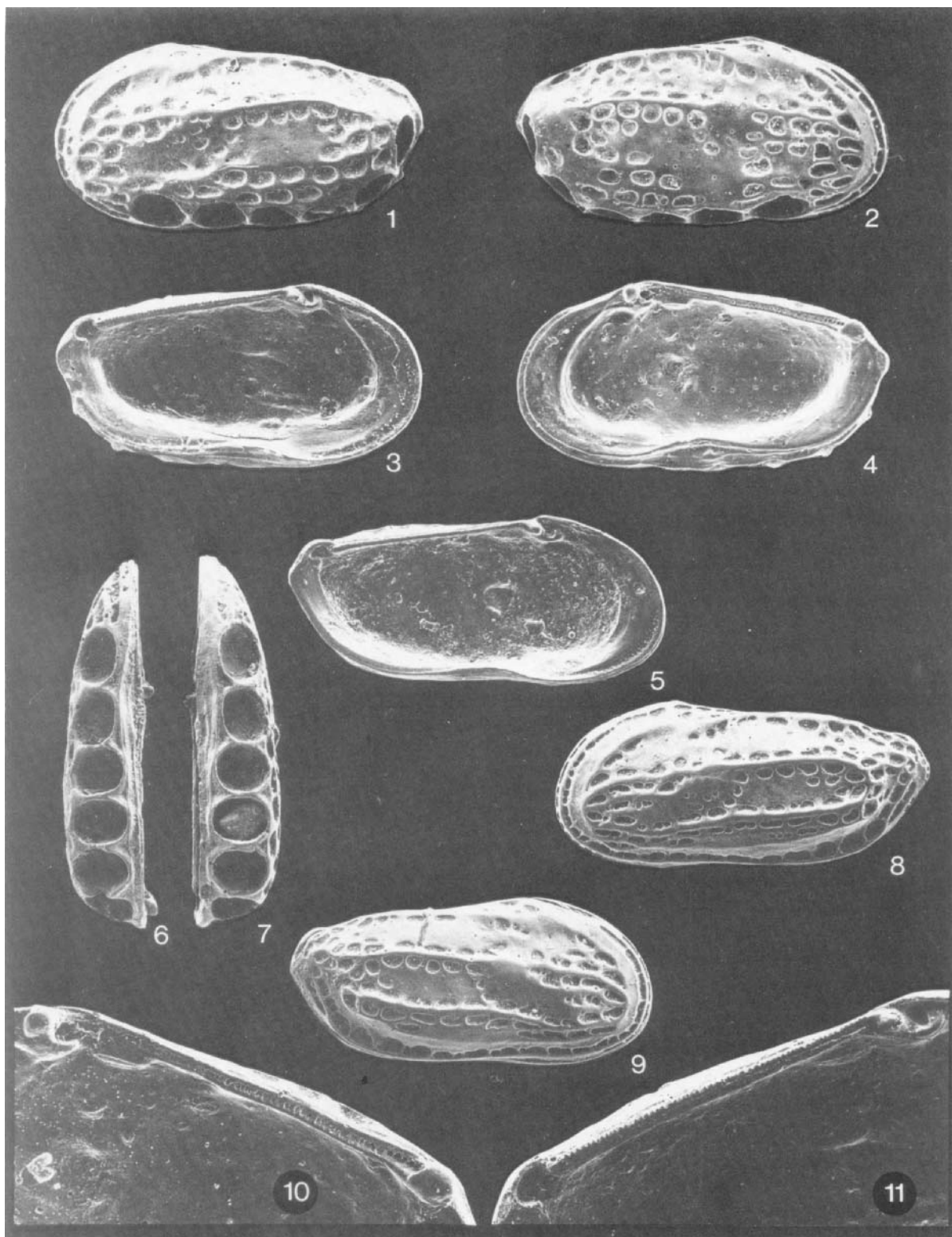
Soft parts unknown.

Distribution. The species was found in three samples from West African beaches; Cap Skirring (Senegal), Bakau and Fajara (both Cape St. Mary, The Gambia). One carapace was found in a sample from deeper water off Guinea; Van Morkhoven's report (1962/63) is also from The Gambia. Possibly also Morocco (Pliocene, see Remarks).

Remarks. The females with their characteristic loculi cannot be mistaken for any other Recent ostracod species. Males of *L. aff. L. pavonia* seem to be quite similar, according to the illustrations in Bismuth *et al.* (1978). Unfortunately, we have no males of this form in our collection. Males of *L. pavonia* have a different ornamentation: the pitting is much finer (especially along the posterodorsal margin), and the ventral ridge is clearly threefold.

Explanation of Plate 2

Figs. 1-11. *Loculicytheretta morkhoveni* sp. nov., fig. 1, ♀ LV, K 7535, lateral view (×90); fig. 2, ♀ RV, K 7530 (Holotype), lateral view (×90); fig. 3, ♀ LV, K 7535, internal view (×90); fig. 4, ♀ RV, K 7530 (Holotype), internal view (×90); fig. 5, ♂ LV, K 7533, internal view (×90); fig. 6, ♀ RV, K 7536, ventral view (×95); fig. 7, ♀ LV, K 7535, ventral view (×95); fig. 8, ♂ LV, K 7533, lateral view (×90); fig. 9, ♂ car., K 7531, right lateral view (×90); fig. 10, ♀ RV, K 7530 (Holotype), hinge structure (×175); fig. 11, ♀ LV, K 7535, hinge structure (×175). All specimens from the type locality.



Oertli, in Bismuth *et al.* (1978, Addendum 3) mentions material that was sent to him by P. Carbonel (University of Bordeaux I) from Upper Miocene and Lower Pliocene sections of Morocco. Three species appeared to be present; two of these (*L. sp. 1* and *L. sp. 2*) were later described by Carbonel & Colin (1982) who assigned them an Early Pliocene and Pliocene age. The third species, represented by one badly preserved specimen only, probably also from the Pliocene, was, according to Oertli (*op. cit.*), most likely *L. n. sp. van Morkhoven*, 1963. If that identification is correct, it implies a considerable extension of the range and distribution of the new species.

Dimensions. Length males 0.63-0.67mm, height males 0.30-0.33mm; length females 0.65-0.71mm, height females 0.33-0.36mm.

ACKNOWLEDGEMENTS

The author wishes to thank the D.F.G. (Deutsche Forschungsgemeinschaft) for giving him the opportunity to participate in "Meteor" cruise no. 65 (Geotropex '83). For my participation in the Cornide '82 cruise, I am indebted to the Instituto Jaime Almeria, Barcelona. All persons involved, as well as the crews of these ships, are thanked. A great number of friends and colleagues are acknowledged for their help and support in various ways. S.E.M. pictures were taken in cooperation with the Werkgroep Electronenmicroscopie of the University of Amsterdam.

Manuscript received September 1985

Revised manuscript accepted December 1985

REFERENCES

- Athersuch, J. 1979. The ecology and distribution of the littoral ostracods of Cyprus. *Journ. Nat. Hist.*, London, **13**, 135-160, 17 figs.
- Athersuch, J. & Bonaduce, G. 1976. *Loculicytheretta pavonia* (Brady). *Pubbl. Staz. Zool. Napoli*, **40**, 349-364, 3 pls.
- Barbeito-Gonzalez, P. J. 1971. Die Ostracoden des Küstenbereiches von Naxos (Griechenland) und ihre Lebensbereiche. *Mitt. Haamburg Zool. Mus. Inst.*, **67**, 255-326, 47 pls.
- Benson, R. H. 1972. Ostracodes as indicators of threshold depth in the Mediterranean during the Pliocene. In Stanley, D. J. (Ed.), *The Mediterranean Sea*, 63-73. Dowden, Hutchinson & Ross, Stroudsburg, Pa.
- Benson, R. H. 1976. Changes in the Ostracodes of the Mediterranean with the Messinian salinity Crisis. *Paleo., Paleo., Amsterdam*, **20**, 147-170, 2 figs.
- Benson, R. H. & Sylvester-Bradley, P. C. 1971. Deep Sea Ostracodes and the transformation of ocean to sea in the Tethys. In Oertli, H. J. (Ed.), *Paléoécologie des Ostracodes*, 63-92. *Bull. Centre Rech. Pau — S.N.P.A.*, **5** suppl., 63-91, 1 pl.

- Bismuth, H., Keij, A. J., Oertli, H. J. & Szczechura, J. 1978. The genus *Loculicytheretta* (Ostracoda). *Bull. Centre Rech. Pau — S.N.P.A.*, **2**(2), 227-263, 6 pls.
- Bonaduce, G. & Masoli, N. 1968. Marine Ostracoda of Tunisia. *Pubbl. Staz. Zool. Napoli*, **36**, 458-470, 2 pls.
- Bonaduce, G. & Pugliese, N. 1975. Ostracoda from Libya. *Pubbl. Staz. Zool. Napoli*, **39**, 128-135, 2 pls.
- Brady, G. S. 1866. On new or imperfectly known species of marine Ostracoda. *Trans. Zool. Soc. London*, **5**, 359-393, pls. 57-62.
- Carbonel, P. & Colin, J. P. 1982. New observations on the morphology of loculate Cenozoic Ostracoda. In Bate, R. H., Robinson, E. & Sheppard, L. M. (Eds.), *Fossil and Recent Ostracoda*, 439-452. Ellis Horwood, Chichester for the British Micropaleontological Society, London.
- Doruk, N. 1974. On *Loculicytheretta pavonia* (Brady). *Stereo-Atlas of Ostracod Shells*, London, **1**, 4, 237-244.
- Harten, D. van 1984. A model of estuarine circulation in the Pliocene Mediterranean based on new ostracod evidence, *Nature*, London etc., **312**, 359-361, 3 figs.
- Keen, M. C. 1972. Recent ostracod assemblages from the coast and shelf of Sierra Leone. *Actes 4 ème Coll. Afric. Micropal.*, Abidjan, 195-205, 6 figs.
- McKenzie, K. G. 1971. Paleozoogeography of freshwater Ostracoda. In Oertli, H. J. (Ed.), *Paléoécologie des Ostracodes*. *Bull. Centre Rech. Pau — S.N.P.A.*, **5** suppl., 207-237.
- McKenzie, K. G. 1973. The Biogeography of some Cenozoic Ostracoda. In Hughes, N. F. (Ed.), *Organisms and Continents through Time*, 137-153. *Spec. Paper Palaeont.*, London, **12**.
- Morkhoven, F. P. C. M. van 1962. *Post - Paleozoic Ostracoda*, vol. 1, 204 pp., 79 figs. Elsevier, Amsterdam.
- Morkhoven, F. P. C. M. van 1963. *Post — Paleozoic Ostracoda*, vol. 2, 478 pp., 763 figs. Elsevier, Amsterdam.
- Müller, G. W. 1912. Ostracoda. In: *Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen*. Königl. Preuss. Akad. Wiss. Berlin. Autorisierter Neudruck 1966, Weinheim.
- Oertli, H. J. 1976. The evolution of *Loculicytheretta* in the Eocene. *Abh. Verh. Naturwiss. Ver. Hamburg*, NF **18/19**, suppl., 153-160, 1 pl.
- Peypouquet, J. P. 1977. Les Ostracodes, indicateurs paléoclimatiques et paléogéographiques du Quaternaire terminal (Holocène) sur le plateau continental Sénégalais. In Löffler, H. & Danielopol, D. (Eds.), *Aspects of ecology and zoogeography of recent and fossil ostracoda*. 369-394. Junk Publishers, The Hague.
- Puri, H. S., Bonaduce, G. & Gervasio, A. M. 1969. Distribution of Ostracoda in the Mediterranean. In Neale, J. W. (Ed.), *The Taxonomy, Morphology and Ecology of Recent Ostracoda*, 356-411. Oliver & Boyd, Edinburgh.
- Ruggieri, G. 1954. Iconografia degli Ostracodi marini del Pliocene e del Pleistocene Italiana. Pte 2a. *Atti Soc. Ital. Sci. nat.*, Milano, **93**, 561-575, figs. 17-41.
- Yassini, I. 1979a. The littoral system Ostracodes from the Bay of Bou - Ismail, Algiers, Algeria. *Rev. Esp. Micropal.*, Madrid, **11**, 3, 353-416. 12 pls.
- Yassini, I. 1979b. Repartition des Ostracodes dans une serie marine régressive d'âge Pliocène dans la région d'Alger, Algérie. *Rev. Micropaléont.*, Paris, **22**, 89-124, 11 pls.
- Wouters, K. 1973. Quelques Ostracodes du Tyrrhénien de Monastir (Tunisie). *Ann. Mines Géol.*, Tunis, **26**, 279-399, 3 pls.