Cluthia miocenica sp. nov. (Ostracoda) from the Middle Miocene of southern Poland (Central Paratethys)

JANINA SZCZECHURA
Zakład Paleobiologii, Polska Akademia Nauk, 02-089 Warszawa, Al. Zwirki i Wigury 93, Poland

ABSTRACT—Cluthia miocenica sp. nov., the earliest known species of Cluthia Neale, 1973, is described from the upper part of the Middle Miocene (Upper Badenian) of south-east Poland. The occurrence of this species supports the hypothesis of climate cooling during Upper Badenian times in the Central Paratethys and suggests that this region was the birth place of the genus.

INTRODUCTION
The ostracod genus Cluthia Neale, 1973 has been hitherto represented by two species: Cluthia cluthae (Brady, Crosskey & Robertson, 1874) and Cluthia keiji Neale, 1985; both recorded from Recent and fossil sediments. They are represented by rare, small and thin-shelled individuals easily destroyed and which may be overlooked by micropalaeo- and microneontologists. This is presumably the main reason why Cluthia is only rarely recorded in Recent and fossil ostracod assemblages. Another reason for its rarity is due to its narrow environmental tolerance. Cluthia is regarded as a cold water taxon, preferring boreal and Arctic waters. Its presence in Late Tertiary and Quaternary sediments of the Mediterranean and central part of the eastern Atlantic areas has been explained by periodic migrations from northern seas (Peypouquet, 1971; Ruggieri, 1977; Llano, 1981; Carbonnel & Balesio, 1982). In the present paper, Cluthia miocenica sp. nov. is described from the upper part of the Middle Miocene (Upper Badenian) of south-east Poland. This oldest known occurrence supports my viewpoint on the origin and migration of Cluthia.

The described material is housed in the Institute of Paleobiology, Polish Academy of Sciences, Warsaw (abbreviated ZPAL).

GEOGRAPHICAL DISTRIBUTION AND ENVIRONMENTAL TOLERANCE OF FOSSIL AND RECENT CLUTHIA
The Recent Cluthia includes two species which are represented by rare individuals but which occur in many regions of the Northern Hemisphere, in waters of different depth and temperature.

Norman (1891) found Cluthia cluthae in the Bog Fjord (E. Finnmark) at a depth of 40-60 m while Scott (1899; see Neale, 1973) collected it from Franz Joseph Land at a depth of about 60 m. Hazel (1970) also collected it from near Greenland at a depth of 13 m and determining its amphiatlantic bathymetry and distribution as being between 20 and 300 m. Benson et al. (1983), however, investigating the biofacies of the Newfoundland continental slope recorded Cluthia cluthae from a depth of 500 m to over 1 500 m, from such different sediment substrates as silt, mud and sand.

C. cluthae has been described from the Bay of Biscay from a depth of 100 m and 600 m by Yassini (1969), and Neale (1975) described C. keiji from the eastern coast of Spain from a depth of 81 m. Bonaduce et al. (1975) found this species in the Bay of Naples and the Adriatic Sea, where it occurs preferably at a depth of about 85 m on a substrate varying from medium sand to sandy silt. Neale (1975) also mentioned the occurrence of C. keiji near the Algerian coast.

In the Quaternary, C. cluthae is recorded from the N.E. Atlantic shelf of Morocco (Llano, 1981), from the Bay of Biscay (Peypouquet, 1971) and from Malta (Neale, 1975). In the Pleistocene C. cluthae has been recorded from the N.W. coastal regions of the USSR (Neale, 1973), from S.W. Sweden (Lord, 1982) and from the Bay of Biscay (Moyes & Peypouquet, 1969). The oldest, so far, recorded occurrence of Cluthia (C. keiji) was described by Carbonnel & Balesio (1982) from the Pliocene of south-east France and northern Italy.

According to Hazel (1970), the amphiatlantic temperature tolerance of Recent species of Cluthia is between 0°C (or even less) to 7°C + and that its southern range is limited by summer temperatures (see also Neale, 1973). Neale estimates that it is a summer surface water temperature of 15°C that limits the southward distribution of Recent and Pleistocene species of Cluthia in the Atlantic.

Other authors, (Moyes & Peypouquet, 1971; Carbonel, 1980; Llano, 1981; Carbonnel & Balesio, 1982) consider Cluthia not only to be a cold water form but also...
nearshore in habit, and as such is an indicator of the palaeocoast in fossil forms. Peyrouquet (1971) also considers the temperature tolerance of Recent Cluthia to be the factor limiting its geographical distribution. This author, investigating Recent and subfossil ostracod assemblages from the shelf sediments of the Bay of Biscay, included specimens of Cluthia into the palaeothenatocoenosis which resulted from the bioocoenosis living during the last glaciation. Similarly Llano (1981), who analysed Quaternary ostracod assemblages from the Moroccan coast, considered the specimens of Cluthia in his material to be representatives of northeastern Atlantic forms from the Norwegian Province, and to be indicative of a cold water palaeothenatocoenosis. One may add here that Quaternary bioocoenoses with Cluthia also contain other cold-water ostracod species.

Carbonnel & Ballesio (1982), regarding Cluthia to be a cold-water ostracod having a very short stratigraphical range in the Pliocene deposits in France and Italy, used it for correlation as well as for designating a zone indicating Middle Pliocene cooling in the Mediterranean basin. In the light of these interpretations of the age and palaeo-temperature conditions of Cluthia, one has doubts about the findings of Cluthia in the Recent Mediterranean Sea (Italy, Algeria, Spain and Yugoslavia coasts).

**CLUTHIA MIOCENICA SP. NOV. FROM THE MIDDLE MIocene OF S.E. POLAND**

Cluthia miocenica sp. nov. has been found in the Middle Miocene (Upper Badenian) deposits of southeast Poland, in Roztocze region. Roztocze, which is a southern margin of the Lublin Upland, forms, together with other Polish Uplands, the northern margin of the Fore-Carpathian Depression. In the Miocene, Roztocze constituted a marginal part of the Central Paratethys and, therefore, deposits of this age represent a shallow water, nearshore zone of sedimentation. The most common sediments are intercalating sands, marls and limestones.

A few specimens of Cluthia have been found in outcrops of Upper Badenian age in the northwest part of Roztocze at Weglin and Trzesiny. At Weglin (cf. Szczechura & Pisera, in press, fig. 2) it has been found in marls overlying lithothamnian limestones and in marly clay from the higher part of the section. In the marls, Cluthia miocenica is accompanied by relatively abundant Aurila cf. A. opaca, Aurila sp., and Semicytherea spp., and very rare Pterygocythereis jonesii, Bairdia sp., Kangarina abyssicola, Cytheropteron sp., Krithe sp., Pseudocythere cf. P. caudata, ?Argilloecia sp., Occulo- cythereis bituberculata and Cythereida acuminata. In the clays, Cluthia and Cythereida acuminata only occur.

Diversity, taxonomic composition of ostracod assemblages accompanying Cluthia, density and population structure as well as analysis of the whole microfauna from Weglin (except from the topmost part of the section; cf. Szczechura & Pisera, in press) are indicative of a non-stable environment, with fluctuating bathymetry (deepening). At least outer infralittoral (sensu Carbonel, 1980) conditions existed during sedimentation of the lower part of the section.

At Trzesiny (cf. Szczechura, 1982, fig. 3) Cluthia occurs in a clay layer (in a sample almost corresponding to sample no. 7), a marly limestone (sample no. 10) and sandstone (sample no. 11). In the clays Cluthia is accompanied by abundant Callistocythere spp., Aurila spp., Semicytherea spp., and Cytheridea acuminata; less common or rare are Loxoconcha sp., Cytheropteron sp., Parakrithe dactylomorpha, P. crystallina, Hemicytherea videns, Paracythereida triquetra, Cnestocythere sp., Xestoleberis sp., Kangarina abyssicola, and Henryhowella asperima. These forms are indicative of an at least circalittoral environment. In limestones the dominant ostracods are Callistocythere spp., Cytheridea acuminata, Loxoconcha spp., Aurila spp., with rare Pterygocythereis jonesii, Paracythereida triquetra and...
Clathia miocenica sp. nov.
Szczechura
Semicytherura sp. This assemblage seems to characterise an inner littoral, phytal environment.

Sands contain a similar assemblage of ostracods although their frequency is lower than in the limestones and ostracods occur mostly as adult carapaces indicating a high rate of sedimentation.

Analysis of ostracod and foraminifera distribution in the whole Trzesiny section suggests changing bathymetry and energy environment in a shallowing upward sequence.

Especially important seems to be the fact that although in all samples from Roztocze, *Cluthia* represents various environmental conditions regarding depth, character of substrate and hydrodynamic energy, it seems to represent rather uniform temperate temperature conditions.

Differences existing between the Early and Late Badenian in the Central Paratethys, concern among others, microfauna distribution and are expressed by the disappearance of termophilic small planktonic and large benthic foraminifera in the Late Badenian. Based on this, I have designated (Szczechura, 1982, 1984) *Globigerinoides* and *Globigerina* ecozones which represent respectively, a tropical climate in the Early Badenian and a temperate climate in the Late Badenian. In this biostratigraphical zonation, *Cluthia* belongs to the *Globigerina* ecozone. Of importance here seems to be the fact that deposits of the *Globigerina* ecozone are impoverished with regard to the numerous ostracod species present in deposits of the *Globigerinoides* ecozone (Szczechura & Pisera, in press).

According to earlier investigations, presented above, the occurrence of *Cluthia* in Poland probably records the drop in temperature of the shallow surface waters of the Late Badenian of the Central Paratethys. The presence of *Cluthia* in deposits of the Middle Miocene of the Central Paratethys also has other consequences in that it allows for the origin of *Cluthia* and the direction of migration to be different from that previously postulated.

**ORIGIN AND MIGRATION PATHS OF CLUTHIA**

Evaluating the so far known geographical and stratigraphical distribution of *Cluthia* (Fig. 1) there is no doubt that it appeared in the Middle Miocene (Late Badenian) of the Central Paratethys presumably during climate cooling. Later, in the Pliocene, it spread into the Tethys (France and Italy) and around its periphery. Northern seas were colonised by *Cluthia* only in the Quaternary, so they cannot be regarded as provinces of origin of this genus.

The existence of a communication between the Paratethys and the Tethys in the Late Middle Miocene (Late Badenian) (Carbonnel & Jiříček, 1977; Jiříček, 1983) allowed *Cluthia* to migrate from the Paratethys into the Tethys and, as a consequence, into the eastern and northern Atlantic. At Roztocze, in deposits which are stratigraphical equivalents of those with *Cluthia*, both *Carinocythereis carinata* and *Cyanocytheridea dertonis* occur. These two species also occur in time-equivalent strata in Italy, and thus permit a correlation

---

**Fig. 1.** Distribution of Recent and fossil *Cluthia* after Neale, 1973, and Szczechura, present paper.
Cluthia miocenica sp. nov.

of the upper part of the Middle Miocene of both the Tethys and the Paratethys (Carbonnel & Jiříček, 1977; Jiříček, 1983). The first of these two species lives today and has a wide distribution in the Mediterranean region and along the eastern coast of the Atlantic between lats. 25° and 60°N. Thus, it seems probable that the Paratethys, beginning in the Late Badenian, was the centre of origin of many marine ostracod species, known subsequently from the Late Miocene of the Tethys.

So far, the influence of the Paratethys on the Tethys, based on ostracods, was postulated to exist in the latest Middle Miocene i.e. in the Sarmatian.

In the light of the data presented above, Cluthia from the bottom sediments of the Mediterranean Sea is an element of a cool climatic paleothanatocoenosis or of a deep water (and so also cool-water) element of a Recent biocoenosis. However, to accept the living presence of Cluthia in the present day Mediterranean Sea, one needs to find it with soft parts preserved.

**SYSTEMATIC DESCRIPTION**

Family Leptocytheridae Hanai, 1957

*Cluthia* Neale, 1973

*Cluthia miocenica* sp. nov. (Pl. 1, figs. 1–7)

Derivation of name. Latin, *miocenica* – occurring in the Miocene.

**Holotype.** ZPAL 0.XXIX/7; Pl. 1, fig. 7.

**Paratypes.** ZPAL 0.XXIX/1–6; pl. 1: 1–6.

Type horizon and locality. Upper Badenian (Middle Miocene), Weglin (Roztocze), Poland.

Material. Eight rather well preserved specimens.

Diagnosis. Non-tuberculate species of *Cluthia*, without posterodorsal, ad marginal rib-like inflation.

**Dimensions (mm)**

|        | ZPAL 0.XXIX/1 | 0.XXIX/4, LV | 0.XXIX/7, LV |
|--------|--------------|-------------|-------------|
| Length | 0.36         | 0.36        | 0.36        |
| Height | 0.20         | 0.20        | 0.20        |
| Width  | 0.16         |             |             |

**Description.** Valve small, thin, laterally compressed, with lateral outline typical of genus. Maximum height anteriorly, greatest width posterointrally. Both valves very similar in size and shape. Dorsal margin straight, ventral margin concave in middle part. Anterior margin broadly and somewhat obliquely rounded, posterior margin less broadly rounded. Anterior cardinal angle better developed than posterior one, being more distinct in the left valve. Distinct lateral inflation best marked behind and below muscle-scar field; in its lower part it extends up to the ventral margin. Weak rib-like inflation runs closely to the posterior margin, in its upper part disappearing below and before the hinge margin, whereas in its lower part gently passing into the ventral margin. Marginal part of the anterior end slightly removed outside and generally thickened distally. Valve surface regularly and densely pitted, with weak and tiny, irregular striae bordering posteriorly the lateral inflation.

Duplicate wide anteriorly, narrow posteriorly, without a vestibule. Hinge margin straight; hinge elements unknown.

**Variation.** Weak variation concerning the size, length: height ratio and details of the valves ornamentation have been observed.

**Remarks.** The described species is very close to *Cluthia keiji* Neale, 1975, described as a Recent species from the Mediterranean region. In contrast to *C. keiji*, *C. miocenica* is larger and lacks the posterodorsal, ad marginal, rib-like inflation.

**Occurrence.** Trzesiny and Weglin, Roztocze region, S.E. Poland, Upper Badenian (late Middle Miocene).

**ACKNOWLEDGEMENTS**

The author is very grateful to Prof. John W. Neale (University of Hull, England) for his helpful remarks on species determination and to Dr. Ray Bate (SSI, Guildford, England) who reviewed the manuscript and gave valuable suggestions for its improvement. S.E.M. photographs were taken at the Electron Microscopy Laboratory of the Nencki Institute of Experimental Biology in Warsaw. The text figure was prepared by Mrs. D. Slawik, Institute of Paleobiology, Polish Academy of Sciences, Warsaw.

Manuscript received June 1985
Revised manuscript accepted August 1985
REFERENCES

Benson, R. H., Del Grosso, R. M. & Steineck, P. Lewis. 1983. Ostracode distribution and biofacies, Newfoundland continental slope and rise. *Micropaleontology*, 29, 4, 430-453.

Bonaduce, G., Ciampo, G. & Masoli, M. 1975. Distribution of Ostracoda in the Adriatic Sea. *Publ. Staz. Zool.* Napoli, 40 Suppl., 1-308.

Carbonel, P. 1980. Les ostracodes et leur intérêt dans la définition des écosystèmes estuariens et de plateforme continentale. Essais d’application à des domaines anciens. *Mem. Inst. Geol. Bassin d’Aquitaine*, 1, 350.

Carbonel, G. & Ballesio, R. 1982. Les ostracodes Pliocènes du sud-est de la France. *Docum. Lab. Géol. Lyon*, 85, 1, 1-113.

Jiríček, R. 1977. Super-zones et datums à Ostracodes dans le Neogene de la Tethys (Bassin du Rhone) et de la Paratethys. *Newsl. Stratigr.*, 6, 23-29.

Hazel, J. E. 1970. Atlantic Continental Shelf and Slope of the United States. Ostracode Zoogeography in the Southern Nova Scotian and Northern Virginian Faunal Provinces. *Geol. Surv. Prof. Paper*, 529-E, E1-E21.

Jiríček, R. 1983. Redefinition of the Oligocene and Neogene ostracod zonation of the Paratethys. *Miscellanea Micropaleont.* A memorial volume dedicated to the 18th European Coll. on Micropaleontology, Hodonin, 195-205.

Llano, M. 1981. Les Ostracodes témoins et traceurs des phénomènes hydrologiques sur les plateaux continentaux; la plateforme continentale atlantique marocaine. *Bull. Inst. Géol. Bassin d’Aquitaine*, 125-160.

Lord, A. R. 1982. Ostracods. In Olausson, E. (Ed.), The Pleistocene/Holocene boundary in south-western Sweden. *Sver. Geol Unders.*, Ser.C no. 794, Arts. 76, nr. 7, 137-147.

Moyes, J. and Peyouquet, J. P. 1971. Les Ostracodes indicateurs d’un paléorivage pléistocène en bordure du plateau continental du golfe de Gascogne. *C.R. Somm. Soc. Géol. de France*, fasc. 44, 219-220.

Neale, J. W. 1973. *Cluthia* (Crustacea, Ostracoda), a new Pleistocene and Recent Leptocytherid genus. *J. pal.*, 47, 4, 683-688.

Neale, J. W. 1975. On *Cluthia keiji* Neale sp. nov. *Streo Atlas of Ostracod Shells*, 2(23), 141-148.

Peyouquet, J. P. 1971. La distinction des biocenoses, thanatocoses, paléothanatocoses. Problème fondamental sur la plateforme continentale. *Bull. Inst. Géol. Bassin d’Aquitaine*, 11, 191-208.

Peyouquet, J. P. 1977. Les Ostracodes et la connaissance des paléomilieux profonds. Application au Cenozoïque de l’Atlantique nord-oriental. *Fac. Sc. Bordeaux*, theses doct. es Sc. Nat., 1, 443.

Ruggieri, G. 1977. Nuovi ostracodi nordici nel Pleistocene della Sicilia. *Boll. Soc. Paleont. Ital.,* 16, 1, 81-85.

Szczechura, J. 1982. Middle Miocene foraminiferal biochronology and ecology of SE Poland. *Acta Pal. Pol.*, 27, 1-4, 3-44.

Szczechura, J. & Piscra, A. In press. The biostratigraphic position of lithothamnian limestones from Chomentów (Komytnica Basin) and Weglin (Roztocze), in Central Poland. *Z. Nauk. AGH, Kraków.*

Yassini, I. 1969. Ecologie des Associations d’Ostracodes du Bassin d’Arcachon et du Littoral Atlantique. Application a l’interprétation de quelques populations du tertiaire aquitain. *Bull. Inst. Géol. Bassin d’Aquitaine*, 7, 1-288.