

BULLETIN ZOOLOGISCH MUSEUM



Vol. 6 No. 15 1978

***CLIO BARTLETTI* N.SP., A FOSSIL NEW TO SCIENCE CLOSELY
RELATED TO *CLIO CUSPIDATA* (GASTROPODA, THECOSOMATA)**

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ABSTRACT

Clio bartletti n. sp. is described from a sediment sample containing a mixture of late Pleistocene and recent pelagic and benthic sediment. The sample is described and correlated with climatic fluctuations using protoconch size as a temperature indicator. In all probability the new species is an Alleröd fossil.

Clio cuspidata (Bosc, 1802) occupies a rather isolated position within the genus *Clio*. A large shell aperture and long, laterally projecting ribs are found only in this species. Recent examination of a sediment sample, taken

by the Bartlett Expedition near the Azores at 37° 13' 48" N 28° 44' 30" W, proved that a related form existed during the Pleistocene ice ages. As far as could be reconstructed from the fossilized fragments, this taxon differs from the recent *Clio cuspidata* in the same characters as *Clio pyramidata* Linnaeus, 1767, forma *pyramidata*, differs from the tropical forma *lanceolata* (Lesueur, 1813). The shell is more slender because of the less diverging lateral ribs, and the protoconch is significantly larger than in *Clio cuspidata*. That this newly described taxon belongs to a cold water fauna is proved by other accompanying cold water elements.

DESCRIPTION OF THE SAMPLE

The sample, which was taken with a rock dredge, consisted of recently sedimented hyaline pteropod and heteropod shells, whitish pteropod shells of an older period, brown pteropod shells, and dark brown moulds of shells. Besides the brown shells, small particles of dark brown concretion of sand, Foraminifera, Bryozoa and shell fragments were also found. Other groups represented were: non planktonic Mollusca, Crustacea and fish-otoliths.

Secondary deposition must have occurred in the

sediment, as recently grown Bryozoa colonies are commonly found on the brown concretions and moulds of shells. Volcanic activities in the area of the Azores may have contributed to the disturbance and mixing of glacial sediments. It is evident that material of three periods is found mixed in the sample. These periods are indicated below as "recent", "subfossil" and "fossil". In table I the pteropod fauna of the sample is given.

TABLE I. Pteropod fauna of Bartlett stat. 2.

	Number of specimens	Protoconch volume in mm ³		
		Y	s	N
RECENT MATERIAL				
<i>Limacina inflata</i>	9			
<i>Styliola subula</i>	21			
<i>Clio pyramidata</i>	85	0.010	0.0015	37
<i>Clio cuspidata</i>	1	0.012	-	1
<i>Cuvierina colummella</i>	4			
<i>Diacria trispinosa</i>	21			
<i>Cavolinia inflexa</i>	+ 300			
SUBFOSSIL MATERIAL				
<i>Limacina retroversa</i> f. <i>balea</i>	5			
<i>Styliola subula</i>	9			
<i>Clio pyramidata</i>	190	0.011	0.0016	44
id. typical: <i>lanceolata</i>	3	0.008	0.0015	3
<i>Clio bartletti</i> n. sp.	19	0.018	0.0029	9
<i>Cuvierina colummella</i>	11			
<i>Diacria trispinosa</i>	2			
FOSSIL MATERIAL				
<i>Limacina inflata</i>	1			
<i>Limacina retroversa</i> f. <i>balea</i>	20			
<i>Styliola subula</i>	25			
<i>Clio pyramidata</i>	246	0.010	0.0015	23
id. typical: <i>lanceolata</i>	36	0.009	0.0015	16
<i>Clio cuspidata</i>	1	0.013	-	1
<i>Cuvierina colummella</i>	2			

DATING AND PALEOCLIMATE

The presence of *Limacina retroversa* at this latitude indicates that the subfossil and fossil material is of Pre-Boreal or older origin.

Comparison with Mediterranean sediments described by Pastouret (1970) shows that the subfossil material originates from the Alleröd (presence of *Diacria trispinosa*), and that the fossil material may date from the Late Würm.

The protoconch size of *Clio pyramidata* is a useful indicator for water temperatures (Diester-Haass & Van der Spoel, in press). The values for the volume of the protoconchae in the recent *Clio* material are slightly higher than expected for the latitude of 37° N. The subfossil material consists of two types of shells, one with an average protoconch volume of 0.011 mm³ and the other with an average of 0.008 mm³, which indicates that material of a colder and a warmer period is mixed. Associated with these specimens of *Clio pyramidata*, a species closely resembling *Clio cuspidata* is found with a protoconch volume of 0.018 mm³. The normal volume for *C. cuspidata* at this latitude is 0.012 mm³ so that the relative of *C. cuspidata* seems to be a cold water form, which lived together with the specimens of *C. pyramidata* with the protoconch volume of 0.011 mm³. The fossil material shows relatively small volumes for the protoconchae, reflecting the presence of the tropical *Clio pyramidata* forma *lanceolata* (protoconch volume 0.007 mm³) together with a form transitional between the cold water forma *pyramidata* and the tropical forma (protoconch volume 0.009 mm³). Probably the brown shells of this sample, "the fossils", are from the interstadial before the Dryas, whereas the "sub-fossil" fraction reflects a period of strong warming up, mixed with cold water forms.

FAUNA OF THE SAMPLE

Limacina inflata (d'Orbigny, 1836) is a common species in this area ranging north to about 50° N.

L. retroversa (Fleming, 1823), (fig. 6-7) is considered to be composed of two forms of which the forma *balea* (Möller, 1841) is found in the

present material. The living species is not known from plankton samples in the area of the Azores, it occurs only more northwestwards of this area. Its presence in the non-recent fraction of the sample points to a climate colder than found in recent times.

Styliola subula (Quoy & Gaimard, 1827) shows the same distribution as *L. inflata* which makes its indicatory value for this area less important.

Clio pyramidata Linnaeus, 1767 (fig. 1-2, 8-9) is normally found in this area over longer geological periods, and the protoconchae are only of value for paleoclimatological indications as discussed above.

Clio cuspidata (Bosc, 1902) (fig. 10), is a common species for this area, ranging north to about 60° N. Its absence in the subfossil material and its presence in the fossil fraction is, however, also an indication for the relatively cold climate during which the subfossil fraction has sedimented. In this cold period the next species may be considered to replace *C. cuspidata*

Clio bartletti n. sp., see below.

Cuvierina columella (Rang, 1827) shows the same distribution as *L. inflata* and *S. subula* and gives no special information on the sample. The fragments of this species were too small to identify it as to forma, but most probably it will be the forma *atlantica* Van der Spoel, 1970.

Diacria trispinosa (De Blainville, 1821) is comparable in distribution with the preceding species, though it penetrates still further north.

Cavolinia inflexa (Lesueur, 1813), only found as recent specimens, also gives no information concerning the age of the sediment.

Clio bartletti n. sp.

(fig. 3-5)

Holotype: ZMUC one protoconch with part of teleconch. Paratypes: ZMUC two protoconchae with fragment of teleconch. Type locality: Bartlett Exped., Station 2; 37° 13' 48" N 28° 44' 30" W, 480 m depth, rock dredge, 30-1-1975.

Description: Shell fragments, usually with protoconchae, are smaller than 4 mm in length.

Holotype, 3.44 mm long, 1.48 mm wide and 2 mm thick at the aperture. The pyramidal shell is slightly bent ventrally, strongly compressed laterally, and provided with nearly straight lateral sides in ventral view.

In the upper part of the fragments the first transversal ribs (3 in the holotype) are seen and the beginning of the lateral ribs. The whitish, somewhat glossy shells show cracks, especially in the lower parts. The embryonic shell is relatively short but still of the droplet shape.

ACKNOWLEDGEMENTS

The author is very much indebted to Dr. J. Knudsen, Zoological Museum, University of Copenhagen (ZMUC), who carefully sorted out and provided the Bartlett material.

LITERATURE

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Received : 23 November 1977
Mailing date: 15 August 1978

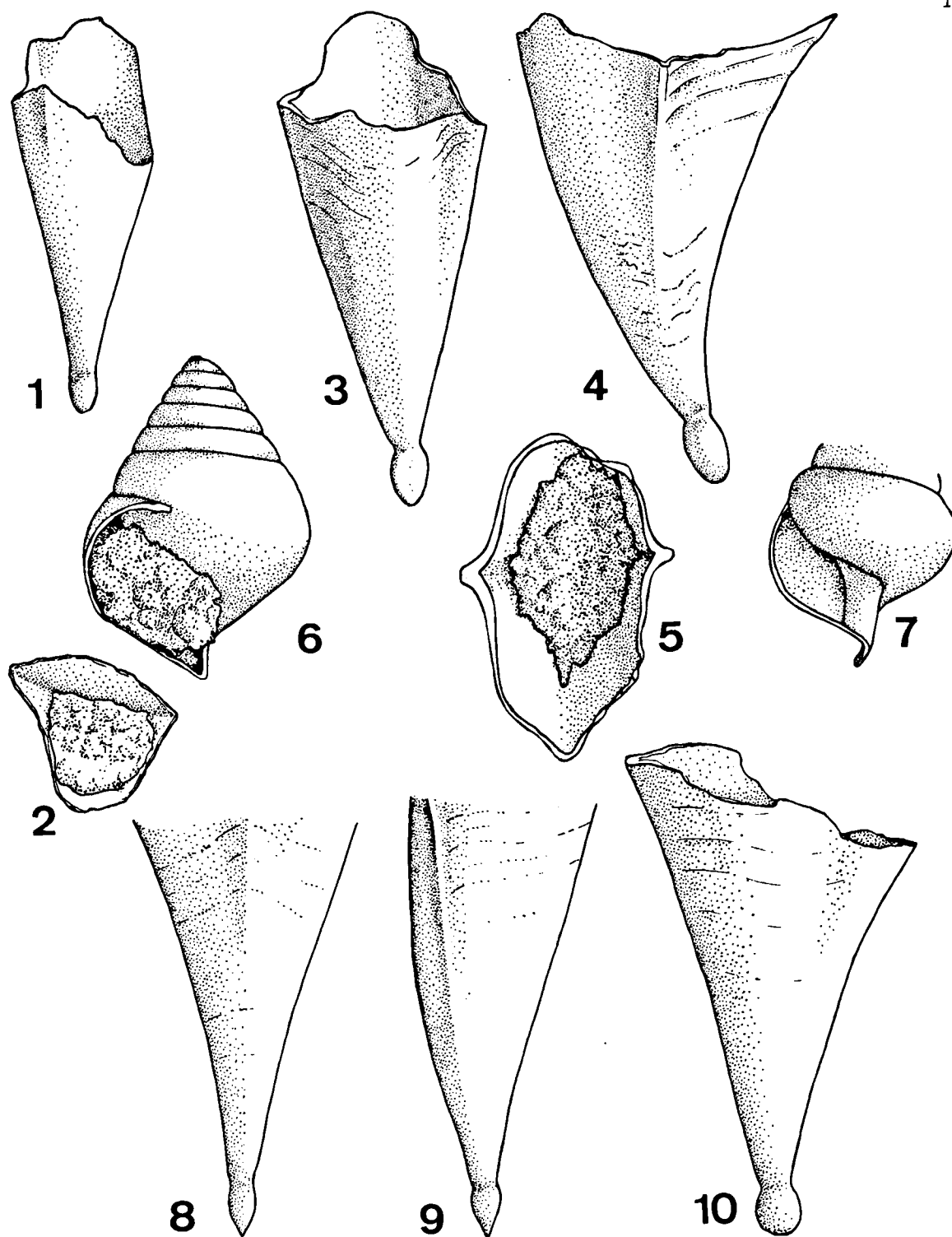


Fig. 1-2 *Clio pyramidata* Linnaeus, 1767, from the fossil fraction. 1: specimen seen from ventral side. 2: same specimen seen from aperture side.

Fig. 3-5 *Clio bartletti* n. sp. 3: holotype seen from ventral side. 4: same specimen seen from lateral side. 5: same specimen seen from aperture side.

Fig. 6-7 *Limacina retroversa* (Fleming, 1823) from fossil fraction.

Fig. 8-9 *Clio pyramidata* Linnaeus, 1767, from recent fraction. 8: specimen seen from ventral side. 9: same specimen seen from lateral side.

Fig. 10 *Clio cuspidata* (Bosc, 1802) from fossil fraction seen from ventral side.