TEREDINID (BIVALVIA) PALLETS FROM THE PALAEOCENE OF NORTH AMERICA

by ALAN M. CVANCARA

ABSTRACT. Well-preserved teredinid pallets from the Cannonball Formation (Danian) of North America are the oldest known for that continent and constitute the second occurrence for the Palaeocene. The Cannonball pallets establish the existence of the extant genus, *Nototeredo*, in the earliest Palaeocene. All Cannonball teredinids are included within *N. globosa* (Meek and Hayden).

FOSSIL teredinid bivalve mollusks are represented usually by globular shells or calcareous tubes lining borings in wood. Unfortunately these structures are of very little taxonomic use (Turner 1966, pp. 61, 64–5). The pallets, hard structures at the base of the siphons for closing the tube, are used primarily for generic and specific determination. Because fossil pallets are discovered rarely, the purpose of this paper is to describe and illustrate well-preserved specimens from the Cannonball Formation (Palaeocene) of central North America (North Dakota).

The Cannonball pallets are the oldest known in North America; elsewhere only in Iraq have they been taken from rocks as old as the Palaeocene (Elliott 1963). Turner (1966, p. 14–17) has reviewed the fossil record of the Teredinidae and noted the relatively few occurrences of pallets from the Tertiary.

The Cannonball Formation is a clastic sequence, of up to 1300 m. (Fox and Olsson 1969, p. 1397) of largely poorly consolidated, light greyish-green sandstone and medium to very dark grey mudstone. I have synthesized the detailed stratigraphy elsewhere (Cvancara 1965). Recently, the age of the Cannonball, based on planktonic foraminiferids, has been assigned as earliest Palaeocene or early Danian (Fox and Olsson 1969, p. 1400). Macrofossils of the Cannonball consist mostly of gastropod and bivalve mollusks, (Stanton 1920, Cvancara 1966), with few crustaceans (Holland and Cvancara 1958) and small coelenterates (Vaughan 1920). Vertebrate fossils, with the exception of shark teeth, are generally rare.

The specimens figured in this paper are deposited at the University of Michigan Museum of Paleontology (UMMP).

SYSTEMATIC DESCRIPTION

Class BIVALVIA Linnaeus 1758
Family TEREDINIDAE Rafinesque 1815
Genus NOTOTEREDO Bartsch 1923

Type species. *Teredo edax* Hedley 1895.

Diagnosis. Pallets oval to broadly oval, with short stalk. Blade thin, outer face convex, inner face concave. Blade segmented, with segments closely packed and appearing arranged concentrically near tip, where small depression may be present. Shells like

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those of *Teredo*, *Lyrodus*, and *Bankia*. Tubes concamerate at posterior end. (After Turner 1966, p. 78; only those characters apparent in fossil species are included.)

Nototeredo globosa (Meek and Hayden) 1858

(for synonymy see Cvancara 1966, p. 350)

Diagnosis. Pallets (Pl. 121, figs. 4, 6–9, 11, 13) elongate, flattened-spoonlike. Stalk hollow, exposed part very short, only about $\frac{1}{6}$ of total length of pallet. On inner face of blade, stalk evidenced as only low, rounded ridge, almost imperceptible on distal half of blade.

Hypotypes. UMMP 47370 and 57578–86.

Material. See Cvancara (1966, p. 357) for all material; twenty-two, mostly incomplete, pallets are included.

Remarks. Teredinids in the Cannonball Formation are evidenced largely by shells (Pl. 121, figs. 1–3, 5, and 10) and tubes, which may be concamerate (Pl. 121, fig. 12). The tubes line borings which occur in well-preserved petrified wood or in very fine-grained sandstone and sandy claystone in which little, if any, of the wood structure remains.

Thin-sections were cut of teredinid-bored wood from six Cannonball localities (including localities 1 and 4, listed below under *Occurrence*). All wood specimens from the six localities were from the lower middle or lower part of the formation. Because of preservation inadequate for details essential for accurate identification, the taxonomy of the bored wood is uncertain. However, both 'hardwoods' and softwoods' are represented, and five species are apparently demonstrated from the six localities. Either *Sequoia* or *Metasequoia* is possibly present, and perhaps *Magnolia*, taken at localities 1 and 4.

Pallets were found at two localities, associated with the *Magnolia*? wood at locality 4 and with unidentified wood at locality 2. At both localities they have been noted in direct association with shells (Pl. 121, figs. 11 and 13, and Cvancara 1966, pl. 9, fig. 28). Pallets were found usually attached to the sides of tubes and they, with the shells, were encrusted uncommonly with calcite (Pl. 121, fig. 11).

EXPLANATION OF PLATE 121

Nototeredo globosa (Meek and Hayden). Cannonball Formation, Palaeocene. All figures are ×4 unless otherwise indicated.

Figs. 1–3. Right exterior, posterior and dorsal views of conjoined valves. Hypotype. UMMP 47370; locality 1.

Figs. 4, 7. Outer and inner faces of two different pallets. Hypotypes, UMMP 57578 and UMMP 57581, respectively; locality 2.

Fig. 5. Interior of left valve. Hypotype, UMMP 57579; locality 2.

Figs. 6, 9. Oblique and proximal views of two pallets in tube. Hypotype, UMMP 57580; locality 2.

Fig. 8. Outer face of pallet attached to tube. Hypotype, UMMP 57582; locality 2.

Fig. 10. Exterior of right valve in tube. Hypotype, UMMP 57583; locality 1.

Fig. 11. Two valves and two pallets, all calcite-encrusted, attached to tube. Hypotype, UMMP 57584; locality 4; ×2.

Fig. 12. Concamerate tubes, that on extreme left with a calcite-encrusted valve. Hypotype, UMMP 57585; locality 3; ×2.

Fig. 13. Tubes with shell and pallets; one tube (left) has conjoined valves and a single pallet and another (right) contains two pallets. Hypotype, UMMP 57586; locality 2.

I have placed all Cannonball teredinid material within *Nototeredo globosa* (Meek and Hayden) although pallets, for assignment to *Nototeredo*, have been taken only at two localities. The specific name '*globosa*' was based originally upon tubes and shells, but it is retained because it was the first name applied to teredinid specimens now known to occur in the Cannonball Formation. I have chosen to assume that all Cannonball teredinid shells, tubes, and pallets were secreted by the same species unless further pallet finds should indicate otherwise.

Occurrence. Pallets have been collected from the middle and lower middle parts of the Cannonball Formation, whereas other teredinid specimens have been taken essentially throughout the unit. Although I have noted teredinid material from 28 Cannonball localities, the specimens illustrated here are from the following four localities:

1. South-facing hillside, NW¼ sec. 26, T. 139 N., R. 81 W., north-west edge of Mandan Foundry, off north end of 12th Avenue Northeast, Mandan, Morton County, North Dakota; University of Michigan accession, 1961/Tpa-23. Lower part of Cannonball Formation.
2. South-facing (left) cutbank of Heart River, SE¼ sec. 10, T. 138 N., R. 83 W., about 7·4 air km. west-south-west of Mandan, Morton County, North Dakota; University of Michigan accession 1962/Tpa-10. Middle part of Cannonball Formation.
3. South-facing, upper part of Mitchell Butte, SW¼ sec. 7, T. 134 N., R. 83 W., about 2 air km. east-south-east of Flasher, Morton County, North Dakota; University of Michigan accession, 1961/Tpa-10. Lower middle part of Cannonball Formation.
4. West-facing (right) cutbank of Heart River, near centre of sec. 21, T. 136 N., R. 86 W., about 6·5 air km. south of Almont, Grant County, North Dakota; University of Michigan accession, 1962/Tpa-28. Lower middle part of Cannonball Formation.

SIGNIFICANCE OF CANNONBALL PALLETS

As noted in the introduction, the Cannonball pallets are the oldest known in North America and the second occurrence recorded from the Palaeocene. Those reported from the Palaeocene of Iraq (Elliott 1963) were described from thin-sections of petrified wood; the Cannonball specimens have been taken from empty tubes and can be studied directly.

The Cannonball specimens also establish the existence of the genus *Nototeredo* at least as early as earliest Palaeocene. This genus is presently world-wide and occurs in fully marine, tropical to cold temperate seas. The Cannonball species is closest to the living *N. norvagica* Spengler which probably occurs largely along the Atlantic European Coast and in the Mediterranean (Turner 1966, pp. 16, 78, and 258).

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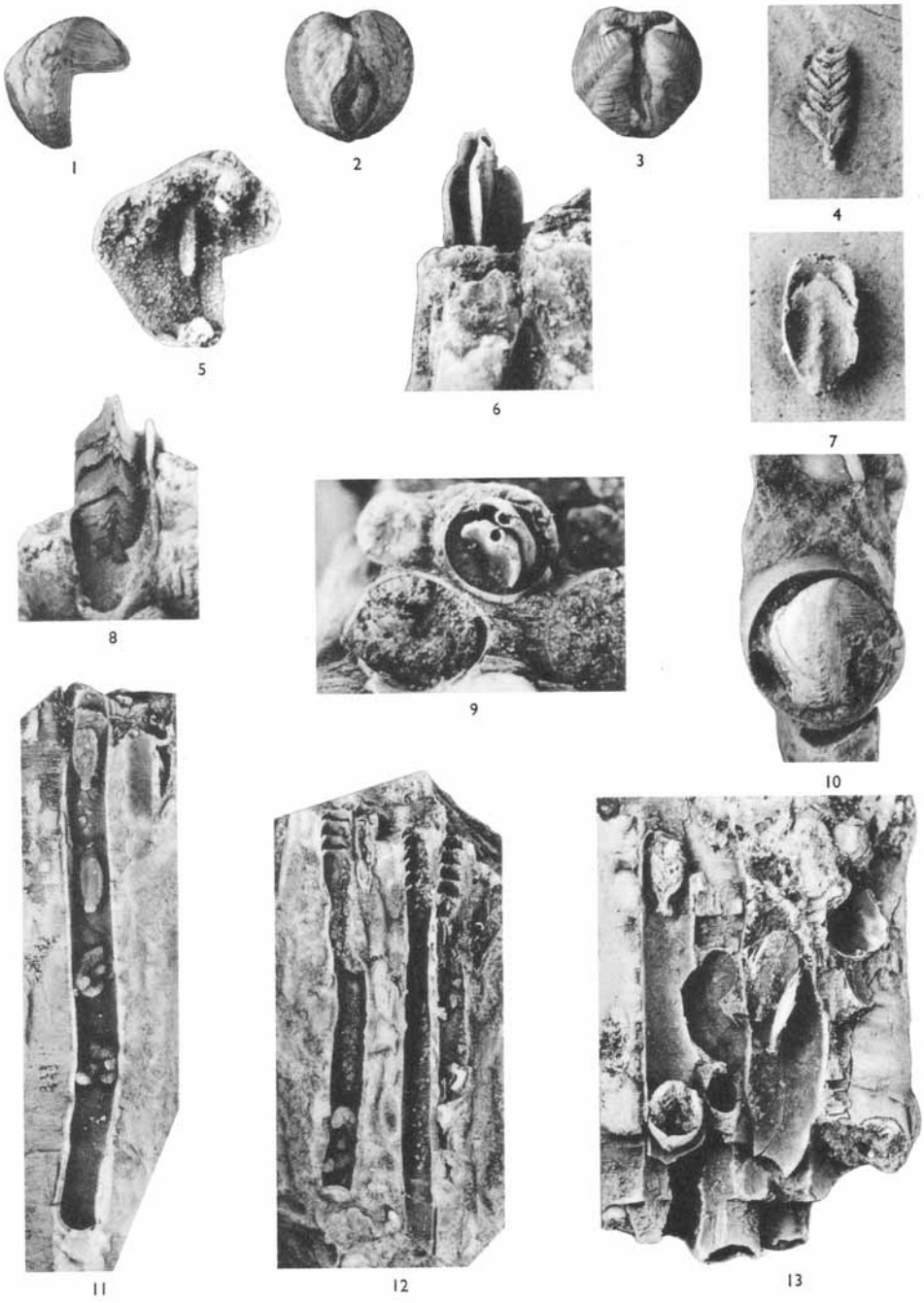

CVANCARA, Paleocene *Nototeredo*