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First record of *Megayoldia thraciaeformis* (Storer, 1838) (Bivalvia) from the Pleistocene of the North Sea Basin

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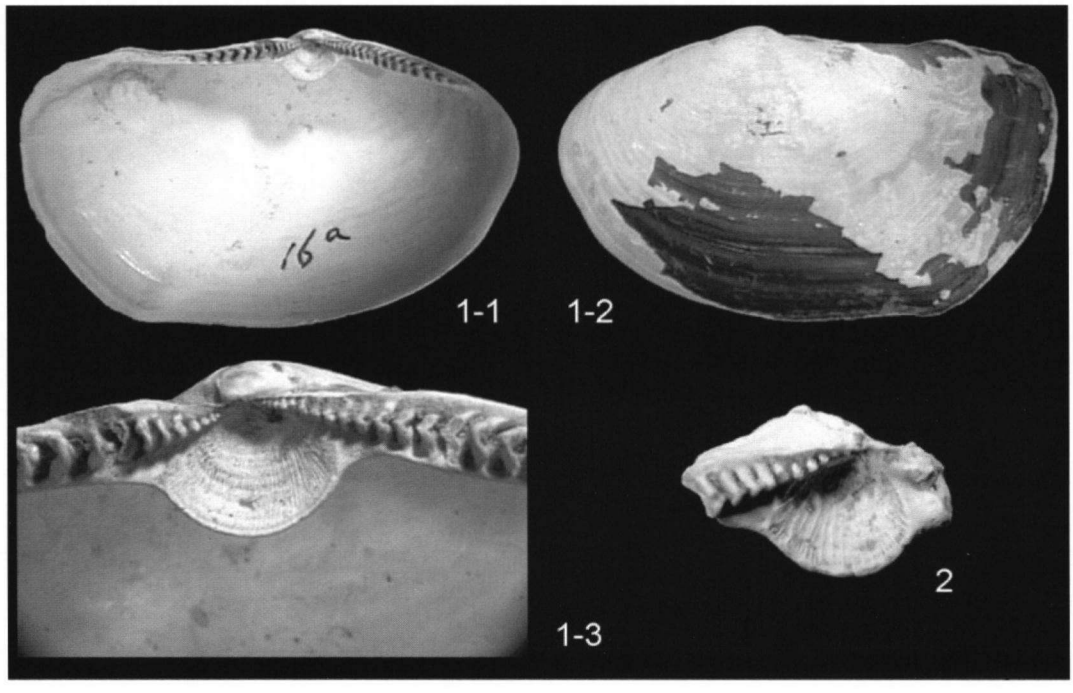
Material assignable to the yoldiid bivalve *Megayoldia thraciaeformis* is recorded for the first time from strata of Early Pleistocene age penetrated in boreholes at Brielle and Noordwijk (the Netherlands). At the present day, *M. thraciaeformis* occurs in the Pacific and western Atlantic.

KEY WORDS: Mollusca, Bivalvia, Yoldiidae, Pleistocene, North Sea Basin.

Introduction

In support of extensive civil engineering projects within the Dutch Deltaworks programme, and in order to monitor ground water level and quality, the so-called 'Deltadienst Rijkswaterstaat' executed numerous wells in the SW Netherlands during the 1950s and 1960s. These boreholes are well documented, with samples deposited in the collections of the Nationaal Natuurhistorisch Museum (Naturalis, Leiden).



Figures 1, 2. *Megayoldia thraciaeformis* (Storer, 1838); **1-1, 1-2 and 1-3**: right valve from Massachusetts Bay, Gulf of Maine (USA), Recent (collections of Mollusca Department, Nationaal Natuurhistorisch Museum, Leiden; leg. unknown); length 41 mm, with detail of ligament area; note typical striae; **2**: fragment of umbonal part of right valve (width 4 mm), from borehole Brielle, depth 272-273 m below surface (collections of Division of Cainozoic Mollusca, Nationaal Natuurhistorisch Museum, Leiden).

Of these, material from borehole Brielle (37D134; Deltadienst code 37D1-23) has been reported on previously, *e.g.* pollen content (van Voorthuysen *et al.*, 1972), terrestrial and freshwater molluscs (Kuijper, 1973), and mammals and pollen (van der Meulen & Zagwijn, 1974).

Recently, the Deltadienst borehole samples have become the focus of renewed interest in the geology of this part of the country, with the emphasis on the lithology and molluscan assemblages (both marine and non-marine) of Pliocene, Pleistocene and Holocene strata.

Borehole Brielle has yielded fragments of a taxodont bivalve which could not be identified with available literature sources for the Pleistocene of the Netherlands. Surprisingly, these have now turned out to be assignable to *Megayoldia thraciaeformis* (Storer, 1838), which at present occurs in the Pacific and western Atlantic oceans. Conspecific material has also been recognised in samples from borehole Noordwijk (30F470). This addition to the molluscan faunas from the Lower Pleistocene of the North Sea Basin is here briefly described.

Systematic palaeontology

Family Nuculanidae Adams & Adams, 1858
Subfamily Yoldiinae Habe, 1977
Genus *Megayoldia* Verrill & Bush, 1897

Type species — *Nucula thraciaeformis* Storer, 1838 (Recent, northern Atlantic).

Megayoldia thraciaeformis (Storer, 1838)

Figures 1-1 to 1-3, 2

Material — Twelve fragments (in six samples) from borehole Brielle (37D134), depth 271-305 m below surface. This material is housed in the collections of the Division of Cainozoic Mollusca, Nationaal Natuurhistorisch Museum, Leiden, the Netherlands. Five fragments (in four samples) from borehole Noordwijk (30F470), depth 251.75-261.75 m below surface. Samples are kept in the Molluscan collection, Palaeoenvironmental Department TNO-NITG, Utrecht, the Netherlands.

Megayoldia thraciaeformis occurs at levels dated as Early Pleistocene, containing such typically Arctic molluscan taxa as *Nuculana minuta* (Müller, 1776), *Nuculana pernula* (Müller, 1779), *Yoldia* spp., *Clinocardium ciliatum* (Fabricius, 1780) and *Pandora glacialis* Leach, 1819.

Description – In view of the fact that the Dutch material consists exclusively of fragments (see Figure 2), the description below is based both on extant shells (Figure 1-1 to 1-3) and literature data.

Adult shells slightly quadrangular in outline, reaching lengths of up to *c.* 65 mm; posterior part of shell widest, anterior part compressed. Umbo is positioned in the anterior part of the shell. Typical are a concave shell margin posterior of the umbo and an oblique fold which runs from the umbo to about the posterior third of the ventral margin. On both sides of the umbo a rather broad row of teeth is present. The well-developed ligament pit directly beneath the umbo is wide and concave; its surface ornamented with radial striae, a feature typical of the genus *Megayoldia*.

Juvenile shells should be more difficult to recognise, as this species shows considerable disproportional growth of the posterior part of the shell during ontogeny. Juveniles are oval in outline with the umbo in the posterior part of the shell. Furthermore, in specimens of *c.* 2.6 mm in length, the ligament pit has not yet developed; it does not become clear until lengths of about *c.* 5 mm have been reached. On account of this disproportional growth, there are numerous synonyms of *M. thraciaeformis* in the literature (Warén, 1989).

Distribution – At present, *M. thraciaeformis* ranges from the northern Pacific to the south (California, San Francisco Bay) and Japan (Sagami), to the northern Bering Sea and low Arctic Ocean (Coan *et al.*, 2000); there are no records west of 160° E. In the western Atlantic, it occurs off Massachusetts and to the north and off the southwest coast of Greenland, at depths between *c.* 25 and 760 metres (Warén, 1989). The species is absent from the Canadian central and eastern Arctic (Lubinski, 1980).

From the fossil record, the species is known from the Oligocene of western North America (Coan *et al.*, 2000), the Miocene, Pliocene and Pleistocene of the northern Pacific province (Scarlato, 1981) and the Upper Pleistocene of Baffin Bay (Canada; see Blake, 1998). From the eastern Atlantic, there is a single record from NW Scotland (Sound of Skye), dredged from depths of *c.* 50 fathoms, in association with *e.g., Portlandia arctica* (Gray, 1824) and *Chlamys islandica* (Gmelin, 1791) (see Wood, 1851), *i.e.* most probably of Pleistocene age. Added to this are the present records from the Lower Pleistocene of the Netherlands.

Discussion

It is remarkable that *M. thraciaeformis* is included in Wood's (1850-1856) monograph on the Crag molluscs of East Anglia. That record is based on a specimen dredged 'at a depth of about 50 fathoms' in the Sound of Skye (Atlantic coast of Scotland). Wood did not indicate the stratigraphic age (nor its range) of this shell, but it seems to us that it cannot be older than Late Pleistocene. Other species recorded from the Sound of Skye, *e.g. Pecten islandicus* (Müller, 1776) and *Leda pygmaea* (von Münster, 1837), have been described from the 'Clyde Beds' which are correlated with the Weichselian. *Leda pygmaea* is already known from Oligocene strata; the Pliocene and Recent form of this species is known as *Yoldiella philippiana* (Nyst, 1845) - it survives along the northwestern coast of England and Scotland.

Megayoldia thraciaeformis is another representative of

a faunal invasion of Pacific taxa into the northern Atlantic which occurred during the Middle/Late Pliocene and Early Pleistocene (Meijer, 1993). Similar to other bivalves, *e.g. Yoldia myalis* (Couthouy, 1838), *Mactromeris polynyma* (Stimpson, 1860) (see Moerdijk, 2003) and *Mya arenaria* (Linné, 1758), it survived to the present day along the east coast of North America, but went extinct in Europe. Apart from Wood's specimen and the present records, we did not succeed in finding any other mention of *M. thraciaeformis* from the eastern Atlantic.

The occurrence of *M. thraciaeformis* in a specific depth range in boreholes Brielle and Noordwijk might reflect a limited duration of this species in the North Sea Basin. In borehole Noordwijk, it is found in the last cold phase of the Praetiglian. The Praetiglian is now considered to be a composite of three short cold phases, separated by two temperate phases (Funnell, 1998). Each of these lasted for *c.* 40 ka. The interval in the Brielle borehole, which has yielded this species, is of Praetiglian age according to van Voorthuysen *et al.* (1972). Thus, *Megayoldia thraciaeformis* may prove to be a useful stratigraphic indicator within the Lower Pleistocene of the North Sea Basin.

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