“Fossil Cuff-links” : A New Miocene Trace Fossil of the Genus Diplocraterion from New Zealand

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"Fossil Cuff-links": A New Miocene Trace Fossil of the Genus *Diplocraterion* from New Zealand

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Abstract

A trace fossil from mudstone in the Lower Miocene Blue Bottom Formation, Westland, New Zealand, producing distinctive cross sections like cuff-links, is a U-tube boring with a *Spreite* linking the arms, and is described as *Diplocraterion morgani* n. sp. It is apparently the first record of *Diplocraterion* from Tertiary rocks.

The Minutes of a meeting of the Geology Section, Royal Society of New Zealand (Wellington Branch) on 10 June 1943, record that "Dr. Marwick exhibited specimens sent to him by Mr. D.E. Morgan of N.Z. Oil Exploration Company, showing fine light mudstone marked by two darker cylinders connected by a band, the size and shape of a cuff-link, collected from Blue Bottom at Dillman's, and asked if anyone would suggest how they were formed". The present paper is a belated answer to this request.

There was much discussion between Dr. J. Marwick, Mr. Morgan and their colleagues on the nature of these fossils, which were facetiously christened "Cufflinkia". As the years went by, descriptions and illustrations of similar structures were noticed in geological literature (especially Richter, 1927) and the New Zealand "fossil cuff-links" were recognized as parts of U-tubes, linked by a septum formed by arcuate relics of collapsed U-tubes, now commonly known by the German word *Spreite* (Fig. 1).

![Fig. 1. Diagram illustrating the general morphology of a rhizocorallid U-boring with Spreite, showing cross-section (x-y) of cuff-link form.](image)

Two of the original "fossil cuff-links" remain in the Geological Survey, labelled "Arahura District" and "Dillman's, Westland" (Pl. 50, figs. 1, 2).

Early in 1971, I asked Mr. Simon Nathan if he could search for the fossil. He recognized the matrix as similar to the lower part of the Blue Bottom Formation in the Grey-mouth-Hokitika area and established its Clifdenian age from Foraminifera examined by Mr. R.H. Hoskins. Later he found similar specimens in outcrops near Kumara and collected a series.

Much has been published on U-tube trace fossils, particularly in Germany, where they occur abundantly in the Bunter (Triassic). A good recent summary in English by Osgood

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* New Zealand Geological Survey, Lower Hutt, New Zealand
(1970) includes illustrations of many examples from the Ordovician of the Cincinatti area, U.S.A.

DOMICHNIA

Trace fossils representing dwelling structures of sessile or partly sessile benthic animals.

Family RHIZOCORALLIDAE Richter

U-tubes with the arms of the U linked by a Spreite, a narrow zone of arcuate relics of U-tube excavation.

Genus Diploceraterion Torell, 1870

Vertical or near-vertical U-tubes with Spreite, the arms of the U parallel or diverging at depth. (see Hántzschel, 1962, p. 192.)

In the type species (D. parallelum Torell), from the Lower Cambrian of Sweden, the upper ends of the tubes end in funnels. Similar tubes without funnels have been grouped as Corophioides John Smith, 1893, based on C. polypusilon Smith from the Upper Carboniferous of Scotland, a genus which has been recorded from Cambrian to Upper Cretaceous (Hántzschel, 1962). Some authors consider Corophioides a synonym of Diploceraterion, the only difference according to Osgood (1970) being the presence of funnels in the latter. Moreover, similar U-tubes have been called Diploceraterion if vertical and Rhizocorallium if oblique or horizontal, the differences being attributed to the depth of deposition and energy of the environment.

The Spreite or sculptured parting that forms the link between the “cuff-links” is the result of collapse when the inhabitant of the U-tube deepened it or moved upwards in the sediment. According to Osgood living amphipods, such as Corophium, construct burrows with Spreite, while the polychaete Polydora, boring in mud or in the aragonite of bivalve shells, also constructs a U-tube with a constructional Spreite.

In the similar genus Rhizocorallium, a curved U-tube lies obliquely or parallel to the bedding and the tubes bend at up to 90° to open at the surface. Rhizocorallium also has striated arms. These differences are gradational and the “ichnogenera” are thus poorly defined.

The New Zealand Tertiary species lies more or less normal to the bedding. Its arms are parallel and close, more like those of Diploceraterion parallelum Torell than of species of Corophioides figured by Hántzschel (1962) and Osgood (1970). The presence of funnels is uncertain. Of all tubes illustrated in available publications, it most closely resembles that of the European Recent Polydora ciliata (Johnston), excavated in semi-consolidated mud exposed to highly turbulent water, figured by Seilacher (1967) but is much larger.

Diploceraterion morgani, n. sp.
Pl. 50, figs. 1–7, Text-fig. 1

Description: – U-tube borings with a Spreite, the tubes ranging from 2 to 6 mm in diameter (mean of 20 measurements, 3.4 mm), parallel and closely approximated so that the Spreite is about the same width as the adjacent tube, rarely reaching twice that width. The arcs of the Spreite are poorly defined and only slightly curved; in the holotype they extend through the lumina of the tubes and are thus retrusive (Osgood, 1970). In one paratype the Spreite bears vertical striae perhaps due to lop-sided development. Length of arms of U-tube exceeding 120 mm; bottom of tube unknown.

Tube filling of granular sediment, probably faecal pellets, commonly strongly but irregularly pyritized. The amount of pyrite varies vertically, and in individual cross
sections shows a tendency to form a horse-shoe open towards the Spreite, as if the inhabitant occupied the mesial side of the tube, filling the rest with facces. Spreite also irregularly pyritized in some specimens. Walls of arms vertically striated. With weathering a halo of iron-oxide extends from the tubes and the lamellar Spreite giving an exaggerated impression of their diameter and resulting in the cuff-link appearance of transverse sections. In one specimen there is no trace of Spreite. In oblique sections the cross-sections are elliptical and the Spreite wider. In one fragment the pyritized contents of the lumen apparently expand from 3 mm to 6.5 mm diameter, suggesting a funnel. Although the collectors report that the tubes are mostly normal to the bedding, one block contains two specimens differing in orientation by 30°.

Holotype and figured paratypes in N. Z. Geological Survey.

Remarks: – D. morganii differs from D. parallellum Torell and from species figured as Corophioides by Osgood (1970) and Hanttschel (1962) in its closely approximated arms and narrow Spreite with shallow arcs; in addition it occurs in a different depositional environment.

This species is dedicated to David E. Morgan, formerly of Bataafse Internationale Petroleum Mij. N.V.

Localities: – “Dillman’s” (=Dillmanstown) and “Arahura District” (S51/784), collected by D.E. Morgan, 1943. South bank, Taramakau River, immediately downstream from bridge (GS 10833, S51/785, grid ref. 727665), holotype and about 20 paratypes (collected by S. Nathan and R.H. Hoskins, Jan. 1971). Judged by differences in preservation, S75/785 is not one of Morgan’s localities.

Age: – S51/784 and 785 are Clifdenian (Lower Miocene) by associated Foraminifera (R.H. Hoskins, pers. comm.).

Paleoecology: – The unweathered matrix is a massive moderately calcareous light gray silty mudstone, containing a rich assemblage of benthic Foraminifera and a smaller number of pelagics, suggesting deposition on the outer shelf in about 120 m (R.H. Hoskins). Scattered macrofossils include irregular echinoderms, Laevidentalium and fish scales.

In the Upper Jurassic of the Boullonais, France, Ager & Wallace (1970) have described a sequence of shallow water deposits containing U-borings. They confirm the conclusions of Seilacher (1967) that there is a general gradation from vertical burrows (Diplocraterion) in the shallowest water (high energy, intertidal) through oblique to horizontal burrows (Rhizocorallium) in fairly deep low energy infra-littoral environments. The association of Diplocraterion morganii with an outer shelf community in a low energy environment and its Miocene age are additional differences separating this species from other species of Diplocraterion and Rhizocorallium and from the much smaller borings of living Polydora (Seilacher, 1967).

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I am grateful to Simon Nathan who located and collected the specimens from the Taramakau Bridge (S51/785) and to R.H. Hoskins who assisted him and reported on the associated microfossils. The photographs are by Mr. Lloyd D. Homer, N. Z. Geological Survey.

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Hänttschel, W., 1962, Trace fossils and Problematica. In Treatise on Invertebrate Paleontology,


Plate 50

*Diplocraterion morgani*, n. sp., ×1

Figs. 1–4. Cuff-link cross-sections, Dillmanstown (1), Arahura district (2) with iron-oxide halo but lacking pyrite; Taramakau River, with horse-shoe fillings of pyrite (3), and with irregular filling, lacking conspicuous *Spreite* (4).

Fig. 5. Largest paratype, showing parallel arms, exceeding 120 mm in length.

Fig. 6. Paratype, showing vertical striations on tube walls.

Fig. 7. Holotype, showing ill-defined arcs of *Spreite*.

*Photo N.Z. Geological Survey*