Bulletin of the Mizunami Fossil Museum, no. 37 (2011), p. 185–188, 4 figs.

The Recent boring *Gastrochaenolites ornatus* Kelly & Bromley, 1984, in a Chalk cobble from Cromer, England

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Abstract

Both ancient and modern borings are of interest to the ichnologist. The beach between Cromer and Overstrand, eastern England, preserves numerous clasts derived from the Upper Cretaceous, mainly flints, but also Chalk preserving rare body fossils and, more commonly, modern borings assignable to a limited range of ichnotaxa. The only large borings, *Gastrochaenolites* ispp., are relatively rare. Most are too incomplete for accurate identification, but rare specimens are assignable to *Gastrochaenolites ornatus* Kelly & Bromley, including the impressive specimen described herein. The Norfolk coast is the type area for this ichnospecies, which has a circular section throughout its length and a basal sculpture of prominent, parallel circular bioglyphs separated by numerous fine, oblique striations. Although at least four bivalve taxa are known to generate such borings, the only shell recognised in the present lot is a byssally-attached nestler, *Venerupis* sp.

Key words: ichnology, Chalk, Norfolk, bioglyph, systematics

Introduction

The divide between palaeontologists and neontologists is not always determined on the grounds purely of the living and the dead. For example, the collection of extant brachiopods in the Natural History Museum in London is housed in the Department of Palaeontology, not Zoology, for the simple reason that this is where the specialists on these organisms are to be found. Ichnology is another area where the boundaries blur. Zoologists rarely work on borings *per se*, but do investigate the borers. The borings are like those found in the rock record and, if the borer is not preserved, they are identical to specimens normally handled by palaeoichnologists. Herein, I present an interesting neoichnological specimen from the north coast of Norfolk and consider it with a palaeoichnological eye.

Pebbles and cobbles (rarely boulders) on the north Norfolk coast in the area between Cromer and Overstrand are dominantly flints reworked out of the Chalk. Clasts of Chalk are rarer, although still moderately common. Erratics reworked out of the Pleistocene deposits (e.g., Donovan, 2010) and other clasts, such as rounded cobbles and boulders of concrete and brick, are rare. Chalk clasts, with or without macrofossils, are of interest to the ichnologist for being the favoured substrates for infestation by a range of invertebrate borers (Donovan & Lewis, 2010). Ichnotaxa that are most commonly encountered include *Caulostrepsis* cf. *taeniola* Clarke, 1908 (commonly produced by annelids), *Entobia* isp. (clionoid sponges) and rare *Gastrochaenolites* isp. (bivalves). Each of the first two, if present in a cobble, are commonly abundant. It is the third ichnogenus, *Gastrochaenolites*, that is rather different in its occurrence. Where present, clasts bearing these large, clavate borings preserve only one or a few examples which are commonly,

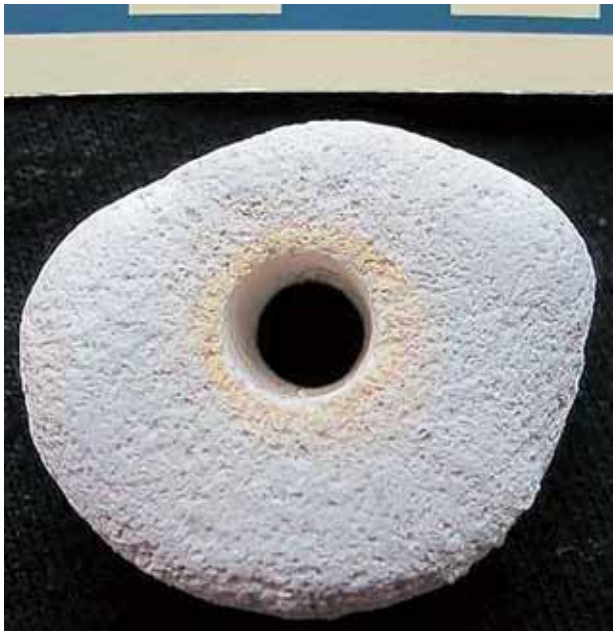

Fig. 1. *Gastrochaenolites* isp., NNM RGM 617 813. Not a Chalk signet ring, but a former cobble that was bored and then eroded down to this pebble with a hole in it. The remnants of the boring is conical, showing that the bivalve was boring and growing in the direction of the camera. Scale bar in cm.

at best, incomplete (Donovan & Lewis, 2011, fig. 3c; Fig. 1 herein). These partial specimens can never be classified any more fully than *Gastrochaenolites* isp. It was therefore unexpected to recover a particularly well-preserved *Gastrochaenolites ornatus* Kelly & Bromley, 1984, a boring which was easily determinable, even though it had been vandalised (but easily restored) shortly before it was discovered by the author. The identification of this fine specimen led to recognition of other specimens of the same ichnospecies.

Material and methods

Specimens described herein are deposited in the Netherlands Centre for Biodiversity - Naturalis (formerly Nationaal Natuurhistorisch Museum), Leiden (NNM RGM). The chalk cobble containing the best preserved specimen (Figs. 2, 3) was collected by the author on the beach at Cromer, north Norfolk, near the east end of the seawall and by the second groyne east of Cromer Pier, approximate NGR TH 227 420, in early May 2010. The beach between Cromer and Overstrand (Fig. 4) is dominantly sandy with numerous pebbles and cobbles of flint, and, more rarely, chalk. Two other cobbles containing examples of the same ichnospecies were collected from this area and a third specimen was broken open to liberate the shell of a nestling bivalve (see below).

Fig. 2. *Gastrochaenolites ornatus* Kelly & Bromley, 1984, NNM RGM 617 814. This is one of three fragments found close together on the beach, the specimen having recently been broken open by person(s) unknown. This and one other fragment has been glued back together, so this view is no longer available, but it has been cast to form an artificial (Fig. 3) infill comparable with the holotype. Scale bar in cm.

Fig. 3. *Gastrochaenolites ornatus* Kelly & Bromley, 1984, NNM RGM 617 814. Latex cast taken from restored specimen. Compare with the holotype, a natural cast (Kelly & Bromley, 1984, text-fig. 7B). Scale bar in cm. Coated with ammonium chloride.

Examination of these specimens was by hand lens and binocular microscope. Photography was with a Canon PowerShot G11 digital camera. The Chalk specimens were not coated for photography, but were soaked in tap water to remove salt and dried in a sunny window. The latex cast was coated with ammonium chloride for photography. Descriptive terminology of borings follows Häntzschel (1975). Our philosophy of open nomenclature follows Bengtson (1988).

Systematic ichnology

Ichnogenus *Gastrochaenolites* Leymerie, 1842

Type ichnospecies: *Gastrochaenolites lapidicus* Kelly & Bromley, 1984, p. 797, by subsequent designation of Kelly & Bromley (1984).

Other ichnospecies: *Gastrochaenolites ampullatus* Kelly & Bromley, 1984; *Gastrochaenolites anauchen* Wilson & Palmer, 1998; *Gastrochaenolites cluniformis* Kelly & Bromley, 1984; *Gastrochaenolites cor* Bromley & D'Alessandro, 1987; *Gastrochaenolites dijugus* Kelly & Bromley, 1984; *Gastrochaenolites hospitium* Kleemann, 2009; *Gastrochaenolites oelandicus* Ekdale & Bromley, 2001; *Gastrochaenolites orbicularis* Kelly & Bromley, 1984; *Gastrochaenolites ornatus* Kelly & Bromley, 1984; *Gastrochaenolites pickerilli* Donovan, 2002; *Gastrochaenolites torpedo* Kelly & Bromley, 1984; *Gastrochaenolites turbinatus* Kelly & Bromley, 1984; *Gastrochaenolites vivus* Edinger & Risk, 1994.

Diagnosis: (After Kelly & Bromley, 1984, p. 797.) "Clavate borings in lithic substrates. The apertural region of the boring is narrower than the main chamber and may be circular, oval, or dumb-bell shaped. The aperture may be separated from the main chamber by a neck region which in some cases may be widely flared. The main chamber may vary from subspherical to elongate, having a parabolic to rounded truncated base and a circular to oval cross section, modified in some forms by a longitudinal ridge or grooves to produce an almond- or heart-shaped section. The general range in morphology of species of *Gastrochaenolites* is shown in [Kelly & Bromley, 1984] text-fig. 3A-H."

Remarks: *Gastrochaenolites* ispp. are typically associated with the actions of endolithic bivalves, but similar borings are also excavated by Recent coralliophilid gastropods and some sipunculan worms (Bromley, 2004, p. 462).

Gastrochaenolites ornatus Kelly & Bromley, 1984

(Figs. 2, 3)

Material: Three cobbles, NNM RGM 617 814–617 816. The best preserved is NNM RGM 617 814, which was found in three pieces; presumably it had been broken to liberate the shell of the borer, now sadly unknown (but see below). One fragment (Fig. 2) and a latex cast taken from the restored boring (Fig. 3) are illustrated; two of the three sections have been glued together and the third is easily removed to demonstrate morphology. Other specimens are not as well preserved. NNM RGM 617 815 shows parts of four (a fifth is *Gastrochaenolites*? isp.) borings and NNM RGM 617 816 retains just one; all five of these specimens are preserved as longitudinal sections.

Diagnosis: (After Kelly & Bromley, 1984, p. 801) "*Gastrochaenolites* that are circular in cross-section throughout. Deepest portion bears circular or spiral bioglyph, sometimes serrated grooves."

Description: (Based on all specimens, but mainly on NNM RGM 617 814 before it was partially restored.) Elongate, unlined clavate borings in a Chalk substrate, circular in cross section and with or without a slightly bulbous basal termination. Not infilled. Neck with a smooth shaft, gently widening towards the main chamber (Fig. 3). The main chamber bears a sculpture of prominent, parallel circular bioglyphs that are separated by numerous fine, short and oblique striations (compare with the holotype; Kelly & Bromley, 1984, text-fig. 7C, D). Aperture unknown. The figured (and most complete) specimen is 63 mm long, albeit incomplete, and about 25 mm in maximum diameter.

Remarks: All of the identifiable *Gastrochaenolites* borings that I have collected from this part of the coast are assigned to *G. ornatus*; many other specimens are too poorly preserved to enable a more complete designation than *Gastrochaenolites* isp. (e.g., NNM RGM 617 813; Fig. 1). Kelly & Bromley (1984, p. 801) recorded the holotype (the Natural History Museum, London, S. Woodward Collection 32602) as coming from the "[p]ost-Pliocene, from Hasborough Cliff, Norfolk". The specimens documented herein thus come from the type area, but are younger than the holotype. Unlike the specimens from Overstrand and Cromer, the holotype is preserved as a natural internal mould, testifying to its ancient origin and bearing witness to the persistence of this manner of infestation in the region.

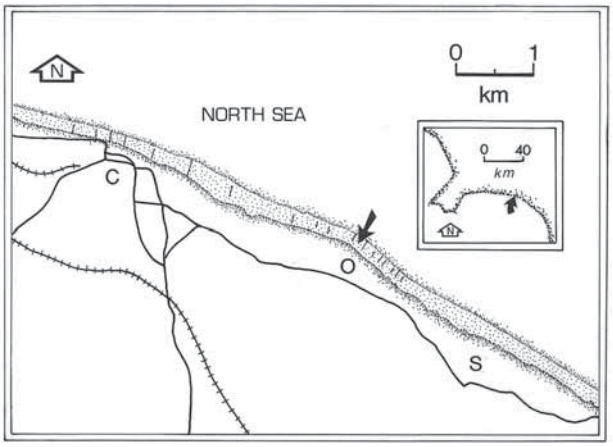

Fig. 4. Outline map of the north coast of Norfolk between Cromer (C), Overstrand (O) and Sidestrand (S), after Donovan (2010, fig. 1). The dark arrow indicates the author's point of access to the beach. The stippled area is between the low water mark and cliff top; it includes both the beach (groynes are indicated) and slope of the cliffs. Principal roads are shown as solid lines; railways are shown as trellised lines.

The holotype contains the *in situ* remains of the boring bivalve *Zirfaea crispata* (Linné) (Kelly & Bromley, 1984, text-fig. 7B). Kelly & Bromley listed a range of further bivalve taxa forming these borings, including *Jouannetia, Barnea* and *Pholas*. A specimen from the beach near Overstrand contained a small bivalve which was released only by breaking the chalk cobble in which it was snugly entombed, but, rather than being the borer, it was a byssate nestler living within the cavity. This specimen has been identified as *Venerupis* sp. (NNM RGM 617 819).

Acknowledgements

I thank the Netherlands Centre for Biodiversity - Naturalis for financial support for this fieldwork. Phil Crabb (Photographic Unit, The Natural History Museum, London) allowed me to use his ammonium chloride puffer in my hour of need. Dr. John W. M. Jagt (Natuurhistorisch Museum Maastricht) is thanked for his detailed review.

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Manuscript accepted on June 20, 2010