Masonshaugh Quarry, Cummingstown, Grampian

[NZ 125 692]

Highlights

Masonshaugh is famous for its fossil reptile tracks. Many complete specimens of trackways were found when the quarry was operational, and these show evidence of many reptiles, small, medium and large, trotting northwards across the sands.

Introduction

Masonshaugh Quarry, situated next to a disused railway line, comprises a 400 m long north-facing exposure on the coast. The quarry lies in aeolian units of the Hopeman Sandstone Formation, and the importance of the site lies in its abundant ichnofauna of tetrapod tracks. The trackways are extremely well preserved and provide almost the sole record of tetrapods from the formation. Masonshaugh Quarry was fully operational in the 1860s, when Martin (*c.* 1860) visited and observed tracks. It was part worked in 1912, and used as a tip in the 1930s as appears in County valuation rolls. The site is now badly weathered and much rubbish has been tipped in front of it. However, the faces are free of overgrowth, and fresh workings would doubtless yield new finds *in situ.*

An extensive quarrying industry was established in Burghead and the coastal area in the 1790s. Many of the townspeople were quarriers and stonemasons and 'five large boats, with six people in each, are also employed in transporting stones from the quarries, to different parts of the country' (Anon., *in* Sinclair, 1793, vol. 8, p. 390). The stone was used largely in 'harbour and seawall building' (Duff, 1842, p. 25).

In October 1850, Captain Lambart Brickenden, a fossil collector who had moved to Elgin from Sussex, obtained a slab from quarrymen at Masonshaugh (Figure 3.5)A which showed a trackway of 34 footprints of a small animal. Since the rock was considered to be of Old Red Sandstone age, the find occasioned great excitement locally (Anon., 1850a, 1850b) and in the scientific world (Lyell, 1852, p. ix; Brickenden, 1852) as evidence of the oldest tetrapod, together with the *Leplopleuron (Teletpeton*) from Spynie (Benton, 1983c).

Numerous further slabs were collected during the 1850s (Beckles, 1859; Huxley, 1859b; Hickling, 1909). Huxley (1859b, pp. 456–9, pl. 14, figs 4, 5) described and figured footprints which were larger than those found by Brickenden. At the same time, Beckles (1859) hired workmen and carpenters and extracted many tracks from the quarry, which was supplying material for the new railway from Burghead to Hopeman on the coast.

Huxley (1877, pp. 45–52, pl. 14–16) described the 'ichnites of Cummingstone' further and named them *Chelichnus megacheirus* (Figure 3.5)B. Hickling (1909, pp. 12–14, pl. 2, figs 6–8) compared the Elgin tracks with those from Mansfield, Notts., and Penrith, and concluded that the Cummingstone (*sic*) beds were Permian in age. The tracks were revised by McKeever (1990, 1991).

Description

Masonshaugh Quarry lies in the Hopeman Sandstone Formation, and is just east of the fault separating that unit from the Burghead Sandstone Formation. In the quarry, 8 m faces of orange-weathered, jointed sandstone are exposed, extensively silicified and hardened near the fault. The well-rounded sand grains and large-scale cross-bedding suggest that the sandstones of Hopeman are here of aeolian origin, although some water-laid pebbly beds were found at the west end of the outcrop near the old railway line.

The Hopeman Sandstone Formation is best observed on the coast between Cummingstown and Covesea Skerries and Haliman Skerries, where it is some 60 m thick. The coastal exposures show large-scale cross-bedding in sandstones generally composed of well-rounded quartz grains and feldspar, often of high sphericity, with only a little mica (Peacock *et al.,* 1968, p. 59). These are features typical of aeolian deposition. Well-developed aeolian dune features have been observed along the coast, and these include complex star dunes which indicate the major wind direction from the NNE, secondary winds from the SSE, and subordinate winds from the NW (Clemmensen, 1987). Rarer lenses of coarse sandstone and well-rounded pebbles with small-scale cross-bedding, as well as contorted beds, indicate times of fluvial deposition (Peacock, 1966). Glennie and Buller (1983) interpret the contorted beds as the result of marine flooding. Williams (1973, pp. 10–11) identified four phases of barchan and seif dune formation, each cycle being followed by water-deposited, contorted beds and sheet-flood or playa-lake deposits.

The tracks are preserved as depressions, often 'smudged', and may be associated with ripple marks and sun-cracks on sub-horizontal flagstones. McKeever (1991) studied the nature of track preservation in the Hopeman Sandstone Formation, and argued that they were not imprinted on dry loose sandy dunes. This has bearing on a debate about track formation in aeolian situations, with some workers (e.g. Brand, 1979) arguing that dune beds bearing tracks must have been laid down entirely underwater, while others (e.g. McKeever, 1991) accept the extensive evidence for aeolian deposition, but find evidence for local and short-term flooding or rainfall. McKeever (1991) found clay minerals in the footprint-bearing levels from Early Permian track sites in Dumfriesshire, clear evidence for wetting of the particular layers. No such clay minerals were found in track-bearing horizons in the Hopeman Sandstone Formation, but other evidence for the presence of water (fluvial lenses; contortion of beds) suggests that footprints may be found where the dune faces are wetted.

The age of the Hopeman Sandstone Formation has, since 1900 at least, been assumed to be Upper Permian, largely because of comparisons with the likely track-makers from Cutties Hillock. Indeed, closer comparisons of the tracks with comparative ichnofaunas in continental Europe and North America, confirm the Late Permian age. On the other hand, Glennie and Buller (1983) postulated an Early Permian age, since they considered that the Hopeman Sandstone Formation was laterally equivalent to the Early Permian Weissliegend (White sandstones) of Germany and the North Sea. In addition, they interpreted the heavily contorted beds in the Hopeman Sandstone Formation (Peacock, 1966) as the result of flooding by the Zechstein Sea (early Late Permian). These views were disputed by Benton and Walker (1985), and the Late Permian age confirmed by a comparison of the footprints with ichnofaunas elsewhere (McKeever, 1991).

Fauna

At least two kinds of footprint have been identified from the Hopeman Sandstone Formation. Footprint Type A is represented by a slab collected in 1850 and is important as the first fossil from Elgin recognized as reptilian (Brickenden, 1852; Hickling, 1909, p. 13). The footprints consist of roughly circular impressions, 30–40 mm long, with the fore and hind feet forming tracks that nearly touch. The stride length is 110–120 mm, the width of the trackway is 80–90 mm and there is no sign of toe marks.

Footprint Type B (Huxley, 1859b, pp. 456–9, pl. 14, figs 4, 5; 1877, pp. 45–52, pl. 14–16; Hickling, 1909, p. 13, pl. 2, fig. 6; Haubold, 1971, p. 37, fig. 22 (4)) was named *Chelichnus megacheirus* by Huxley (1877) and type C15 by Hickling (1909). The fore and hind feet were clearly different. The print of the fore foot (smaller print) is semicircular, about 40 mm long and 60 mm wide, with impressions of nine or five claws at the front. The sole part of the footprint is 60 mm wide, 30–40 mm long and the claws would measure 10–15 mm. The print of the 'hind foot' (larger print) is longer: 80–90 mm long and 80mm wide, bearing five claw marks at the front 20–40 mm long. The prints overlap in pairs and show a stride length 300–400 mm, with the width of trackway (between midpoints of tracks), *c.* 150 mm.

There may be a third track type, like Type B, but larger. Huxley (1877, pl. 15, fig. 6) described such a track (prints 170 mm long and 140 mm broad) and with impressions of three claws. These larger tracks measure 150–250 mm long and 100–150 mm wide, and the stride length is 700–800 mm. A slab of such large prints, 100–150 mm wide, and with a stride length of 700–800 mm (Figure 3.5)C, were observed *in situ* in Clashach Quarry (Benton and Walker, 1985, p. 208).

McKeever (1990, 1991) has revised the Hopeman Sandstone footprints, and notes the presence of the ichnogenera *Chelichnus, Laoporus, Herpetichnus* and *Palmichnus.* Fuller details of these determinations have yet to be published.

Footprint specimens from Masonshaugh Quarry include: BGS(GSM) 113445 (Brickenden's 1850 specimen) and BGS(GSM) several slabs (Huxley 1859b, 1877). Undescribed material includes ELGNM (six slabs), NMS (several slabs), and other material in Forres Museum, Inverness Museum and MANCH.

Interpretation

Brickenden (1850, 1852) thought tracks of Type A were produced by tortoises, and Huxley (1859b, p. 459) thought the track type B might have been formed by *Stagonolepis,* but in 1877 (pp. 49–51) he could not ascribe them to any definite fossil amphibian or reptile then known. In a recent review of vertebrate tracks, Haubold (1971, p. 37) describes *C. megacheirus* (Type B) as possibly formed by a dicynodont, and indeed *Gordonia* from Cutties Hillock is the right size.

The footprints may be preserved on low-angle dune foresets, but this has only been observed in a few *in situ* occurrences. The slabs collected in the nineteenth century may include some from horizontal bedding planes. However, there is usually a mound of sand behind each print (Brickenden, 1852; Huene, 1913; Watson and Hickling, 1914), perhaps indicating that the producers of most trackways were moving uphill. These mounds are seen also behind the large footprints at Clashach.

Martin (*c.* 1860) gave a detailed account of the occurrence of tracks at Masonshaugh, and notes that all were heading in one direction (towards today's North Pole). He considered that the producers were moving down to the Moray Firth across the beach to find the sea! Benton and Walker (1985, p. 217), more plausibly, interpret the footprints as individual trackways probably formed by two or three species of mammal-like reptiles (?anomodonts), each displaying a range of sizes, heading across a dune-field towards the depositional basin to the north.

Comparison with other localities

Trackways and individual footprints similar to those from Masonshaugh have been observed in Greenbrae and Clashach Quarries. The 16 m working face in Greenbrae Quarry [NJ 137 692] displays large-scale cross-bedding in fine- to medium-grained, yellow-brown sandstone. Evidence of water action includes fine lamination, small channels, ripple marks and small quartz pebbles. In addition to footprints, Peacock *et al.* (1968, p. 59) report an unidentified bone fragment from this locality. This quarry is still worked to some extent for ornamental stone (1990).

Clashach Quarry [NJ 163 702] is also still in operation to a small extent and contains stone very like that at Greenbrae. Murchison (1859, p. 429) recorded tracks from this quarry, and some poor specimens were noted by Peacock *et al.* (1968) and Walker (pers. comm., 1990). A range of tracks from small 5 mm lizard-like' forms to large 100 mm dicynodont prints was seen *in situ* and on nearby spoil tips at Clashach by M.J.B. (April, 1980).

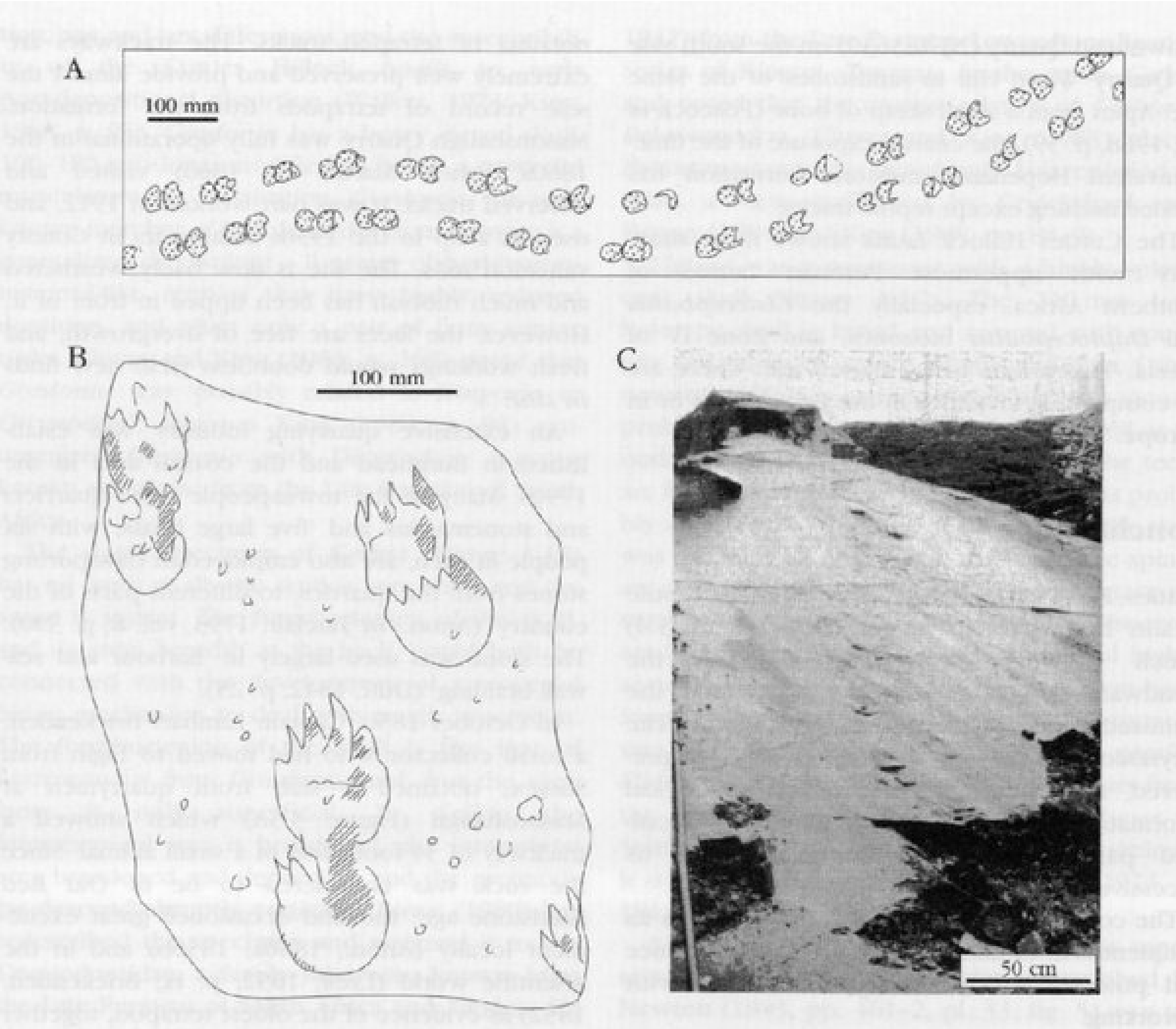
A third kind of track (Type C) was described from the coastal exposure of Hopeman Sandstone by Huxley (1877) and Hickling (1909, pl. 2, figs 7 and 8), and Watson and Hickling (1914, p. 400, fig. 1) found 'one of the typical Cummingstone footprints' (i.e. Type C prints) in a quarry '300 yards WNW from the Cutties Hillock reptile quarry', from a site that cannot now be identified. Tracks of this type were also seen at Cutties Hillock Quarry in 1878 before the reptiles there were discovered (Peacock *et al.,* 1968, p. 73) and these have occasionally been seen since (Walker, pers. comm., 1981). These footprints are similar to the Type B prints from Masonshaugh, but the toes are broader. The dimensions are: print 30 mm wide, 20 mm long; toes 8 mm long, 6 mm wide. These footprints supposedly differ from Types A and B in having broader toes, but the generally poor preservation of most specimens makes such a distinction inadvisable.

Conclusions

The best British Late Permian tetrapod trackway site. Its importance rests on the diversity of tracks observed there, and their potential in allowing stratigraphic and palaeobiological observations.

Despite the partial degradation of the site by weathering and infill, its importance in Britain and potential for re-excavation give it significant conservation value.

References



(Figure 3.5) Reptile footprints from the Late Permian Hopeman Sandstone Formation of Masonshaugh Quarry, Morayshire: (A) small prints; (B) medium prints, Chelichnus megacheirus Huxley, 1877; and (C) large prints. After Benton and Walker (1985).