
'The Brand' (Charnwood Forest)

[SK 537 121]

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Introduction

'The Brand' GCR site is of outstanding importance to British Precambrian stratigraphy in that it contains excellent exposures of rocks forming the uppermost part of the Charnian Supergroup, the age of which is currently controversial. Watts (1947) had originally proposed a twofold subdivision of these strata, into a 'Brand Series' and an overlying 'Swithland Stage'. This scheme was partly followed by Moseley and Ford (1985), who renamed them the Brand Hills Formation and Swithland Formation respectively, including them within the Brand Group. The real significance of 'The Brand' GCR site centres around the present controversy over the age and stratigraphical affinities of these strata (see also, Rushton *et al.*, 1999). They had always been thought of as Precambrian, but following the discovery of trace fossils in the Swithland Formation (Bland, 1994), and a re-appraisal of the detrital petrography of the lower beds in the Brand Group (McIlroy *et al.*, 1998), they could now be as young as Cambrian. A major unconformity could therefore separate the Brand Hills Formation from the Precambrian proper, although whether this is the unconformity at the top or the base of the underlying Hanging Rocks Formation is debatable (McIlroy *et al.*, 1998; Boynton and Moseley, 1999).

The younger age now proposed for the Brand Hills and Swithland formations implies that these units are part of an extensive Cambrian sedimentary sequence that flanks Charnwood Forest. Such beds are believed to crop out, in contact with late Ordovician granodiorites of the Mountsorrel complex, about 2.5 km to the north-east of 'The Brand' (Le Bas, 1972; see also descriptions of the Buddon Hill site in GCR Volume 17, Stephenson *et al.*, 1999). Further evidence for the nature and age of this Cambro-Ordovician basement comes from several deep boreholes in the East Midlands (Merriman *et al.*, 1993; McIlroy *et al.*, 1998).

The Swithland Formation contains a penetrative cleavage of Acadian (Siluro-Devonian) age (see Chapter 2, Introduction). It has provided the raw materials for a local slate-quarrying industry dating from at least Roman times, but which was curtailed following importation of Welsh slates around the middle of the 19th century (Herbert, 1944). Consequently, at 'The Brand' there are numerous disused quarries and smaller-scale workings for slate (Figure 9.3) and, to a lesser extent, sandstone. Exposure is somewhat discontinuous but there are many excellent sections through the various members and formations of the upper Brand Group.

Description

The revised stratigraphy erected for the Brand Group by McIlroy *et al.* (1998) is followed here. Worssam and Old (1988) referred to the basal unit of the Brand Hills Formation as the Swithland Camp Member. This member, 0–5 m thick and intermittently exposed beyond the western margin of this site e.g. [SK 5332 1330], is distinctive, with abundant, subrounded, disc-shaped, deep purple-grey siltstone clasts in a similarly coloured siltstone matrix. Igneous rock fragments are scattered throughout (Moseley, 1979), one being identified by McIlroy *et al.* (1998) as a granophyric diorite, indistinguishable from lithologies of the South Charnwood Diorites emplaced into the underlying Charnian Supergroup.

The transition from the Swithland Camp Member to the overlying Stable Pit Member is probably gradational at 'The Brand', via a largely unexposed sequence of beds. Boynton and Moseley (1999) have equated these, and the underlying Swithland Camp Member, with a unit that they named the 'Hanging Rocks Member'. The Stable Pit Member is well exposed along the prominent line of crags and quarries on the western flanks of the Brand Hills. Here, a 9 m-thick measured section ([SK 5350 1320]; Locality 1) shows a sequence of dark grey weathering, medium- to thickly bedded amalgamated sandstones; it is multiple graded, with a superimposed overall fining upwards trend. The lower bed exposed, 0.8 m thick, is typical in showing internal grain size variations producing a diffuse parallel stratification. It also

shows normal grading, and coarsens down to dark grey, coarse-grained sandstone with sporadic granules and small dark green-grey pebbles. In thin section these pebbles are shown to be composed of varieties of microcrystalline to spherulitic-textured volcanic or hypabyssal rocks, but there are also dioritic lithologies consisting of plagioclase and alkali feldspar aggregates with patchy developments of granophyre. Some of the latter are texturally similar to the South Charnwood Diorites of the Cliffe Hill GCR site. This is abruptly succeeded by 0.22 m of medium-grained, parallel-laminated sandstone, and then by another graded bed that shows concentrations of pink to green, volcanic and igneous clasts in its basal part. The thin siltstone capping this bed shows erosion and incorporation as rafts into the overlying sandstone, and is in turn succeeded by a further graded bed (Figure 9.4). The stratigraphically higher sandstone beds are up to 2 m thick and predominantly medium-grained; they possess a bedding structure that in places outlines thick sets of faintly defined low-angle cross-bedding.

Around the summit of Cuckoo Hill (Locality 2), exposures show grey, massive to thinly bedded or laminated fine- to medium-grained sandstone with one 10 cm thick layer of matrix-supported small-pebble conglomerate containing angular to subrounded clasts. In thin section these clasts consist of: fine-grained to vesicular volcanic rock, possible tuff, and medium- to coarse-grained granophyric-textured quartz diorite. The stratigraphical position of these beds is uncertain, but the rounding of matrix grains and pebbles, and presence of granophyre clasts, indicates equivalence to the Brand Hills Formation, almost certainly to the Stable Pit Member.

McIlroy *et al.* (1998) note that at 'The Brand', sandstones of the Stable Pit Member are 'greywackes', with well-rounded grains of quartz and metaquartz-arenite, flattened clasts of pelite and sporadic igneous clasts. The sequence also contains sparsely glauconitic greywacke-type siltstones and sandstones, and there is an occurrence of a pipe-like trace fossil comparable to *Arenicolites* sp..

The Swithland Formation, which represents the youngest component of the Brand Group, is exposed in a series of former slate quarries to the south-east of the Brand Hills [SK 5370 1320]. Typical lithologies (Locality 3) are medium-grey to purple-grey and from a distance appear to be massive, apart from sporadic laminated layers that define the bedding. Studies of the highly inaccessible quarry faces by McIlroy *et al.* (1998) have revealed decimetre-thick layers of heavily disturbed strata showing U-shaped *Teichichnus* burrows. This is the first published report of these trace fossils *in situ*, since their discovery on local gravestones carved from 'Swithland Slate' (Bland, 1994; Bland and Goldring, 1995). These in-situ occurrences are flooded and difficult to view, but excellent examples of *Teichichnus* can be seen on certain gravestones in Ratby churchyard [SK 5132 0590], 8 km to the south-west, as illustrated in (Figure 9.5). These gravestones also display thin beds of erosively based sandstones showing normal grading and parallel to low-angle cross-lamination (Bland and Goldring, 1995).

The penetrative cleavage typical of the Charnian Supergroup is displayed at 'The Brand', as a WNW (110°), sub-vertical foliation that locally is gently crenulated. Perhaps because of the upper greenschist metamorphic grade of this Acadian event (see Chapter 2, Introduction), the cleavage is rather coarse although still slaty.

Interpretation

The amalgamated sandstones of the Stable Pit Member, forming the lowest exposed beds at this site, are immature and lithics-rich in contrast to the quartzose sandstones of the Stable Pit type locality. The combination of normal grading and parallel- to very low-angle stratification is in keeping with rapid deposition, probably from erosive, sandy to gravelly turbidity currents (e.g. Lowe, 1982). Their content of glauconite is indicative of a marine origin, and it is therefore possible that the member represents material accumulated in a submarine fan environment. Although the sequence is incompletely exposed, it shows evidence of fining upwards, and is thus interpreted to be gradational with overlying mudstones of the Swithland Formation.

The fine sections through the Swithland Formation in the various slate quarries at 'The Brand' have been the focus of much new work since the discovery (Bland, 1994) that the uppermost part of the Brand Group may be Lower Cambrian, rather than Precambrian in age. Important biostratigraphical correlations follow from the fact that the quarry exposures in the Swithland Formation have yielded in-situ occurrences of heavily bioturbated beds containing the trace fossil *Teichichnus* (McIlroy *et al.*, 1998). In the Avalon sequences of Newfoundland *Teichichnus* first appears in the

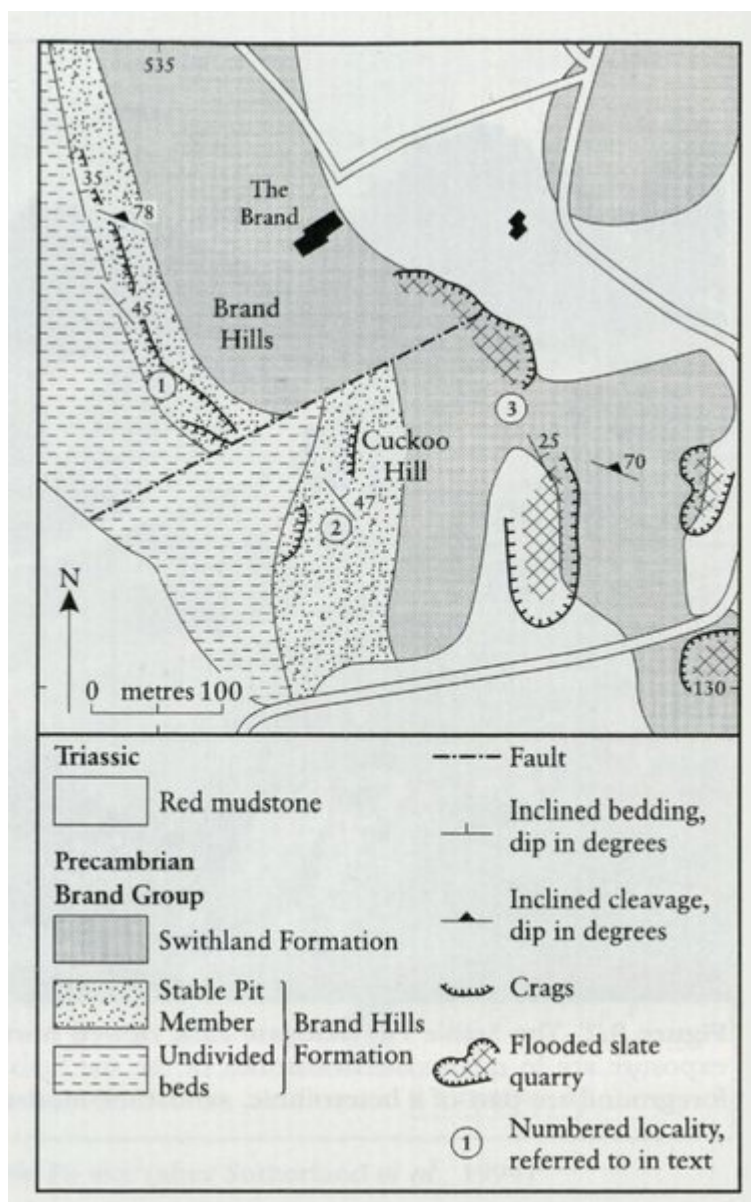
Rusophycus avalonensis (trace fossil) ichnozone of the Lower Cambrian Placentian Series (Narbonne *et al.*, 1987), but mudstones churned by *Teichichnus* only occur above the quartz arenites of the Random Formation. The bioturbated horizon is of early Iammotian to early Atdabanian age (Brasier, 1992), and this is therefore the correlation of the Swithland Formation favoured by McIlroy *et al.* (1998). The Swithland Formation contains graded beds and appears to represent a continuation of turbidite deposition, albeit of a more distal facies. Bland and Goldring (1995) discussed the environmental implications of the *Teichichnus* occurrence; although it is not a typical trace fossil in turbiditic mudstones, it has nevertheless been recorded in deep-water sediments of this facies.

As noted by McIlroy *et al.* (1998), the lower sandstones of the Brand Hills Formation, comprising beds of the Stable Pit and Swithland Camp members, generally plot within the recycled orogenic source compositional field of the QFL ternary diagram (Dickinson and Suczek, 1979). They are thus different from the underlying Maplewell Group rocks, which have a dissected magmatic arc provenance. McIlroy *et al.* (1998), describe clasts up to 40 mm across of granophyric diorite from the beds here. In addition, they found that the Nd isotope compositions of similar granophyric clasts in the Swithland Camp Member (underlying the beds exposed at this GCR site) are comparable with those of the South Charnwood Diorites. The clasts therefore demonstrate that intrusions comparable to the South Charnwood Diorites had been unroofed and were undergoing erosion prior to deposition of the Brand Hills Formation. The precise age of these diorites is not yet known for Charnwood Forest, but on the basis of Nd isotope studies (McIlroy, 1996), they are considered equivalent to diorites dated at 603 ± 2 Ma at Nuneaton, which represent the closing stage of Charnian volcanic arc magmatism (Tucker and Pharaoh, 1991). McIlroy *et al.* (1998) went on to suggest that this part of the Brand Group is probably equivalent to the Lower Cambrian Hartshill Sandstone Formation of Nuneaton since certain arenaceous lithologies are petrographically comparable between the two areas. Nevertheless, it should be stated that the arenaceous strata of the Brand Hills Formation are in aggregate considerably thinner than the c. 260 m-thick Hartshill Sandstone, nor do they encompass the same sedimentological and environmental ranges as the latter strata (e.g. Brasier *et al.*, 1978; Carney, 1995).

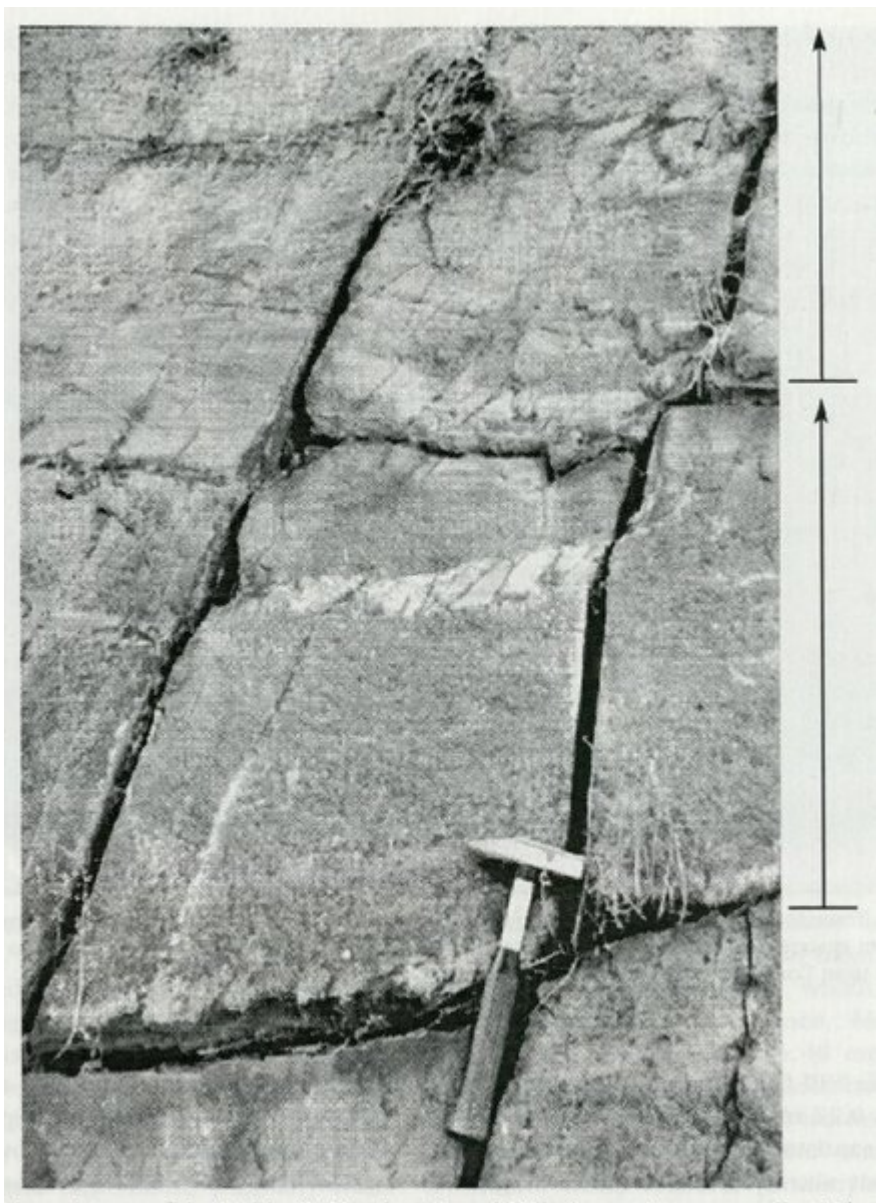
Conclusions

'The Brand' GCR site is of national geological importance since it contains some of the best exposures in the upper part of the Brand Group, whose age is the subject of a current controversy. The exposures demonstrate a sequence of marine origin, consisting of rapidly deposited turbidite-facies sandstones, in the Stable Pit Member of the Brand Hills Formation, fining up to distal facies, mud-rich turbidites in the Swithland Formation. Clasts in the coarser basal parts of many turbidite beds were apparently derived from the local Precambrian substrate, including the South Charnwood Diorites, indicating an erosional unconformity at the base of this sequence. The location of this hiatus is not yet clear, but it must contain the local Precambrian–Cambrian boundary since the in-situ occurrence of the trace fossil *Teichichnus* in the Swithland Formation indicates that this part of the succession was probably deposited in Lower Cambrian times.

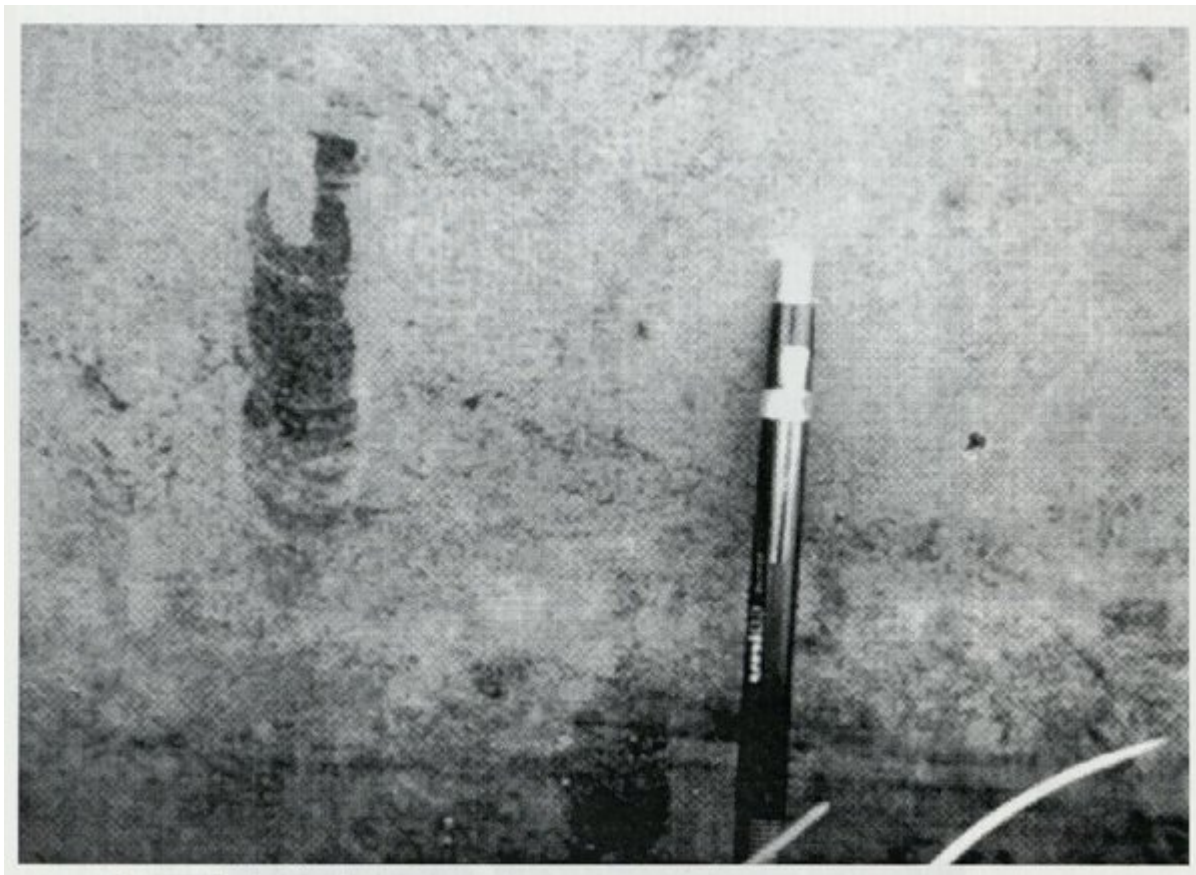
[References](#)



(Figure 9.3) Geological map of 'The Brand' site



(Figure 9.4) Graded sandstone of the Stable Pit Member, Brand Hills Formation, exposed at 'The Brand'. The arrows show two superimposed fining-up sedimentary cycles. Note the sediment raft 'floating' near the top of the lower graded bed. (Photo: J.N. Carney.)



(Figure 9.5) Trace fossil, identified as a Teichichnus burrow, on a gravestone at Ratby churchyard. The stone was worked from quarries in the Swithland Formation and the trace fossil is of a type that has not been found in rocks older than Lower Cambrian. (Photo: J.N. Carney.)