Dunbar excursion A — Belhaven and the Parade

E.H. Francis

(Route: (Map 14))

Belhaven and the Parade

Starting from the car-parking area at Belhaven Beach [NT 662 787] the walking distance is about 2 km ending in a steep flight of steps up from the beach behind the Bathing Pool. It is a similar distance returning to the car park along Back Road or, preferably, along the Parade itself, which offers fine vantage points down to the foreshore.

1. Linear breccia and quartz-dolerite dyke

The sediments at Belhaven consist mainly of rhythmic alternations of Lower Carboniferous cementstones and mudstones with one thick bed of sandstone. They dip generally south-eastwards. They are traversed at H.W.M. by an ENE linear volcanic breccia which is irregularly intruded by the widest of the local quartz-dolerite dykes. Its margins are defined by faults inclined towards one another and locally flanked inside by blocks which are aligned parallel to the margins. Eastwards the faults diverge, the southern having a displacement of about 30 m. At its western extremity the breccia includes large blebs of 'white trap'. The breccia, which has two small cryptovolcanic ring structures emplaced along the northern bounding fracture, is assumed to belong to the early Carboniferous volcanism.

2. Cryptovolcanic ring structures

Five small areas of breccia (a–e, (Map 14)) are referred to as ring structures, though they tend to be oval rather than circular in plan. In some places their contacts with the surrounding sedimentary rocks are vertical or steeply inclined inwards; in other places an impression is gained of high-angled outward dip though this is nowhere capable of demonstration. The breccias consist mainly of local cementstones and marls. Peripherally the flat surfaces and longer axes of the blocks become orientated with the margins. At the centre, however, the blocks are usually completely jumbled, though in one ring (e) the centre consists of relatively undisturbed cementstones and marls. Two rings (b, d) contain red tuffs which appear to penetrate the breccias; they are most prominent at the margins, but also (c) form dykes and pods associated with veins and blebs of decomposed chilled basalt ('white trap').

Maufe (in Clough et al. 1910, p. 90) thought that they were necks which pierced low domes and were contemporaneous with, and overlapped by the sediments. However, they are now believed to be incipient pipes which never reached the surface. Those margins which show apparent overlap merely reflect the upwards pressure of the gas-tuff stream, while the inwardly-inclined fractured margins represent a slightly lower erosional level in funnel-shaped fractures, with the marginally orientated blocks evidencing a variety of now-banding.

3. Belhaven Point Neck

The margin of the neck is irregular in outline. To east and west, where the irregularity is least prominent, the adjacent sediments are turned down towards the margin, but where the neck extends southward the sediments are either horizontal or dip away from the contact. The neck filling ranges in grade from fine-grained tuffs to lapilli-tuffs and has a red colour mottled by yellow and green juvenile basaltic material. Near the margin the tuffs also contain blocks of cementstone and sandstone similar to the country rocks outside. The tuffs have an unbedded appearance except for what seems to be a vertically stratified discrete raft, measuring 2.5 x 7.5 m. near the centre of the neck. Two small bosses, measuring 3.5 x 6 m. and 7.5 x 7.5 m. to south and centre respectively, are of basanite similar to the other vent intrusions of the district, though they are partially carbonated.

4. Parade Neck: west margin

The largest neck in the area, nearly 1 km in diameter, takes its name from the promenade along the top of the cliffs in which it is well exposed. The cementstones immediately outside the neck are nearly flat at L.W.M. but at H.W.M. they dip in towards the margin at progressively higher angles until they pass into a zone 9 to 15 m. wide in which the sediments are highly inclined or vertical and show signs of shattering and squeezing out. Inside the neck also, the easterly dip of the bedded tuffs becomes steepest adjacent to this zone, though in places the bedded tuffs appear to pass into massive tuffs containing blocks of sedimentary rock. In the cliff about 15 m inside the margin is a spectacular intrusion of sandstone within the tuffs. It is partly sill, partly dyke, arranged in 'step-and-stair', but the internal layering, which resembles bedding, remains parallel to the enclosing walls. This, together with off-shoots of sandstone which peter out at various angles into the tuffs, shows the body to be intrusive.

Still nearer to the western margin of the neck a 2 m. dyke of mottled grey and purple sandstone can be traced northwards, first thinning out for a short distance, then forming pods inside a line of crush and later reappearing as a sill which seems in ground plan to change horizon through the bedded tuffs. An offshoot dyke, 25 to 40 cm thick, is intruded westwards to cut the vent-marginal zone of crushed and inwardly down-turned sediments. The main dyke contains some magmatic debris and two separate elements of vertical flow-banding, one of which crosses the other obliquely in much the same way as current bedding in sedimentary rocks. At H.W.M. the main dyke pinches out more abruptly, though its course is continued into the cliff by a line of disturbance. On the western side of the dyke there is another 3 m. intrusion, consisting of a purple sandy siltstone banded with streaky, purple and yellow tuff. At first sight this seems to be a large xenolith of bedded tuffaceous sediment dipping westward at 65°–85° and crumpled and faulted on a small scale. On closer examination, however, the streaky yellow layers in the tuff are seen to be flow-banded and intrusive into the siltstone and the adjacent dyke of sandstone. The flow-banding of yellow basaltic lapilli and the 'bedding' of the siltstone, moreover, remain orientated parallel to the margins of the mass as it pinches out southwards. It is suggestive of two, if not three, successive pulses of intrusion hereabouts.

5. Parade Neck: bedded tuffs and sandstone dykes

Along the shore and in the cliffs the vent-filling consists of bedded reddish and brown tuffs ranging from fine-grained to lapilli-tuffs. They consist of variable proportions of two main components. One is a sandstone suite seen in thin section to consist mainly of quartz grains with subordinate amounts of orthoclase, microcline, plagioclase and mica: the other is basaltic and consists partly of crystalline material, but more abundantly of yellow vesicular glass (refractive index exceeding 1.54 and usually replaced by carbonate. kaolinite or turbid decomposition products). Some of the glassy fragments appear to have enclosed grains of quartz. In some of the fine layers the glass is elongated parallel to the bedding, giving rise to a macroscopic vitroclastic texture. Blocks of basalt, tuff, indurated cementstone, cornstone, sandstone and shale ranging in diameter up to 1.2 m. but averaging about 12 cm. are scattered throughout. Local disruption of the subjacent layering and sagging in the beds a little farther below testify to their emplacement as bombs: some of the basaltic bombs. Moreover, are grouped in a manner suggesting spatter. However, although the tuffs near the western margin appear to be of similar ash-fall origin, the cross-bedding throughout the remainder of the neck is on a scale which is entirely consistent with deposition from a series of base-surges driven from an eruptive source or sources located to north-east, east or south-cast (Leys 1982).

The tuffs are crossed by a roughly rectilinear pattern of master joints trending north-east and north-west. The younger quartz-dolerite dykes have been emplaced along the fractures, as have many further sandstone dykes laminated parallel to their high-angled enclosing walls. This lamination, an alignment of micas, is less pronounced at the centres of the dykes than at the margins. Some dykes are cemented by, or pass laterally into carbonate. The joint system and the sandstone intrusions are believed to date from the subsidence stage of the Parade Neck.

6. Parade Neck: eastern margin

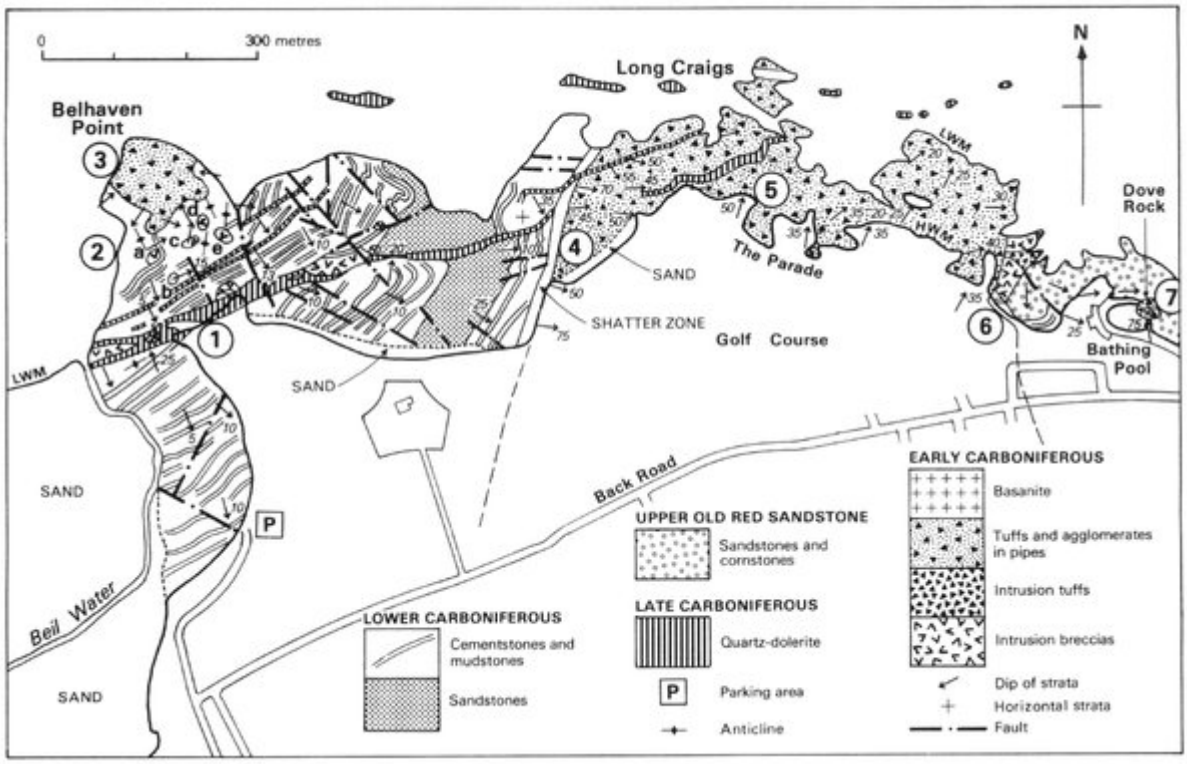
The eastern margin is outlined by a boulder-strewn trench. narrowing northwards and containing a partially exposed band of green and purple streaky rock which is up to 1 m thick and is inclined westwards into the neck at 60°. This appears to be fault-gouge rather than flow-banding. Inside the margin the tuffs display an intricate pattern of small-scale faulting, but there is no local breakdown of bedding as there is in the west. In further contrast the dip continues unchanged up to the edge of the neck where the tuffs are laced with anastomosing veins of carbonate and/or hematite which have a

sub-parallel alignment with the neck margin. Such veining is characteristic of the inner linings of pipes which have undergone subsidence and is presumed to have formed during that process. At high water mark the relationship of the neck to the sediments is obscured by sand and shingle, but to the south-east a junction is exposed in the cliff alongside the path, where it is marked by a block of false-bedded sandstone 1 m wide, narrowing downwards and tilted at 70° away from the hematite-veined tuffs.

Outside the margin the massive sandstone is diced by small-scale fractures, and the blocks so formed are dislocated and recemented by sand apparently derived from the breakdown of the same beds. The bulk composition of the rock is thus unchanged, but the large constituent blocks can be picked out on weathered surfaces by slight differences in coarseness, colour and orientation. An irregular fracture plane separates this slightly brecciated zone from the undisturbed massive sandstone to the east. The sandstones inside and immediately outside the brecciated zone have rough carious surfaces showing anastomosing patterns of grooves and ridges. They result from fracture during the volcanism and from the filtering and forcing of fine sand along the fractures by gas action.

The brecciated zone is traversed by a dyke of intruded tuff, about 60 m long, tapering from 15 m to 9 m in width as it is followed north-eastwards to low water mark. It is cut off to the west by the gouge at the east margin of the neck and traversed by a north-westerly fault which has a landward down-throw. The outcrop of the tuff dyke is shifted by this fault in a direction which indicates that the dyke is inclined south-eastwards. The tuff is a green, or patchily red, well-mixed rock full of basaltic lapilli. Against the north-western wall of the mass the lapilli are orientated to display flow-banding. The tuff may represent an apophysis, intruded Upper Old Red Sandstone, of the material which filled the vent at its pre-subsidence level.

References



(Map 14) Belhaven and the Parade.