

WESTERN BOUNDARY OF THE MALVERNIAN, NORTH MALVERN HILLS  
WORCESTERSHIRE

by

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Summary

A temporary exposure at North Malvern is described, which exposes red Cowleigh Park Beds (Llandovery) adjacent to Malvernian diorites and dolerites. The contact is marked by a thin band of black shale dipping at 65° to the east. Evidence from other nearby exposures of Wych Beds and Groom's detailed records from this area (1900) suggests that, as proposed by Brooks (1970), the western boundary of the Malvern Hills is an unconformable junction cut by a series of parallel faults.

Introduction

The new exposure lies to the east of the road known as the Old Hollow Lane which runs around the northern tip of the Malvern Hills (76554730). It has been excavated for building development. The exposure occupies an area of 20 × 30 metres, most of which was covered in July 1973 by much loose debris derived from higher slopes of the Pre-Cambrian mass. (text-fig.1).

The local succession

The oldest rocks exposed in the Malvern area are the Pre-Cambrian diorites, granites, dolerites and gneisses. Structurally, these rocks are very complex and have only been described in fairly general terms by previous workers. A recent summary of the Malvernian rocks is given in the Geologists' Association Guide to the Malvern Hills (Penn, 1971).

The remaining rock types belong to the Cambrian and Silurian Systems. Those of the Cambrian have been recorded from the southern Malverns where the following succession has been described:

Bronsil Shales: grey shales  
Whiteleaved Oak Shales: black shales  
Hollybush Sandstone  
Malvern Quartzite

There is no present day evidence for Cambrian rocks in the north Malverns area, but Groom (1900) recorded black shales from a well, the log of which is given in a later section.

The lower Silurian rests unconformably on the Cambrian and Pre Cambrian in the southern Malverns. The local succession of the Silurian rocks in the North Malvern - Cowleigh Park area is:

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1974. pp. 65-70. 3 text-figs.

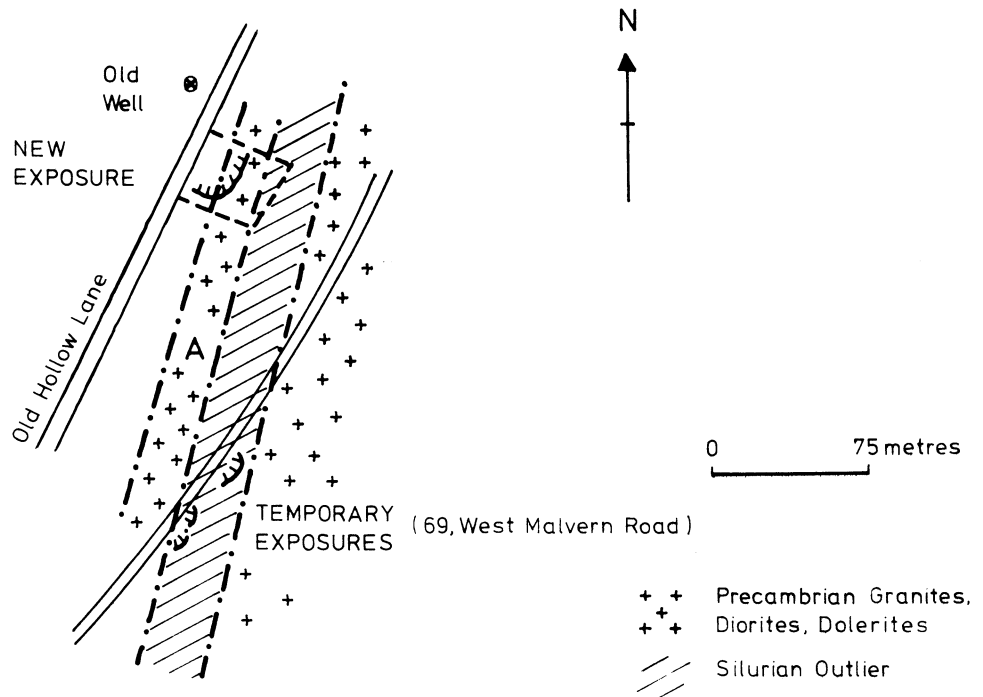


Fig. 1A Locality Map of the New Exposure

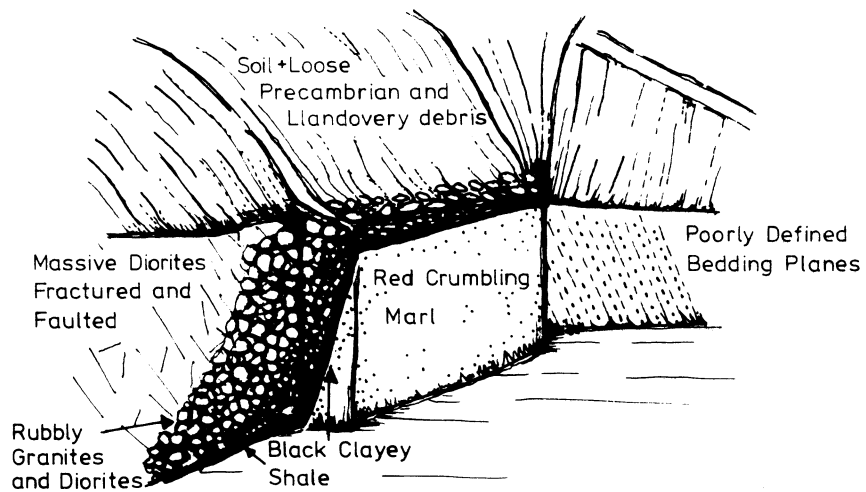


Fig. 1B Field Sketch of Exposure looking S.E.

Text-fig. 1 - Temporary exposure at North Malvern.

Woolhope Limestone	30 metres	Wenlock
Wych Beds	100 metres	} Llandovery
Cowleigh Park Beds	100? - 130? metres	

The thicknesses are quoted from Ziegler, Cocks and McKerrow (1969)

#### Description of the exposure

A large scale plan of the exposure is reproduced as text-fig.1B. In the middle of the south-east corner, a fresh cut exposed 8 x 5 metres of red marly sandstone dipping 80° to the west. At the northern end of the cut, an angled east-west face exposed the contact of the red marly sandstone with the Pre-Cambrian rocks. This contact dipped 65° to the east and was seen to strike approximately north - south, the line of contact not being exposed far enough to get an accurate strike determination. Four cm. of black fine grained clayey shale was overlain by a yellow rubbly breccia of Pre-Cambrian detritus, mostly diorite with some granite. The breccia graded rapidly into massive Pre-Cambrian diorites. About 10 metres to the north of the contact, massive dolerite was seen to intrude into the diorites striking north-west to south-east, with contacts not clearly exposed.

Both the red marly sandstone and black shale were sampled. The sandstone was free of any fossiliferous material, being mostly composed of rounded and angular grains of quartz and felspar up to 1 cm. diameter set in a fine grained marly iron - rich matrix. Nearly all the grains were coated by haematite, except for about 2%, which were small angular masses of a yellow sandstone similar to the Hollybush Sandstone of the southern Malverns. The samples were processed for microfossils, but none were found.

In the black shale, two very small specimens of Lingulids were discovered but otherwise it proved to be unfossiliferous. Age dating of these sediments has been a problem. The red marly sandstone is thought to be the equivalent of the basal Cowleigh Park Beds seen at Eastnor, and exposed by Butcher in a Geologists' Association dig in 1963. Ziegler and others, (1968), described this basal member as being up to 5 metres thick, but at this new locality it could be thicker, as at least 5 metres were exposed. The age of the black shale is even less certain. It could be a faulted remnant of the Cambrian shales adhering to the Pre-Cambrian or it could be the very basal phase of the Upper Llandovery in this locality.

#### Relationships to other nearby exposures

A temporary exposure (text-fig.1a) at 69, West Malvern Road, (76544714), 160 metres south of the new exposure, was interpreted as Wych Beds, dipping steeply to the west 60 - 80°, but showing some signs of overturning at the top of the exposure, possibly due to hill creep. The rocks were composed of greenish yellow siltstones typical of the Wych Beds in the Malvern area. A little to the north east along the West Malvern Road, further exposures of the greenish yellow sandstones were seen again dipping 60° - 80° to the west. This site is now covered by a concrete foundation for a new house.

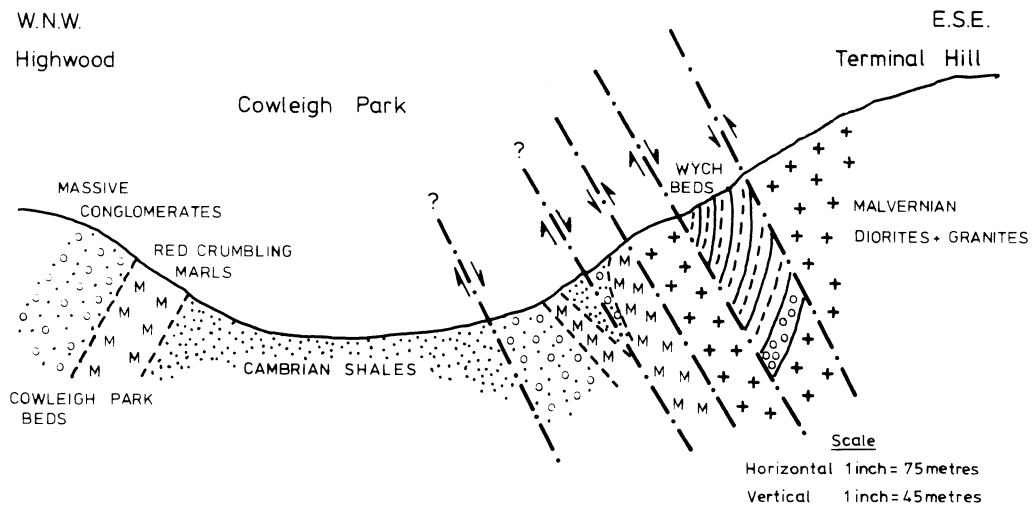
Groom (1900, pp. 152 - 153) probably described the latter exposure, but his details of its position, at that time an old quarry, make it difficult to locate the exact position at the present time. The "archaeal" fault contact seen by Groom at the base of the quarry, "striking 3°, dip 60° to the east," was not exposed. This fault if continued northwards would pass about 20 metres east of the contact described by the Old Hollow Lane. The mass of Malvernian rocks, marked A on text-fig.1, is then a wedge in the Silurian sediments. In the overburden at the new exposure much loose Wych Bed detritus was seen, presumably derived from the Llandovery outlier.

The present new exposure beside the Old Hollow Lane is just to the south of the site of an old well (76564733, Brooks 1970). The following log is quoted from Groom (1900, pp. 157 - 158):

- |   |       |
|---|-------|
| (1) Surface gravel hill debris  | 12 ft |
| (2) Red crumbling marl with small pebbles   | 24 ft |
| (3) Coarse grey and red sandstone and conglomerate  | 16 ft |
| (4) Very hard breccia of quartz pebbles in a red and yellow matrix                        | 6 ft  |
| (5) Black Cambrian shale with <i>Olenus</i> ,<br><i>Conocoryphe</i> , <i>Lingulella</i> . | 18 ft |
| (6) Repetition of beds 2 and 3  | 13 ft |

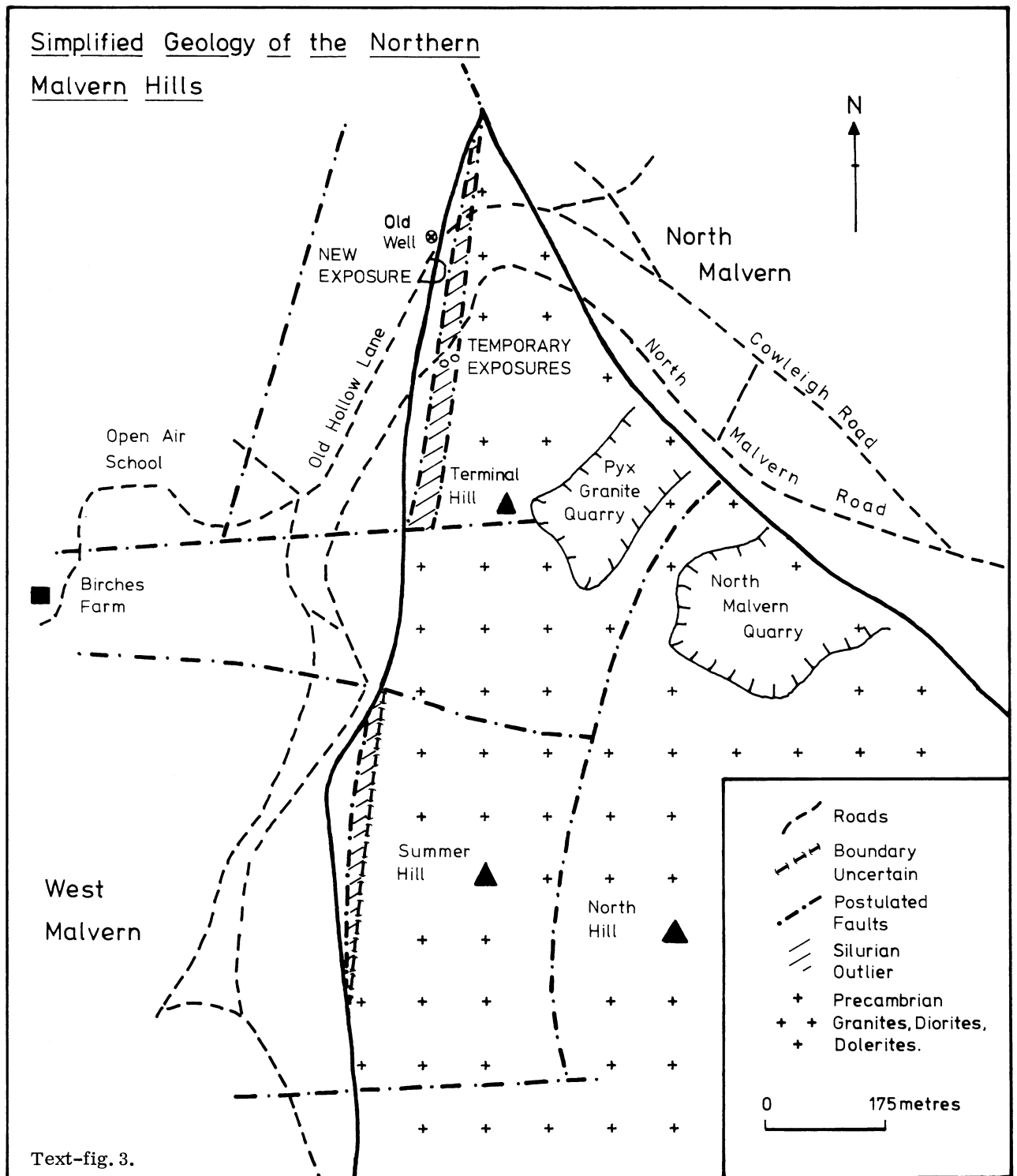
The red crumbling marls with small pebbles (bed 2) are undoubtedly the equivalent of the red marly sandstone exposed at the Old Hollow Lane locality. Beds 5 and 6 were described later in the same paper by Groom (1900 pl. 62) as dipping 50° to the north east but bed 4 dipped in the same direction at a steeper angle, indicating the presence of a fault between beds 4 and 5. Groom also suggested a fault separated beds 5 and 6, but it is possible that the red beds (bed 2) are resting unconformably on the black shales. Unfortunately the dip and strike of Groom's faults were not recorded, but were interpreted as striking to the north-west. From the other field evidence it seems more likely that they are aligned approximately north-south.

The cross-section, text-fig.2, combines evidence from Groom's well log, from his quarry exposure and from the new temporary locality on Old Hollow Lane.



Text-fig. 2. Section across the Western Side of Terminal Hill and Cowleigh Park

Simplified Geology of the Northern Malvern Hills



Text-fig. 3.

Structurally, the major movements on the north-south faults are 'normal', as predicted by Butcher (1962) and similar in strike and direction to the eastern boundary fault pattern that produced the deep Mesozoic basin on the eastern side of the Malvern Hills.

In more general terms the north-south faults must be related to the surrounding geology. The important oblique north-west striking fault, forming the north-east face of Terminal Hill and North Hill (text-fig. 3), truncates the north-south faults to the north. To the south, cross faulting in an east-west direction brings a higher structural level of the Malvern fold to the surface just south of Birches Farm (759469). Detailed studies of the Pre-Cambrian geology made by the author suggest that the Terminal Hill block is up-faulted with relation to that of Summer Hill.

### Conclusions

The new exposure provides additional information on the nature of the western boundary of the Malvernian of the Malvern Hills and rejects the theory of Phipps and Reeves (1964, 1970) of one large fault forming the whole of the western boundary to the Malvernian. It supports the theories of Pre-Llandovery tectonics in the Malvern area as postulated by Brooks (1970).

### Acknowledgements

This piece of work came about as a result of the author's structural and geochemical studies at Nottingham University on the Pre-Cambrian rocks of the northern Malverns. He wishes to acknowledge useful discussion of the Malvern tectonic problem with Dr. R.J. Firman, Dr. R.J. Aldridge, and Dr. J.A.T. Smellie and the technical assistance of Miss S. White for the preparation of samples and Miss B.A. Livingstone for final copies of the maps and diagrams.

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