HULL GEOLOGICAL SOCIETY VISIT TO NORTH STAFFORDSHIRE 1991

SUNDAY JULY 29th 1991 : LEADER DAVID B. THOMPSON (UNIVERSITY OF KEELE).

1. MEET AT MAIDEN CASTLE CAR PARK, PARK HALL COUNTRY PARK, NEAR THE VILLAGE OF HULME, near LONGTON, STOKE-ON-TRENT, AT 11.00 am

2. VISIT WILLFIELD QUARRY. OBSERVE VARIOUS FACIES OF THE MIDDLE COAL MEASURES (WESTPHALIAN B) OF THE CENTRAL PENNINE BASIN, NOW FOLDED INTO THE SOUTHWARD PITCHING, PLUNGING POTTERIES SYNCLINE - HERE ITS EASTERN LIMB. THESE STRATA OVERLAIN BY THE PEBBLY SANDSTONES OF THE HAWKSMOOR SANDSTONE & CONGLOMERATE FORMATION (? SCYTHIAN, LOWER TRIASSIC) OF THE NEEDWOOD BASIN INVESTIGATE THE FACIES, FAULTING & APPLIED GEOLOGY.

3. WALK EASTWARDS TO THE PLAY CANYON (= HULME CENTRAL NORTH QUARRY). INVESTIGATE THE CONGLOMERATIC & PEBBLY SANDSTONE FACIES A to E OF THE HAWKSMOOR SANDSTONE & CONGLOMERATE MEMBER AND INTERPRET IN TERMS OF BRAIDED RIVER PROCESSES AND STRUCTURES (SHEET BARS, MID-CHANNEL SAND BARS, IMPERSISTENT PERIODS OF LOW DISCHARGE AND STILLING OF WATERS. APPLIED GEOLOGY.

4. TRAVEL ACROSS THE POTTERIES SYNCLINE AND THE SITE OF THE TRENT VALE EARTHQUAKES (TO BE INTERPRETED IN TERMS OF SHALLOW SEISMICITY INDUCED BY RAPID LONGWALL COAL MINING METHODS IN SEAMS BELOW VOIDS LEFT BY THE WORKING OF OLD COAL MINES & SEAMS ABOVE, RATHER THAN THE ACTION OF THE NEWCASTLE FAULT TODAY)

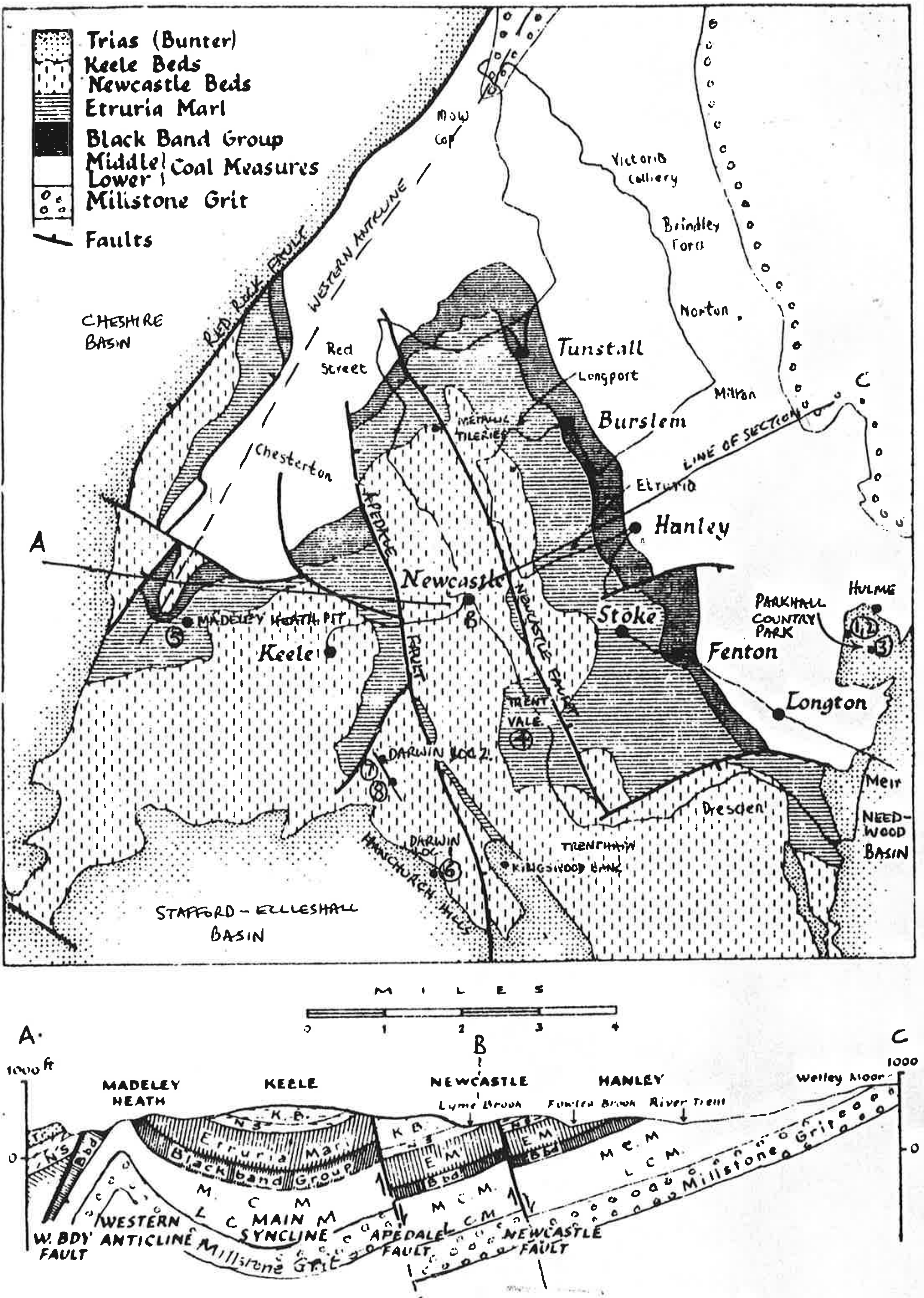
5. TRAVEL TO MADELEY HEATH CLAY PIT OF STEETLEY BUILDING PRODUCTS LTD., STILL ON THE EASTERN LIMB OF THE SOUTH PITCHING, PLUNGING POTTERIES SYNCLINE. THROUGH THE KIND PERMISSION OF THE WORKS MANAGER, MR S. J. DUTTON, EXAMINE THE CONSIDERABLE ROCK SUCCESSION ON THE EASTERN & SOUTHERN SIDES OF THE PIT: ETRURIA MUDSTONE FORMATION (DIACHRONOUS WESTPHALIAN B - D ; MEANDERING RIVER FLOODPLAINS WITH FERRICRETE PALAEOSOLS BEARING EQUATORIAL PALAEOMAGNETIC EVIDENCE ; SANDSTONE & CONGLOMERATE CHANNEL FILLS) OVERLAIN (?LOCALLY UNCONFORMABLY) BY THE NEWCASTLE SANDSTONE FORMATION (RIPPLE DRIFT BEDDING, ROLLED PLANT FOSSILS AND FORMERLY A TREE STUMP IN SITU) WITH AN INTERESTING ALGAL LIMESTONES (WITH NON-MARINE LAMELLIBRANCHS & OSTRACODS BOTH ABOVE AND BELOW THE LIMESTONES) GLACIAL TILL AT THE TOP OF THE PIT.

6. TRAVEL TO THE HANCHURCH HILLS (IN THE NORTHERN PART OF THE STAFFORD-ECCLESHALL PERMO TRIASSIC BASIN) TO THE LOCALITY WHERE CHARLES DARWIN IS REPUTED TO HAVE LOCATED A TRAP DYKE IN 1842, SOON AFTER HIS RETURN FROM THE VOYAGE OF THE BEAGLE (1831-1836). THE DYKE IS NOW KNOWN TO BE OF EOCENE YPRESIAN AGE 52 ± 1.4 mya AND CUTS THE CANNOCK CHASE PEBBLE BEDS FORMATION (?SCYTHIAN, LOWEST TRIASSIC)

7. TRAVEL TO BUTTERTON LODGE GATES WHERE DARWIN IS REPUTED TO HAVE SPOTTED A SECOND EXPOSURE OF THE BUTTERTON - SWYNNERTON DYKE.

8. INVESTIGATE THE ROCKS OF BUTTERTON CHURCH WOOD QUARRY THROUGH THE KIND PERMISSION OF FARMER C.F. MATTHEWS WHERE THE KEELE SANDSTONE FORMATION (WESTPHALIAN D and STEPHANIAN?) IS EXPOSED. INTERPRET IN TERMS OF FLUVIAL CHANNEL FILL BY CURVE-CRESTED SUBAQUEOUS DUNES. CONSIDER THE APPLIED GEOLOGY.

D.B. THOMPSON 26.7.91



THE POTTERIES COALFIELD

MCM
BROOKHOUSE
BULLHURST
BOULDER CLAY
SANDSTONE & SHALE
COAL & DIRT
COAL
FIRECLAY
Bark House
Springfield House
Ford Hayes
Widowfield
EXTENSION OF BERRY HILL FAULT
ASSUMED FAULT
Rookery Farm
COCKSHEAD
Wood
TO COCKS HEAD
Hulme
Smithy
Coyney Arms
Holly Cottage
ROOKERY
SHINGLE BEDS
Co. Boro. & Boro. Const. By.
STINKERS
HARDMINE
HOLLY LANE
TEN FEET
Colliery
LOC A
LOC B
PB
Waterfield Farm
Old Shafts
GAINMORE
Old Shafts
MEADOW
Blythe House
YARD
Adderley Colliery
ADDERLEY GREEN
MASSFIELD
Park Hall Road
Park Hall
Springs
Boat Ho.
Fish Pond
SOFT COARSE RED FALSE BEDDED SANDSTONE WITH SCATTERED PEBBLES
Anchor Brook
Little Weston
Weston Coyney
KS
KM
700
800
600
93
94

KEY TO 1 : 10 560 GEOLOGICAL MAP

EXPLANATION of Geological Signs and Colours

DRIFT

RECENT AND PLEISTOCENE

	Peat	
	Alluvium	

UNCONFORMITY

	Boulder Clay	GLACIAL
	Sand and Gravel	GLACIAL

UNCONFORMITY

SOLID

TRIASSIC

KM	Keuper Marl	KEUPER
KS	Keuper Sandstone	KEUPER
PB	Pebble Beds	BUNTER

UNCONFORMITY

CARBONIFEROUS

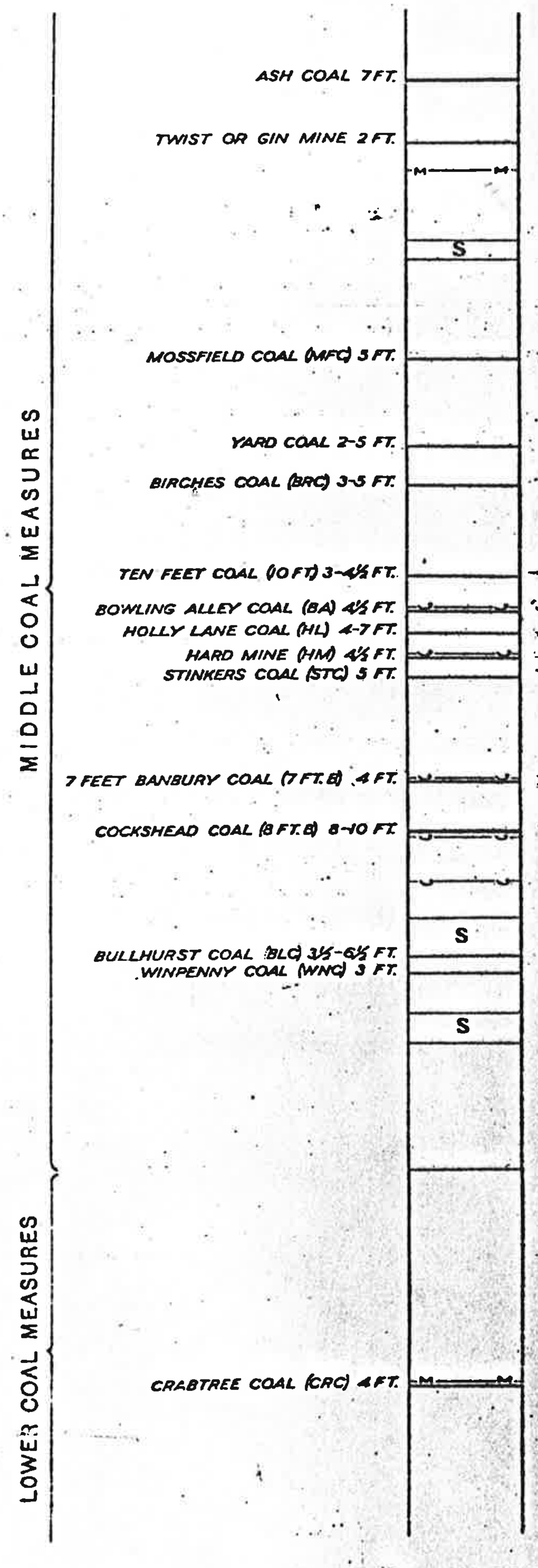
MCM	Undivided (Mainly Shale and Mudstone)	COAL MEASURES – MIDDLE
S	Sandstone	COAL MEASURES – MIDDLE
LCM	Undivided (Mainly Shale and Mudstone)	COAL MEASURES – LOWER
MG	Undivided (Mainly Shale and Mudstone)	MILLSTONE GRIT

- 20 *Dip at surface, the angle in degrees.*
- *Dip underground in seam indicated.*
- *Geological boundary (Drift).*
- *Geological boundary (Solid).*
- *Coal-crop.*
- *Position of fault at surface (white or coloured copi*
- *Position of fault underground (yellow on Solid coloured copies) seam name or symbol on coal side.*

  Throw of fault where known is given in feet, crossmark indicates downthrow side.
- M—M *Marine band.*
- *'Mussel' band.*

  Broken lines denote uncertainty.
- *Well.*
- *Borehole.*
- *Mine shaft.*
- *Mine shaft, abandoned.*
- *Adit mouth, abandoned.*

GENERALIZED VERTICAL SECTION of the COAL MEASURES (Scale: 1 Inch to 400 Feet)

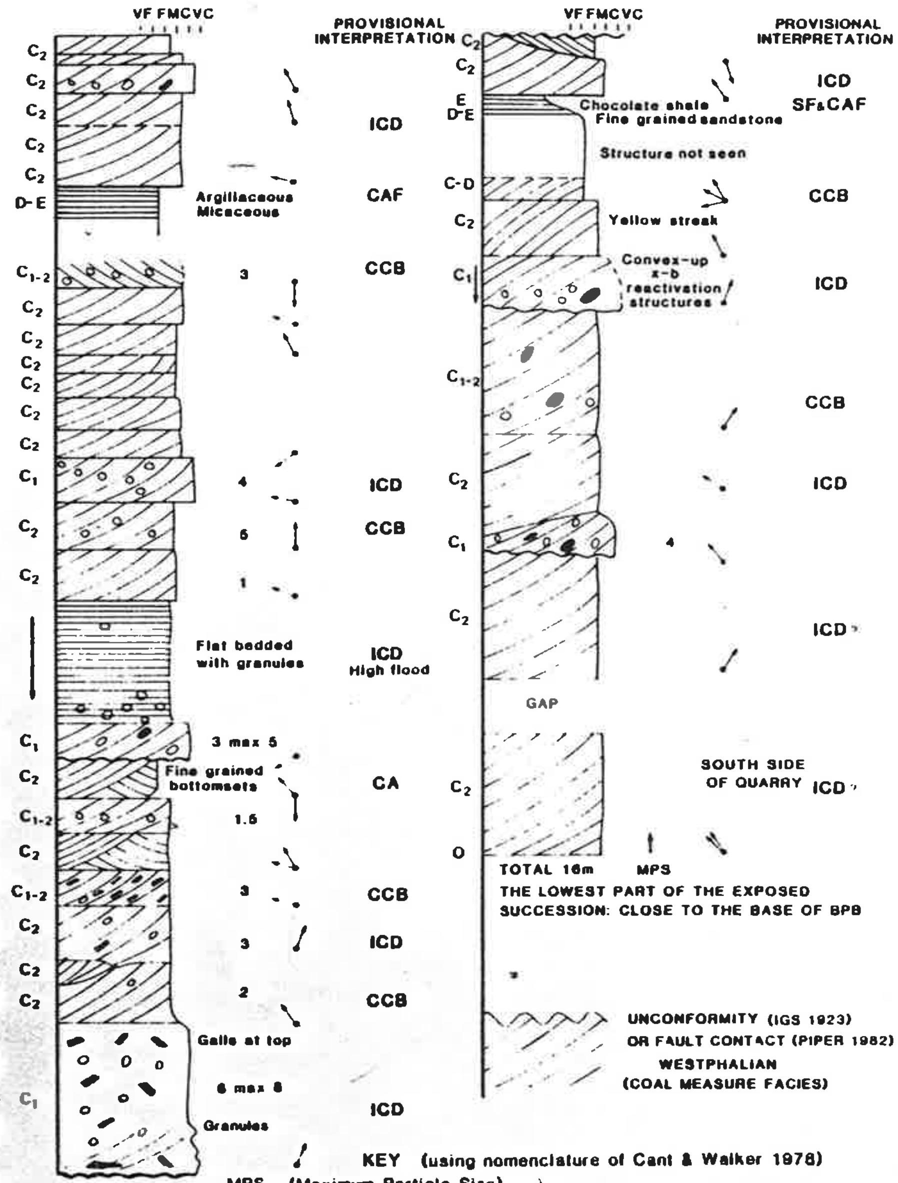


WILLFIELD QUARRY

2.4 The Quarry: SJ927452.

Here, a spoil heap of Coal Measure sediments and fossils related to the Gainmore Mine Shaft is seen at the unconformable contact between the Westphalian and overlying Hawkesmoor Sandstone and Conglomerate Formation [Piper 1981, Charsley 1981]. Viewed from the south, the quarry face displays several small faults and one large fault which throws the Hulme Conglomerate Member against the lower sandy beds of the Formation. These lower sandy sediments are typical of the overall coarsening-upwards sequence with which the Pebble Bed sequence begins but are atypical in that the clasts they contain are not dominantly local [Figure 28]. This differentiates these beds from those of the Huntley Formation [Piper 1981,

Figure 28. Succession exposed in Willfield Quarry showing nature of the Hawkesmoor Sandstone and Conglomerate Formation. Author's Survey.



KEY (using nomenclature of Cant & Walker 1978)

MPS (Maximum Particle Size)

ICD In channel deposition

SF Slough fill

CAF Channel aggradation & fill

CCB Cross-channel bar

C1, C2, etc - give facies described in text:
C2 usually lack pebbles C1 are abundantly pebbly.

Charsley 1981]. At this locality there is no representation of the aeolian Bridgenorth Sandstone Formation, which usually occurs between the Coal Measures and the Trias. Either it was never deposited or the sediments were completely removed before deposition of the Hawkesmoor Sandstone and Conglomerate Formation.

Steel and Thompson [1983] analysed the complete 'Pebble Beds' succession in North Staffordshire and detailed the array of lithofacies present [Table 1]. At this locality only three are present:

Facies C. Generally planar, rarely trough, crossbedded medium-grained sandstones, which in places show basal erosion surfaces, reactivation surfaces, convex-up foresets, and intraformational clast horizons [mostly at the bases of sets but also within the cosets]. Within-facies variation is from beds with abundant pebbles and intraclasts to beds where they are absent or few and the grain size is marginally finer. Palaeocurrent data are unimodal, clustered and centred on 307°. Sharp changes of azimuth of successive crossbeds are recorded.

Facies D. Planar or trough crossbedded, argillaceous, micaceous fine-grained sandstones. Palaeocurrent data are similar to Facies C.

Facies E. Interbedded argillaceous, micaceous fine-grained sandstones, siltstones and mudstones.

Two further minor facies seen here are flat-bedded, coarse-grained pebbly sandstone and flat-bedded, medium-fine grained, argillaceous sandstone. These are better developed at other localities where both display primary current lineation.

The sediments are interpreted as those of a pebbly, sandy braided river system. Although there are clear indications of within-plain erosion and reworking of fines, one surprising feature is the scarcity of indication of rapid fluctuations in discharge [reactivation structures, deformed cross-bedding, water-escape structures, etc.].

2.5 The Play Canyon [Hulme North Central Quarry]: SJ931450.

This large quarry [Figure 29] is excavated in the Hulme Conglomerate Member of the Hawkesmoor Formation [Piper 1981, Steel and Thompson

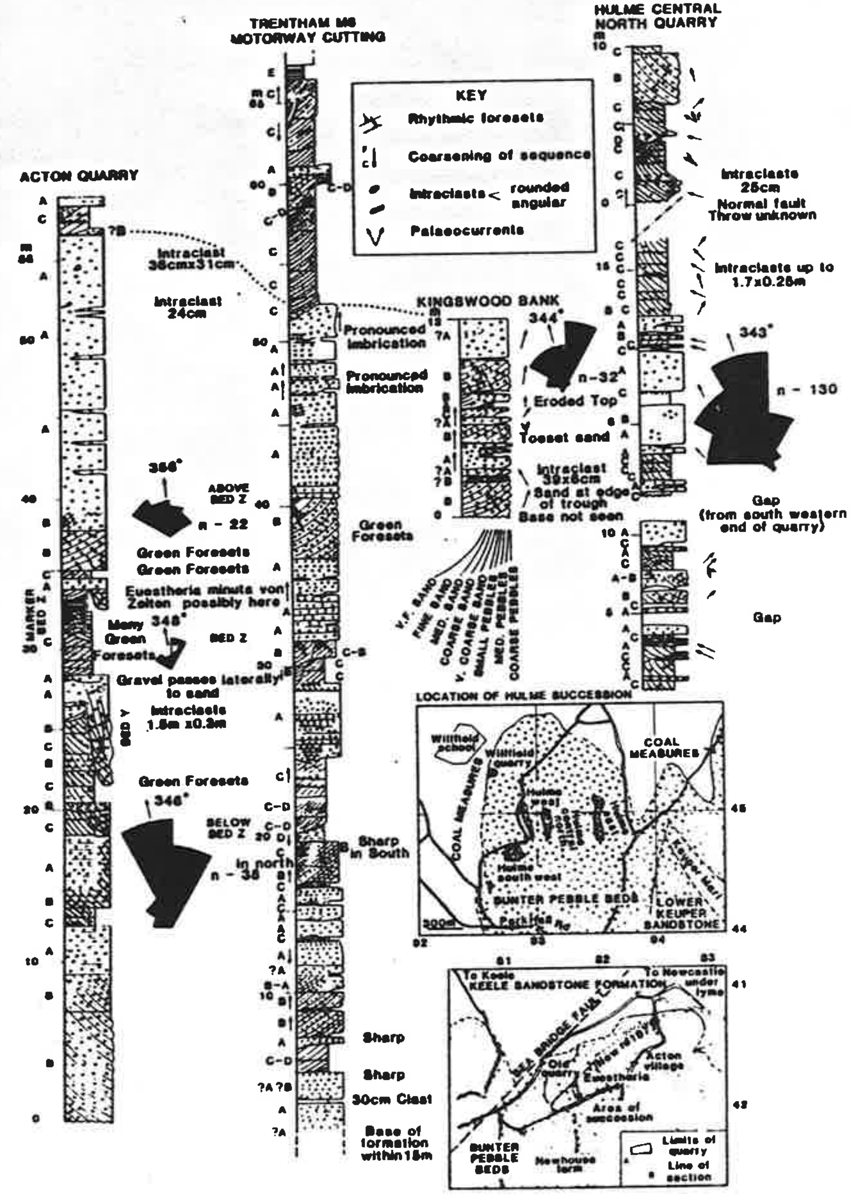
Table 1. Nature and frequency of incidence of lithofacies in the Pebble Beds of North Staffordshire (after Steele and Thompson 1983)

LITHOFACIES	OUTLINE DESCRIPTION OF LITHOFACIES	PERCENTAGE OF SUCCESSION AT: ACTON	M6 MOTORWAY CUT TRENTHAM	HULME
A	Horizontally stratified conglomerates: a spectrum of types: simple disorganised clast- or matrix-supported conglomerate to complexly organised rhythmically graded types with three parts, [i] bimodal, often matrix-supported conglomerate separated by a discontinuity from [ii] finer clast-supported open-framework conglomerate, and [iii] small-pebble bimodal clast-supported conglomerate with a framework filled by sand, silt or clay. Imbrication is common.	43.0	34.8	26.8
B	Cross-stratified conglomerates often with rhythmically developed textures and structures on the foresets, all bimodal: [i] planar types, [ii] trough types. The cross-strata may be related laterally to beds of lithofacies A.	34.0	17.8	18.9
C	Pebbly (C') and less pebbly (C") cross-bedded medium-grained sandstones. Cosets of: [i] planar and [ii] trough type, with lenses and stringers of pebbles along internal erosion surfaces.	20.0	36.1	52.0
D	Argillaceous, medium and fine-grained crossbedded sandstone Some intraformational pebbles. Soft sediment deformation structures. Gravel lenses and stringers of pebbles are much rarer.	2.1	10.0	0.7
E	Horizontally stratified parallel-bedded interbedded fine-grained argillaceous sandstone, siltstone and mudstone with Euestheria.	0.9	1.3	1.5
	Thickness of relevant sections used for calculations.	c. 69m	c. 80m	c. 35m

1983; see also Buist and Thompson 1982, Thompson 1982]. On the eastern side of the major fault there is a long panorama exposed which is approximately parallel to the palaeocurrent of both the gravels and the sands; on the northwestern side a shorter panorama is available [Figure 30]. Several lithofacies are present, the characters of which are given in Table 1, and common associations of these facies can be identified, notably where Facies B is succeeded by Facies A; where Facies A is followed laterally by Facies B, and where subfacies C' is succeeded laterally and vertically by subfacies C" and this in turn by Facies D. In two places at the north end of the quarry it is possible to consider hypothesies relating to syndepositional rather than post-depositional faulting.

These gravelly rocks are interpreted as products of a braided river. In detail, the gravels are envisaged as having developed in an environment where water depths at high stage were greater than the depths in most braided stream plains of proglacial or alluvial fan type, but shallower than those associated with glacial and post-glacial catastrophic floods. Recent braided streams with confined channels and considerable bar/channel relief provide better analogues [e.g. Bluck 1976, 1979]. Thick sequences consisting largely of horizontally stratified gravel [facies A] represent continuous but episodic upbuilding of proximal, mid-channel, longitudinal sheet bars over which discharge and water depth varied considerably. Matrix-supported gravels were deposited from dense flows at high discharge and stage with the framework being filled with finer-grained sediment during slowly waning discharge; open framework gravels result from very rapidly waning discharges [Smith 1974]. Successive sets of crossbedded gravel [facies B] represent the migration of successive gravel bars. The upwards-coarsening sequences, where horizontally stratified conglomerates overlie cross-stratified conglomerates, are best explained by the presence of medial or mid-channel bars with a two-tier structure. Sheets of pebbly sandstone [facies C] lying between the conglomerates, represent in-channel deposition from sandwaves and dunes, and rare blocks of tilted intraformational mudstones represent former channel-floor deposits. Shoaling of bars resulted in the rare flat-bedded sandstones with primary current lineation, whilst finer-grained, interbedded, argillaceous sandstones, siltstones and mudstones are interpreted as waning flood deposits which occasionally display symmetrical ripple marks and interference ripple marks, indicating that wind and wave processes affected stillwater ponds or pools at times of no discharge and lowest stage.

Figure 29. Sedimentological successions at selected localities in the North Staffordshire area.



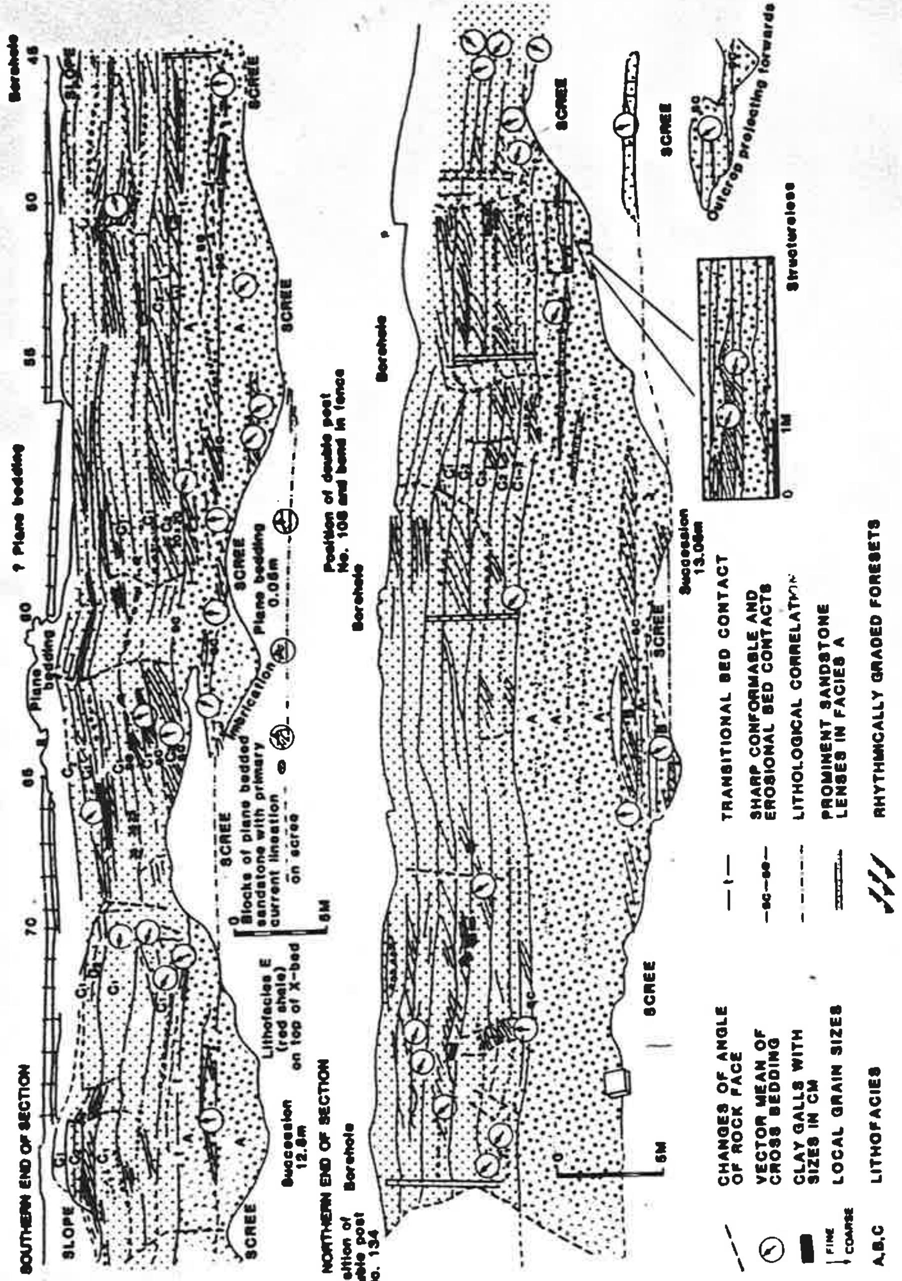


Figure 30. Two sedimentological panoramas of the eastern face of the Play Canyon (Formerly Hulme Central North Quarry) to illustrate the sedimentary organisation of facies generally parallel to the palaeocurrent.

The temporal trend of sedimentation could be explained by several combinations of eustatic, climatic and tectonic causes, but it is believed that basin-forming tectonism of increasing intensity probably influenced the initial coarsening upwards of the lower half of the succession seen at locality 2.4. In contrast, more stable tectonic conditions and decreasing relief on the margins of the basin and in the areas of provenance in the Midlands and the Hercynides, best account for the upwards fining of the upper part of the succession which will be seen at the next two localities.

Travel via the A520 to Meir, take the A50 then B5307 and the A road from Longton to Trentham; follow the B5038 and A53 to Whitmore and Baldwins Gate.

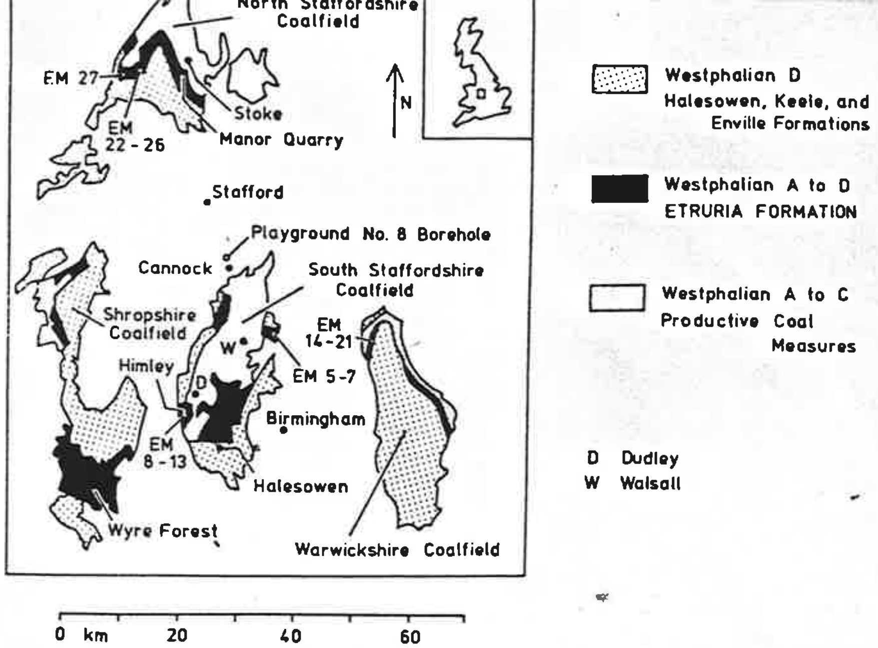


FIG. 1. Location map of Westphalian outcrops in central England. Numbers preceded by EM indicate localities of samples subjected to palaeomagnetic analysis.

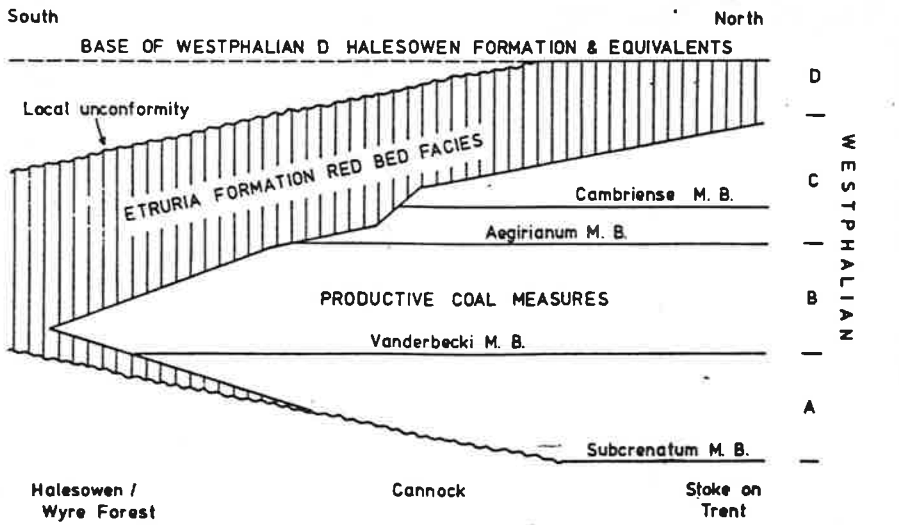


FIG. 2. Regional stratigraphy of the Westphalian in central England showing the diachronous distribution of the Etruria Formation red beds. M.B. indicates stratigraphically important marine bands.

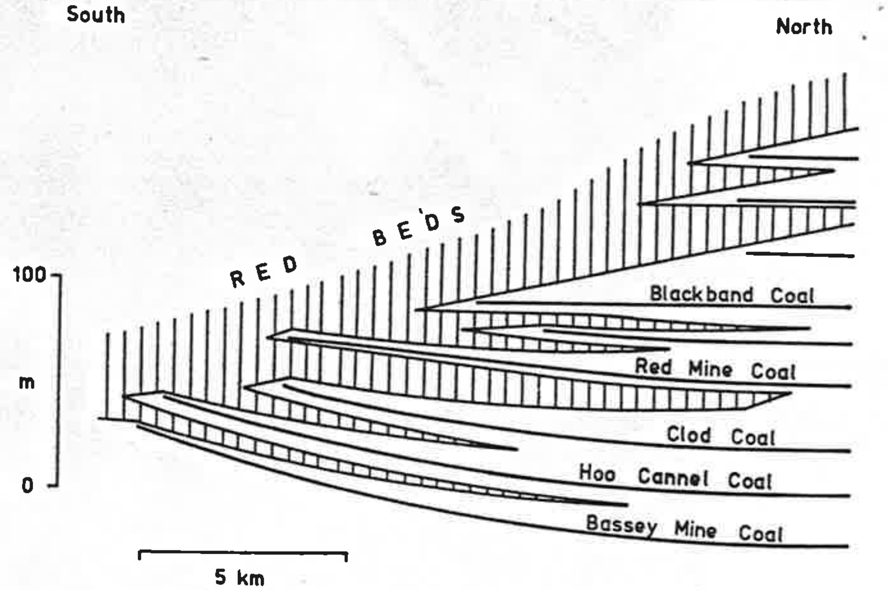


FIG. 3. Interdigitation of coal-bearing grey beds and red beds in the southern part of the North Staffordshire coalfield. Data from NCB boreholes and shafts, collated by E. L. Boardman.

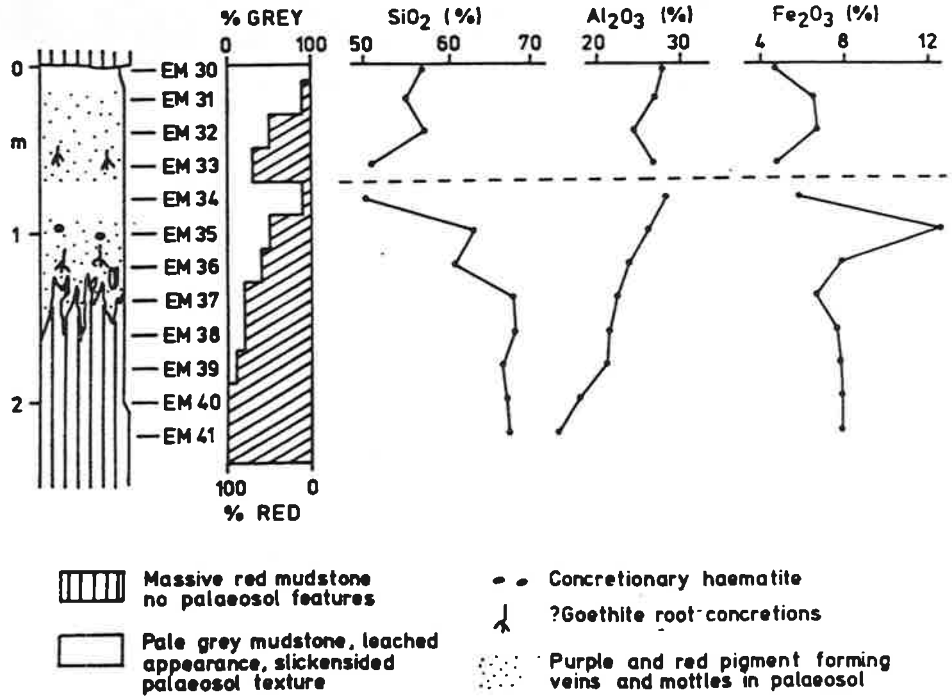


FIG. 6. Vertical lithological and geochemical section through an evolved palaeosol in Manor Quarry, Fenton, Stoke-on-Trent.

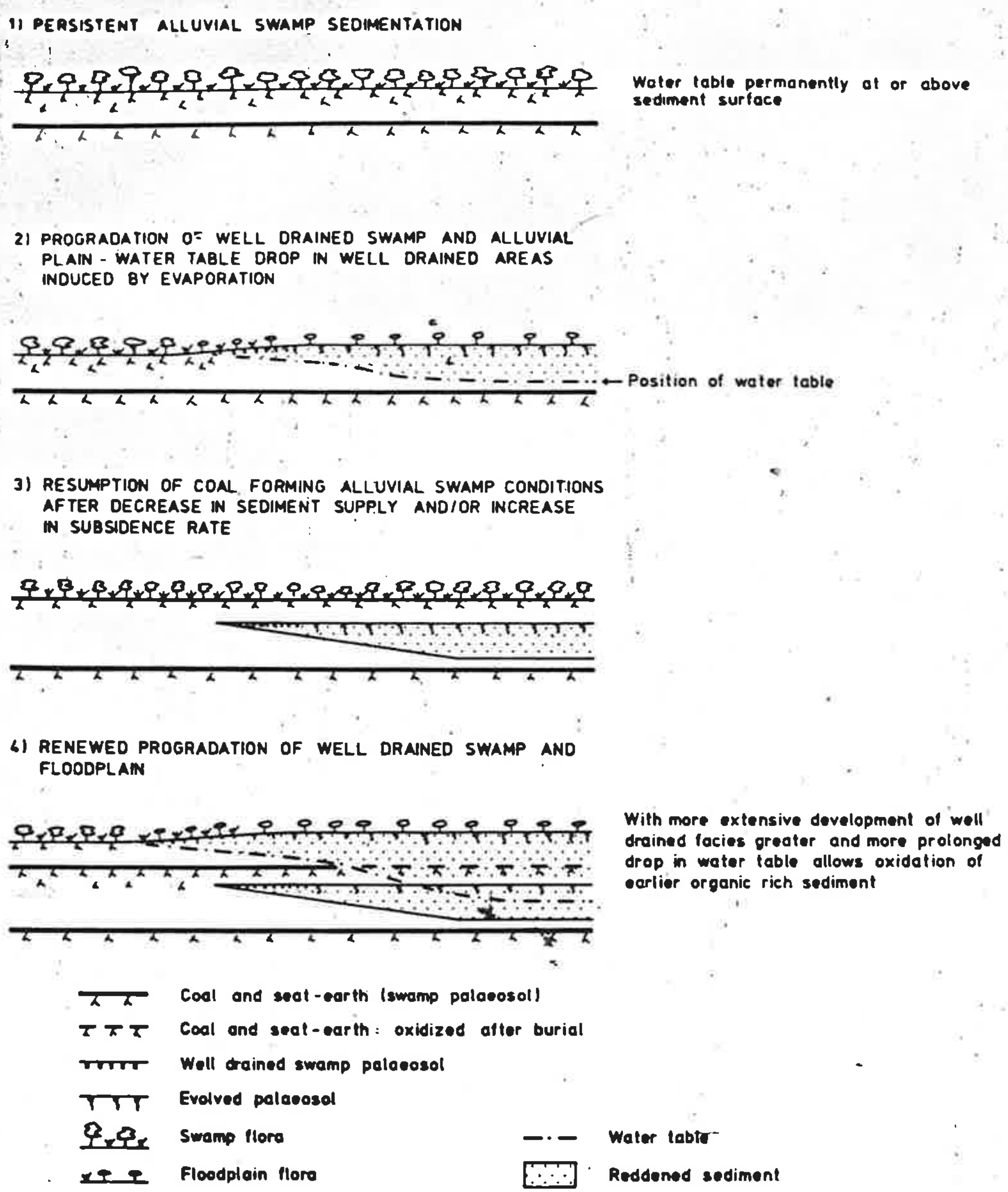


FIG. 11. Suggested sedimentological model for the formation of interbedded and diachronous red beds marginal to a coal-forming swamp area in the Westphalian of central England.

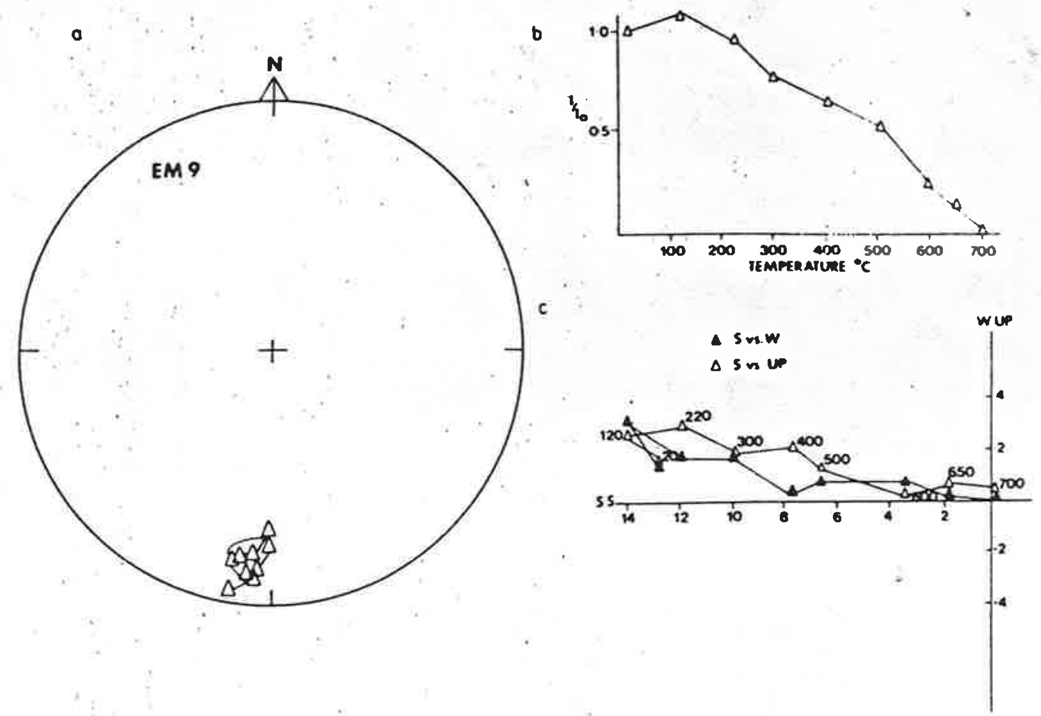


FIG. 7. Partial thermal demagnetization of sample EM9. (a) Stereographic projection showing directional changes at successive temperature increments; open symbols = upward inclination, closed symbols = downward inclination. (b) Normalized curve showing the decay of total intensity. (c) Zijderveld diagram showing the successive end-points during thermal demagnetization. Intensity in μG.

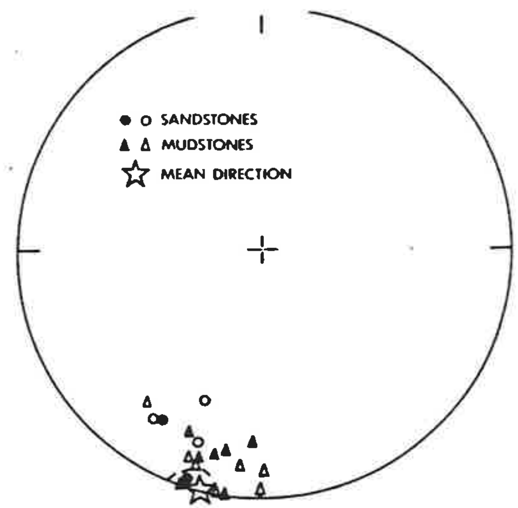


FIG. 10. Stereographic projection of site mean directions for the Etruria Formation; open symbols = upward inclination, closed symbols = downward inclination. Circles denote sandstones; triangles denote mudstones. Mean direction: Dec. = 197°, Inc. = −1°.

PROCEEDINGS OF THE YORKSHIRE GEOLOGICAL SOCIETY
VOL. 38, PART 3, NO. 15, PP. 329–342, PLS. 27–28, 14TH MAY, 1971

ALGAL LIMESTONE IN THE UPPER COAL MEASURES (WESTPHALIAN D) AT CHESTERTON, NORTH STAFFORDSHIRE

BY J. E. POLLARD AND JULIE F. WISEMAN

(*Read at Hull, 7th November*, 1970)

CONTENTS

SUMMARY

Small isolated lenses of algal limestone discovered at the junction of the Etruria Marl and Newcastle Group in north Staffordshire contain algae of the genera *Girvanella*, *Ortonella*, *Garwoodia* and *Bevocastria* associated with *Anthraconauta*, ostracods, *Spirorbis* and plant fragments. The lenses represent preservation *in situ* of sediment formed in temporary pools rich in calcium and other carbonates. The algae grew as thin crusts and small colonies in these saline pools before the deposition of the Newcastle Group and the introduction of the non-marine fauna.

I INTRODUCTION

In the course of a systematic study of Upper Carboniferous *Spirorbis* limestones of the Midlands, small isolated lenses of biorudite limestone were discovered at the junction of the Etruria Marl and overlying Newcastle Group at Metallic Tileries marl pit, Chesterton, north Staffordshire (SJ 840490). Gibson (1905, 1925) recorded the presence here of the upper part of the Etruria Marl and the lower part of the Newcastle Group, while Williamson (1946) described the espley rocks within the Etruria Marl and referred to the occurrence of several calcareous bands. The lowest beds of the Newcastle Group in this pit were described by Myers (1954) when he first recorded the zonal bivalve *Anthraconauta tenuis* (Davies and Trueman) at this horizon, but, to date, no detailed section of the strata has been published.

Fig. 1 represents the generalized succession of strata in this marl pit at the present stage of working and the precise details of the rocks in which the algal lenses were found. The Etruria Marl

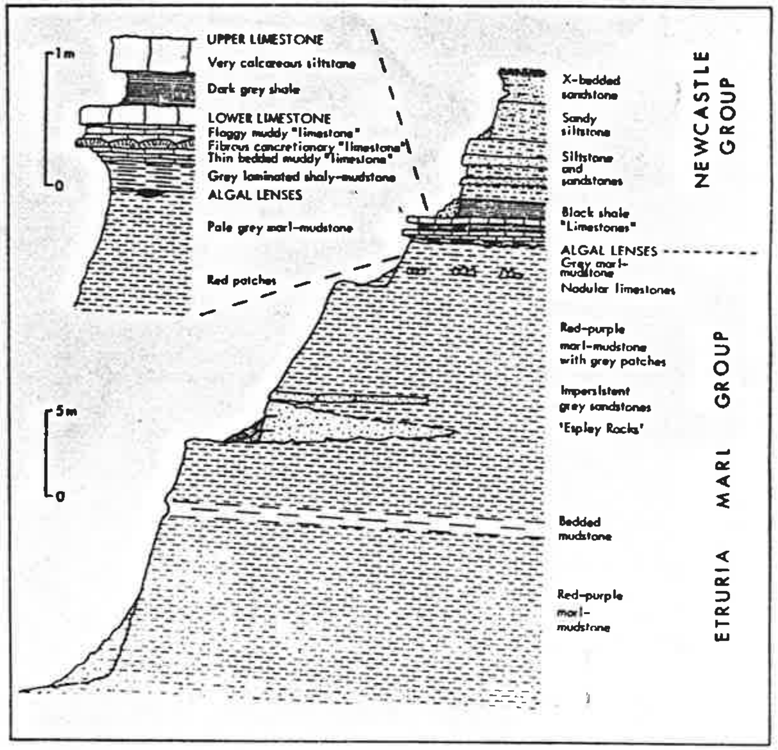


FIG. 1.—Sketch section of strata in Metallic Tileries marl pit, Chesterton. Detail of level of algal lenses inset. The Etruria Marl Group has not been examined or recorded in detail.

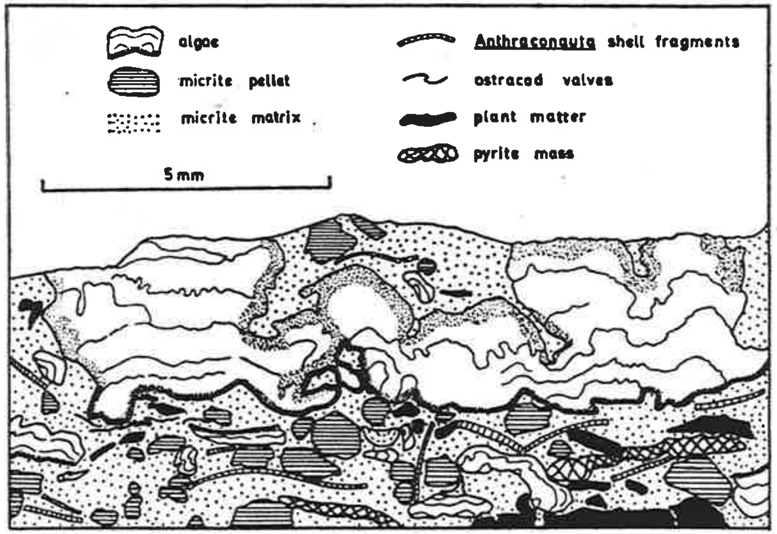


FIG. 2.—Nodose algal mat in growth position in upper part of layer D of lens MT. 6 showing relationship to other constituents.

Some buried Tertiary dykes of Britain and surrounding waters deduced by magnetic modelling and seismic reflection methods

SUMMARY: Dykes of Tertiary age have been identified by modelling offshore marine and aeromagnetic data and onshore aeromagnetic data. Dykes have been found in the North Sea off NE England, and in the Irish Sea. Published aeromagnetic maps have also been used to locate non-outcropping Tertiary dykes in the Scottish Borders. Many of the offshore anomalies are caused by multiple dykes that cannot be separately resolved. All dykes retain the dominant NW-SE trend of the known Tertiary dykes although this trend approaches E-W near the east coast of England. Under the North Sea the trend swings back and becomes increasingly southerly trending. The dykes may be the result of NW-SE compressional or NE-SW tensional stress with deep crustal weaknesses causing changes in trend.

J. geol. Soc. London, Vol. 142, 1985, pp. 1047–1057, 12 figs.

S. R. Kirton & J. A. Donato 1985

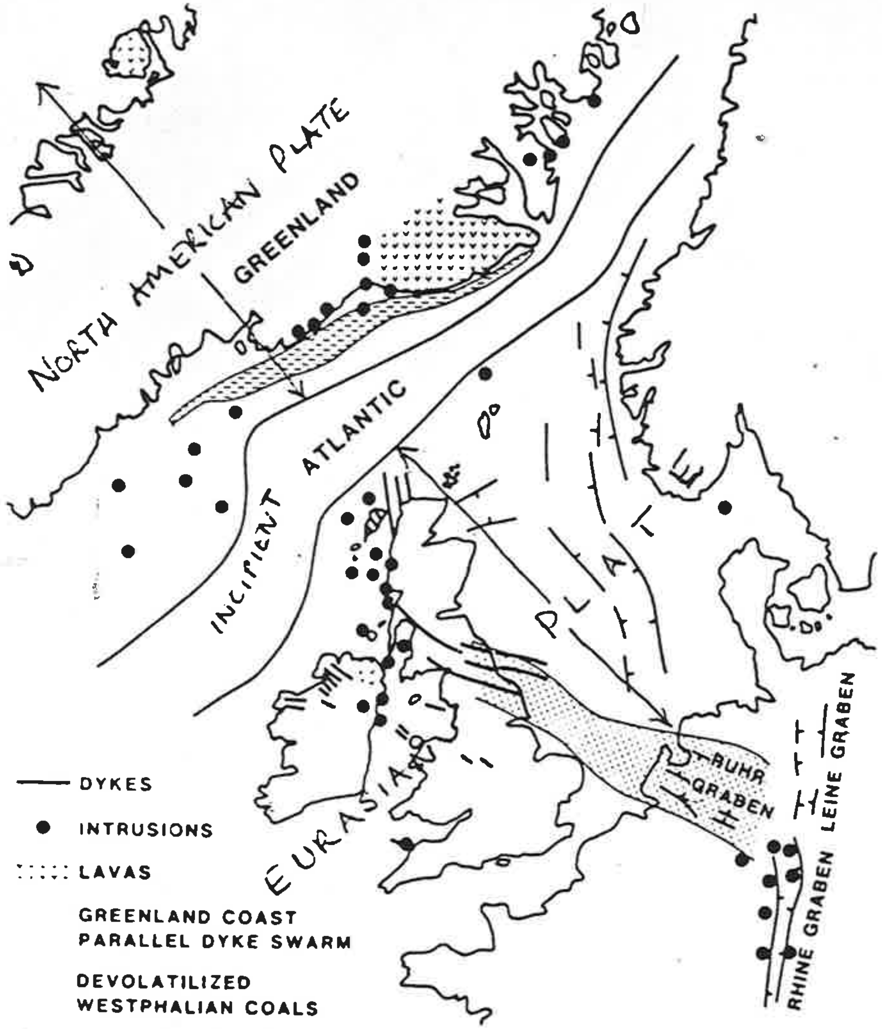


FIG. 12. Tertiary reconstruction of North Atlantic areas showing generalized Tertiary dyke pattern. diagram in Bell (1976).

In recent years the British Geological Survey (formerly Institute of Geological Sciences) has run extensive geophysical surveys over the UK mainland and surrounding continental shelf. For this paper marine and aeromagnetic surveys have been used in conjunction with commercial multichannel seismic surveys to define the extent of some proposed non-outcropping Tertiary dykes in Britain and surrounding waters. In particular, some examples with pronounced linear magnetic anomalies off the coasts of NE England, the Lake District and Anglesey have been investigated (Fig. 1). These have been modelled and compared to an anomaly of a known Tertiary dyke in the Scottish Borders.

Selection of interpreted anomalies

Data coverage is excellent for the entire area shown in Fig. 1. Marine traverses generally form a grid with a line spacing rarely greater than 6 km in any direction.

Tectonic significance of dykes

The areas of crustal weakness primarily utilized by the dykes are the igneous centres but, given a NW–SE oriented compressive stress as postulated by Vann (1978), it is unlikely that dykes could be intruded along the dominant NE–SW oriented Caledonian structures. It is far more likely that the dykes utilized a zone of devolatilized coals in the southern North Sea may be associated with Tertiary dykes extending, at depth, to the European mainland.

Although all the dykes retain a general NW–SE trend, the Scottish-centred dykes describe a sinusoidal curve. The most northerly are N–S trending but become increasingly easterly trending to the south. Near the North Sea coast they once more start to return to a more southerly trend.

The swarms are thought to be the result of NW–SE compressive (NE–SW tensional) stress, but underlying pre-existing or developing major crustal weaknesses approximately parallel to the compressive stress. Structural features of this trend are present in the North Sea as indicated by the anticlinal and synclinal axes shown on Figs 1 and 4; these features may have provided suitable zones for dyke intrusion in the North Sea. If Tertiary dykes are present at depth as indicated by the zone of devolatalized coals, the dykes may have been influenced by features as remote as the Ruhr Graben (Fig. 12). In S Scotland and N England, dykes initiated fractures uniting the pre-existing zones of weakness, i.e. those of the North Sea and of the igneous centres of Scotland, and did not utilize existing crustal weaknesses.

Conclusions

Modelling of magnetic anomalies suggests the existence of Tertiary dykes in the western part of the North Sea and the Irish Sea. Most of the latter are probably related to the centres of Ireland, while those in the North Sea are part of the swarm centred on Mull. The total length of the swarms radiating from the Scottish centres can be demonstrated to be at least 800 km and crustal weaknesses have determined local variations in the strike of dykes.

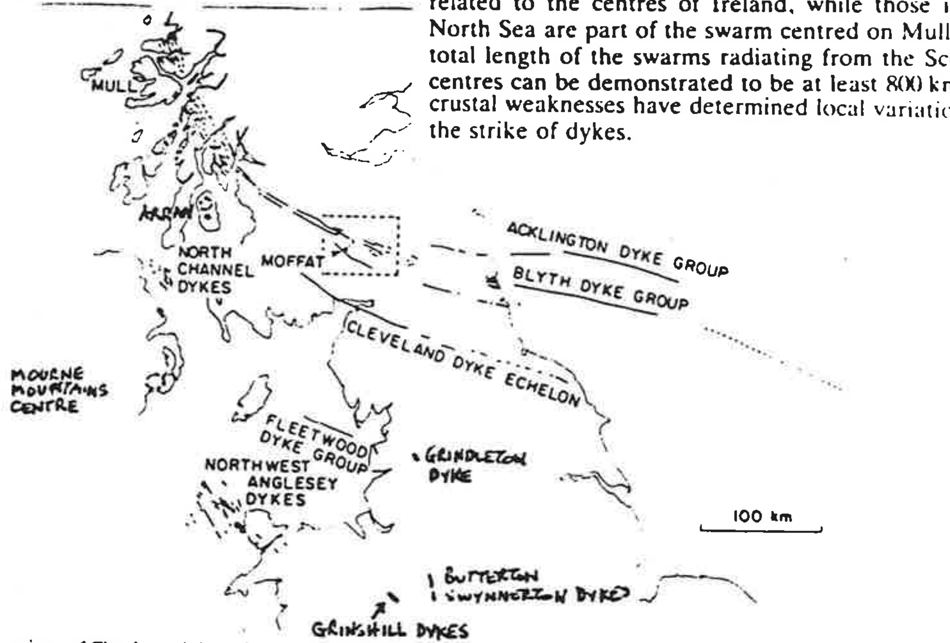
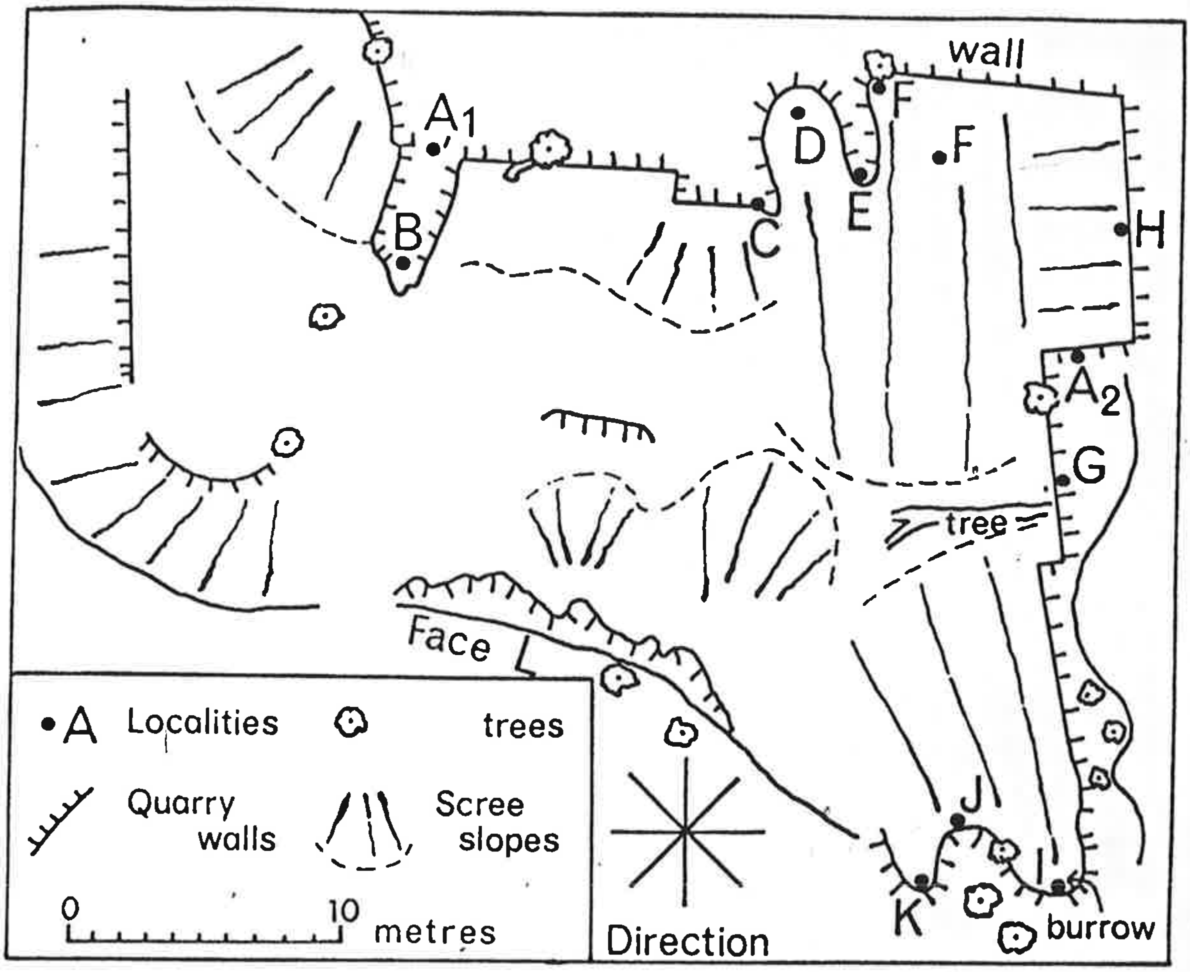


FIG. 1. Location of Tertiary dykes. Includes dykes marked on published geological maps and dykes inferred from magnetic anomalies. The distribution is generalized in west of Scotland. The dashed line indicates central line of the zone of linear anticlinal and synclinal features of mid-Tertiary to Zechstein age referred to in the text. The dot-dash



Church Quarry.

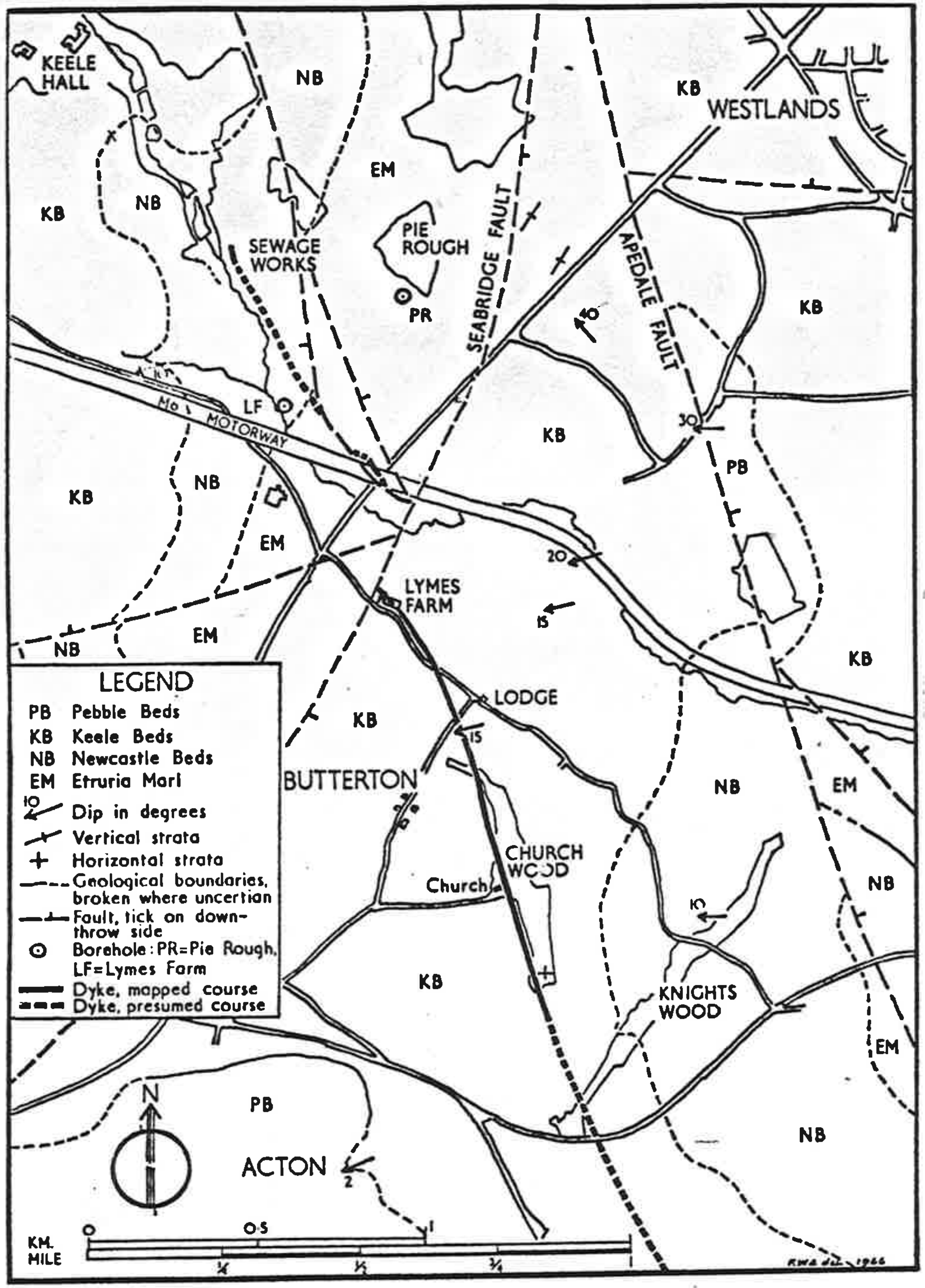


Figure 1 - Geological sketch-map of the area between Keele, Newcastle, and Butterton, Staffordshire, to show the course pursued by the Butterton Dyke. (F.W. COPE 1966)

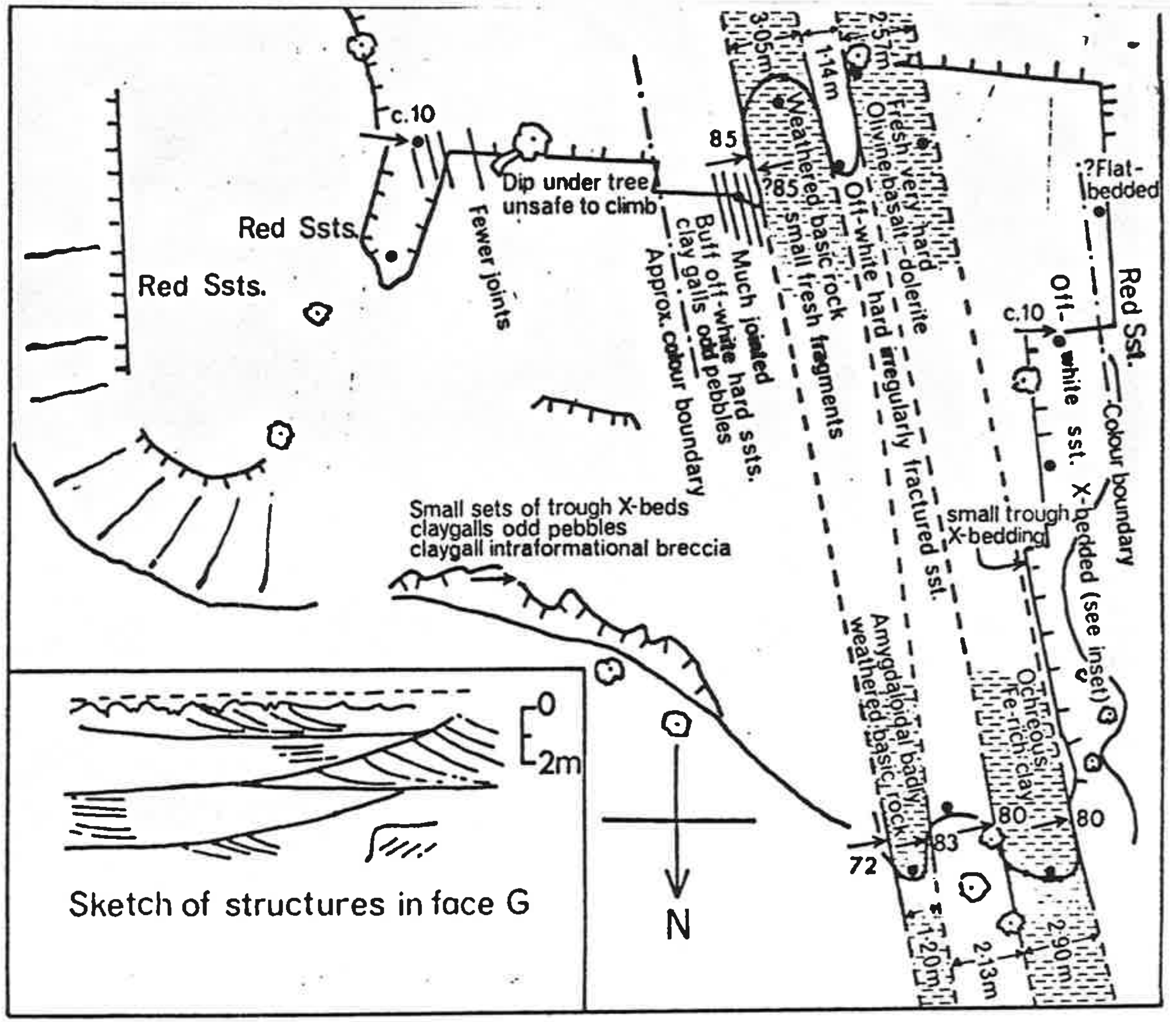
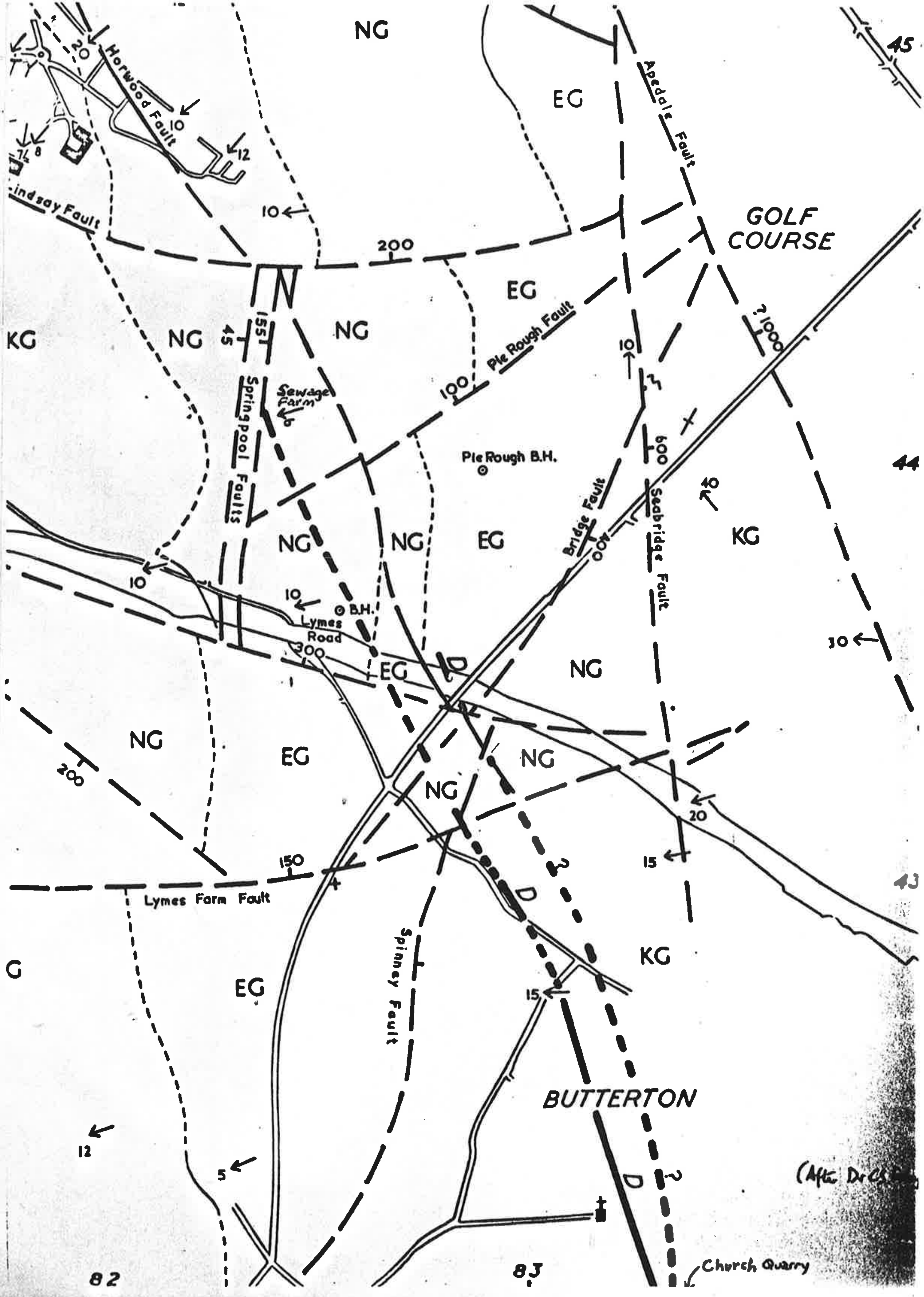


Fig. 3. Outline geological map of Butterton Church Quarry. Correction: For C10 near top centre of map read C7.
(D.B. THOMPSON 1975)



NG
EG
Horwood Fault
Apedale Fault
45
Lindsay Fault
200
GOLF COURSE
EG
KG
NG
NG
Pie Rough Fault
?1000
Springpool Faults
Sewage Farm
100
Pie Rough B.H.
600
44
Bridge Fault
Seabridge Fault
NG
NG
EG
KG
B.H.
Lymes Road
300
EG
NG
NG
EG
NG
NG
200
150
Lymes Farm Fault
43
G
EG
Spinney Fault
KG
BUTTERTON
82
83
Church Quarry