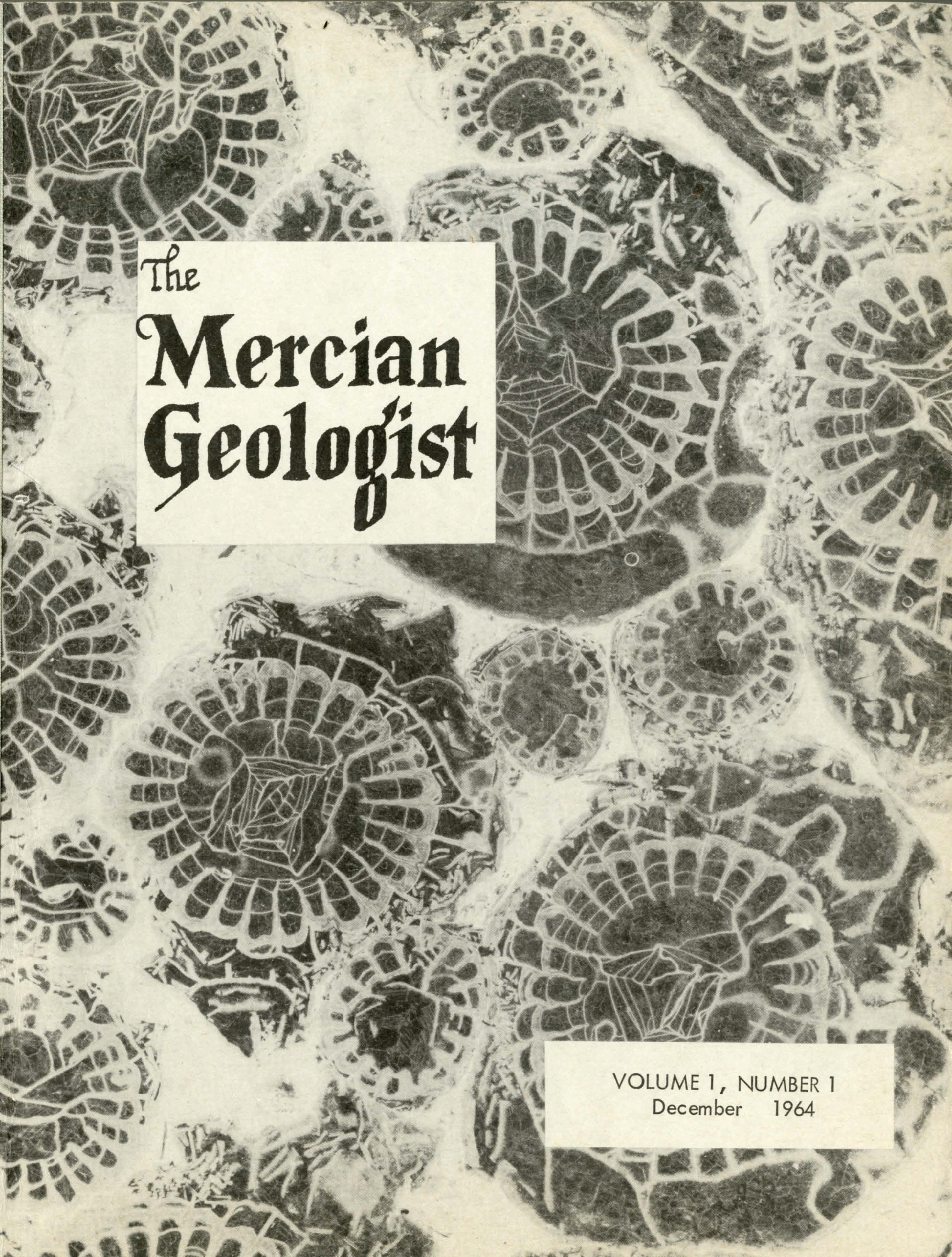

The Mercian Geologist

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December 1964

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JOURNAL OF THE EAST MIDLANDS GEOLOGICAL SOCIETY

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The Cover: A transverse section of the Rugose coral *Lonsdalia duplicata* (Martin) D_2 zone, Visean, Carboniferous Limestone, Cressbrookdale, Derbyshire.
Section and Photograph by Dr. F. M. Taylor

EDITORIAL

The Midland counties of England are a focus of intensive working of rocks and minerals; Coal, gypsum, salt, iron ore, calcite, fluorspar, barytes, petroleum, chert, silica sands and ganister, sandstone, limestone, granite and basalt for roadmetal, clay for brickmaking, alluvial sands and gravels are all being exploited at the present, and in the past, copper, lead, zinc, and a number of other minerals. The history and geography of the region have thus been very directly determined by its geological circumstances.

It is therefore, perhaps, not surprising that there should be a widespread interest in geology in the Midlands. What is more surprising is that the region has failed to produce any geological society comparable in stature to the Yorkshire, Glasgow, Edinburgh, Liverpool and Manchester Societies. Certainly there have been numerous bodies with a geological interest, but usually this interest has been subsidiary. Birmingham and North Staffordshire have local branches of the Geologists' Association; and some other societies, notably the Leicester Literary and Philosophical Society and the North Staffordshire Field Club, have strong geological sections. But that is all. Nor has the region given birth to any geological journal of stature: important papers on Midland geology have been published in reports or transactions of a number of societies, but there has been no obvious focus for such papers.

This geological vacuum has been at its most pronounced in Nottinghamshire and Derbyshire. Nonetheless, the existence in these counties of a considerable interest in geology has been made manifest by the way in which evening classes have flourished. It was the enthusiasm of two such classes, respectively under the tuition of Dr. Frank M. Taylor and the writer, which led directly to the formation of the East Midlands Geological Society. Membership has grown so swiftly that field meetings regularly attract attendances of 70 and indoor meetings, of over 100: the Society looks set for a bright future.

Publication of a journal was among the initial objects of the Society. It was felt that there was a real need for a journal to provide a milieu for the publication of work on Midlands geology. Geological research is at present especially intensive in this region: two conferences for geologists working in the Southern Pennines have been held at Keele University, with conspicuous success, and in the Welsh borderland, the Ludlow Research Group has been operative for a number of years. At present, publication of work on stratigraphy is relatively difficult: this topic falls outside the scope of many specialist journals. The "Proceedings of the Yorkshire Geological Society" is a natural focus for work on north-eastern England, the region in which that Society operates: the "Geological Journal", associated with the Liverpool and Manchester Geological Societies, fulfills a similar function for the north-west. The "Proceedings of the Geologist's Association", although by intent national in coverage, has come to be identified, rightly or wrongly, with south-eastern England. Papers dealing with Midlands geology have appeared in all three journals: but the societies sponsoring them have little association with the Midlands, and the amateur geologist, in particular, cannot identify himself with them.

It is hoped that "The Mercian Geologist" may come to be considered a natural place for the publication of work on the geology of the Midlands. Although the journal is specifically the organ of the East Midlands Geological Society, the scope of its contents is intended to be somewhat wider - a coverage of the counties of Lincolnshire, Leicestershire, Rutland, Northamptonshire, Nottinghamshire, Derbyshire, southernmost Yorkshire, Staffordshire, Warwickshire, Worcestershire, Herefordshire and Shropshire. Its name was chosen in this view: its content is intended to comprehend all aspects of Midland geology, together with review articles of more general geological interest.

In order to attain a balance between the requirements of the amateur and the professional geologist, we hope to publish papers that are of real value but written with sufficient clarity and detail as to be readily comprehensible to readers with no more than a broad knowledge of the subject. Some authors have already been asked to lengthen their contributions with this end in view - surely a rare request from any Editor.

The potential value of work by amateur geologists is considerable. However, the amateur is often hesitant to place his results before the critical eye of the professional geologist, and much good work may be lost as a result. The Editorial Board is most willing to help meet difficulties in this direction by advising on presentation and by suggesting amendments: provided the work is of real value, no manuscript will be rejected simply on grounds of inadequate presentation. Articles and letters should be addressed either to the Editor or to the Secretary of the East Midlands Geological Society: contributions are invited equally from members and non-members.

William A. S. Sarjeant

A NEW FISH BED IN THE CARBONIFEROUS LIMESTONE OF DERBYSHIRE

by

Trevor D. Ford

Summary

A new discovery of a bed crowded with the dermal denticles of *Petrodus patelliformis* M'Coy is described. It occurs in the uppermost Visean limestones and is thought to be M'Coy's type locality. Comparisons are made with other fish beds in the Carboniferous Limestone of Derbyshire and the palaeoecology is discussed.

Introduction

Whilst fossil fish remains are to be found sporadically distributed through the limestones of Derbyshire, they have only been found in abundance at two localities previously. These are at Ticknall (Wilson 1880) and in the Barmoor Clough Quarry near Chapel-en-le-Frith (Jackson 1908). The first of these is now overgrown and partly filled in and the other is completely filled in. Thus it was a considerable surprise to find a new fish-bearing bed near Wirksworth and this note records the details.

Locality and Stratigraphical Relationships

The new fish bed is in Steeplehouse Quarry, approximately mid-way between Wirksworth and Cromford, immediately west of the railway siding at the crest of Bole Hill (National Grid Reference SK/288554). Here some 3 feet of limestone with intervening shale bands in a crinoidal off-reef facies have been found to contain large numbers of dermal denticles of *Petrodus patelliformis* M'Coy. (Dermal denticles are broadly equivalent to scales embedded in the skin of early shark-like fishes, but have the internal structure of teeth). The beds in the quarry were mapped by Shirley (1958) as part of the Cawdor Limestones at the top of the Lower Carboniferous succession in Derbyshire, and the beds were referred to the P_1 sub-zone by comparison with the Cawdor Quarry some 2½ miles to the north. Shirley made a reference to fish remains being present.

The quarry, temporarily not being worked, exposes some 25 feet of limestones, of which the upper 20 feet are fine-grained calcarenites with some chert nodules and scattered Gigantoproductus shells. There is a downward passage into the crinoidal facies, which reaches a little over 6 feet in thickness in the step in the middle of the quarry floor. The lowest bed visible, forming the quarry floor, is characterized by numerous burrows and other trace fossils, rarely seen in Derbyshire. The step is formed of beds of crinoidal limestone 12 to 18 inches thick with shale-partings in places up to an inch thick. Traced laterally some of the partings die out and massive beds 1½ to 2 feet thick result. The fish dermal denticles are present throughout some 3 feet of beds as scattered individuals, but become concentrated at the top of each limestone below the shale-parting, and in the shale itself. The quarrying away of blocks left the shales exposed to weathering and some surfaces were so rich in dermal denticles that hand-fulls could be scooped up. Samples of the shale-partings reaching 20% by weight of dermal denticles have been obtained. Traced laterally, westwards along the north wall of the quarry the grain-size of the crinoidal limestone is rapidly reduced, and dermal denticles are no longer found after some 20 yards from the quarry step. Southwards the shale-partings die out, but a weathered joint face shows dermal denticles following the line of one parting as a layer in a limestone bed, until this disappears into the southern quarry wall, which is largely hidden by debris. The next quarry, 100 yards away to the south, fails to reveal any dermal denticles. The occurrence thus seems to be confined to a small thickness of beds, 3 feet, over an area not more than 50 yards across from north to south. The west wall of the quarry on the same horizon reveals no fish remains, whilst the gentle easterly dip conceals the continuation of the beds. Any renewal of quarrying may remove it altogether.

The Fauna

The fish fauna consists almost entirely of dermal denticles of Petrodus patelliformis, the details of which are discussed below. Other fish remains are a few teeth of Cladodus type all damaged too much for specific identification.

A varied invertebrate fauna is found in both limestones and weathered shale-partings, and it includes:-

The corals Dibunophyllum bipartitum M'Coy; Caninia juddi (Thomson); Zaphrentis spp; Michelinia tenuisepta (Phillips); Emmonsia parasitica (Phillips); and Chaetetes septosus (Fleming)

The brachiopods Echinoconchus punctatus (J. Sowerby); Pustula pustulosus (Phillips); Gigantoproductus giganteus (J. Sowerby); Dictyoclostus semireticulatus (Martin); Athyris sp.; and Spirifer bisulcatus J. de C. Sowerby. Numerous Bryozoa. Crushed crinoid calices and ossicles.

Systematic Palaeontology

Sub phylum Pisces
Class Chondrichthyes
Subclass Elasmobranchii
Order Selachi
Suborder Hybodontoidea
Family Hybodontinae

Petrodus patelliformis	M'Coy	1848	Ann. Mag. Nat. Hist. (2) II pp. 132-3.
-ditto-	M'Coy	1848	Proc. Camb. Phil. Soc. 1 p. 66
-ditto-	M'Coy	1854	Contrib. British Palaeont. p. 27.
-ditto-	M'Coy	1855	British Palaeozoic Fossils in the Sedgwick Museum, Cambridge. p. 637 and Plate IIIG figs. 6,7,8.

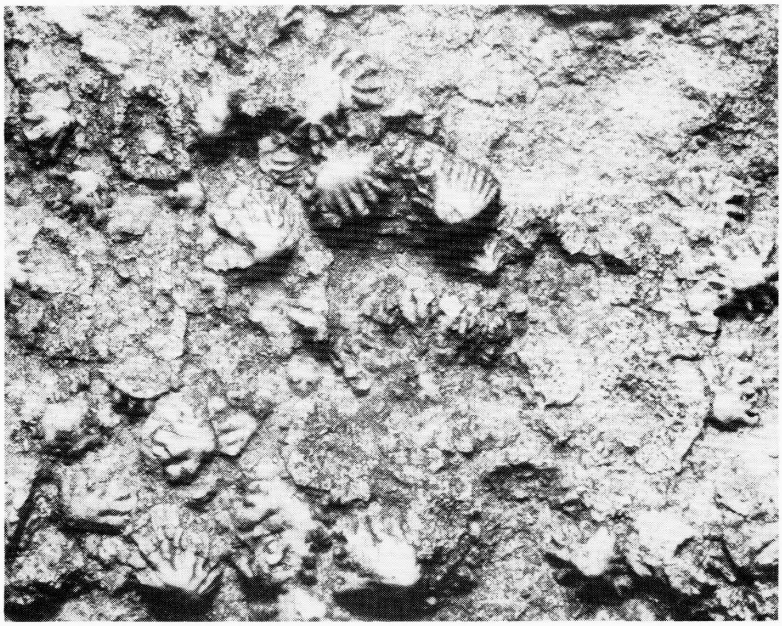

Fig. 1. Part of the Petrodus patelliformis bed at Steeplehouse Quarry, near Wirksworth, showing the abundance and random disposition of the dermal denticles. Magnification X2

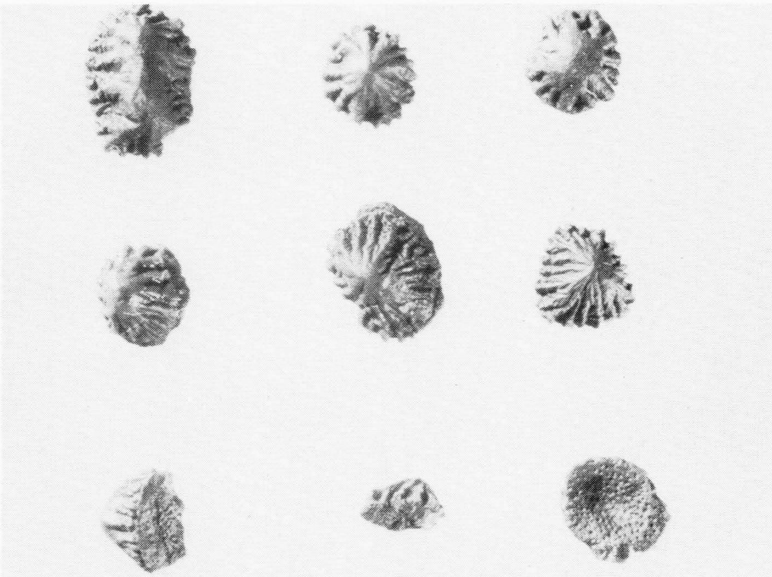

Fig. 2. Dermal denticles of Petrodus patelliformis M'Coy to illustrate the variation in original shape and abrasion. Magnification X3.5.

Petrodus patelliformis	Davis	1883	Trans. Roy. Dublin Soc. (2) I p. 400 Tablet 208 Plate LI figs. 16, 16a, 16b.
-ditto-	Moy-Thomas	1935	Proc. Leeds Phil. Lit. Soc. III pp. 68-72, pl. 2 and fig. 1.
Petrodus petalliformis	Morris	1854	Cat. Brit. Fossils p. 337.
-ditto-	Woods	1891	Cat. Type Foss. Woodwardian Museum p. 165.

Ostinaspis barbotana (Romanovsky) Trautschold 1874 Nouv. Mem. Soc. Imp. Nat. Hist. Mosc. XIII.

Listracanthus hystrix (Newberry & Worthen) emend. Demanet (pars). Demanet 1941. Mem. Mus. Roy. Hist. Nat. Belg. No. 97, pp. 159-61. Pl. VIII, figs. 5-9.

M'Coy's original description is here quoted in full:-

"Conical, height one-half to two-thirds the width of the base, which is round or rarely subtrigonal; apex rudely pointed, becoming flat by wear; sides radiatingly ridged with about thirteen or fourteen very strong, single or dichotomous ridges, the sides of which are usually cut by numerous deep oblique sulci; the ridges are highest at the base, where they terminate abruptly; osseous base a little wider than the crown. Diameter of base three to four lines.

This tooth presents considerable variation in the proportion of height to width of the base, and also in the number and relative thickness and complexity of the ridges; there is no variety however sufficiently striking to require particular notice or occasion any difficulty in the identification of the species.

It seems abundant in some parts of the Derbyshire limestone."

Remarks: M'Coy's type material was noted as being in the Cambridge University collections, and Specimens E 4509 to 4511 in the present Sedgwick Museum Collections are listed as syntypes, being referable to M'Coy's 1855 illustrations Pl III G figs. 6, 7, 8 respectively, and E 4512 as a paratype. The material was listed as from "Derbyshire - presented by W. Hopkins". Hopkins published a short paper on the stratigraphy of the Derbyshire limestones in 1834 but did not refer to any fossil fish localities, so that the type locality is not known any more accurately than "Derbyshire". Green in the North Derbyshire Memoir (1887) lists only this together with Morris's (1854 p. 337) mis-spelling of the specific name. In view of M'Coy's reference to its abundance and the fact that the species is not listed from either of the other Derbyshire fish beds it seems highly likely that the locality described here was Hopkins' original locality.

Petrodus patelliformis was listed from "the Yoredales of Todmorden, Lancashire" by Sherborn and Woodward (1890) (specimen No. P 5855 in the British Museum (Natural History)), and this vague locality may be the same as that which provided the slab with a pectoral girdle and crushed skull in the Wellburn Collection at Leeds Museum described under the same name by Moy-Thomas (1935). Wellburn's locality was similarly vague, "Local Shales, Dane Valley, Pendlesides", and it cannot now be identified. Naming the pectoral girdle and skull Petrodus patelliformis by Moy-Thomas was perhaps unwise as the association with scattered dermal denticles is based on the evidence from a single slab only. The assignation to the Family Hybodontidae is similarly tenuous and is based on an apparent resemblance to the pectoral fin of the Jurassic Hybodus. Woodward (1903) found similar dermal denticles in association with a spine of Listracanthus wardi Woodward in the Gin Mine marine band of the North Staffordshire coalfield but he referred them only to Petrodus sp., though he likened them to the denticles of Hybodus sp.

The denticles herein described appear to grade into the form described from Indiana as Petrodus sp. by Newberry (1873) and into a form from Illinois described by Newberry and Worthen (1866, p. 72 and Pl. IV, fig. 17) as P. acutus. These species were described also from the Carboniferous Limestone of Mjatschkowa, Russia, mistakenly referred to the Devonian by Trautschold (1874) and Davis (1883, p. 401). Trautschold placed them in a new genus Ostinaspis, listing Petrodus as a synonym, but Sherborn and Woodward (1890) list Ostinaspis as a synonym of Petrodus! Trautschold's figures of Ostinaspis barbotana Romanowsky (1875 Pl. XXVII, figs. 12a to f), some of which are reproduced by Woodward (1903, figs. 9 and 9a) on the basis of specimens in the British Museum (Natural History) (No. P 5117), differ only by a prolongation of the radial ridges into flanges. Woodward appears to regard these as possibly transitional with the longitudinal ridges on the spine fragments of Listracanthus wardi, though without much evidence quoted.

Demanet (1941) described and figured spines of Listracanthus hystrix Newberry and Worthen in assemblages with Petrodus patelliformis in the Lower Namurian of Belgium. Demanet referred both spines and dermal denticles to the species Listracanthus hystrix on the grounds that, although Petrodus patelliformi had priority, Woodward had referred the denticles to the prior genus Hybodus. This is incorrect as Woodward merely noted a similarity to Hybodus but did not refer the denticles specifically to that genus. Thus M'Coy's name must still stand.

The association of these denticles with a pectoral girdle and skull and with spine fragments elsewhere may or may not be fortuitous and it is regretted that the remains at this new locality throw no further light on the subject. The considerable variation in the denticles at Steeplehouse Quarry does however suggest that separation into a number of species is unfounded. The association with Cladodus teeth may be similarly fortuitous but on the other hand they too may be part of the same fish, indicating an association of "primitive" Cladodont teeth with more "advanced" Hybodont dermal denticles.

Trautschold also figured (Pl. XXVIII figs. 12 g, h and i) Ostinaspis simplicissima, but the description appears to have been omitted from his paper. No comparable denticles have been seen at Steeplehouse Quarry. Trautschold's paper was published in 1874, although the title page of the volume gives 1860, so that his generic name in invalid; so the last named species may possibly stand as Petrodus simplicissima Trautschold until further material is available.

Comparison with other Fish Beds in the Carboniferous Limestone of Derbyshire

The fish bed in Bolt Edge Quarry, Barmoor Clough, near Chapel-en-le-Frith (SK 088798) yielded a number of palatal teeth to T. Parker which were listed and briefly described by Davis (1886). The list was added to by Jackson (1908), who noted that the worn appearance of the teeth was similar to the worn and damaged brachiopod shells, and he concluded that this was a beach deposit similar to that described at Castleton by Barnes and Holroyd (1896). Davis had suggested that the brachiopod shells were damaged owing to having been crushed by the fish but Jackson found no evidence to support such a conclusion. The bed is now buried under a rubbish tip.

Scattered fish teeth have been found in similar beds in the "Beach Beds" in a small disused quarry (now a private garden) at the foot of Treak Cliff (SK 139829) (Barnes and Holroyd 1896) and apparently in two other localities between Castleton and Sparrowpit though their wording is ambiguous (1897 p. 182) and they cannot be found today.

The Ticknall locality was noted by Wilson (1880), again without sufficient detail for it to be found today with certainty, but a few finds (not in situ) by the writer suggest that it was in coarse crinoidal limestone in the now very overgrown quarries to the north of the road through Ticknall. Wilson also listed a few teeth from Ashford-in-the-Water and Bakewell, again without detailed localities.

Bemrose's (1907) discussion of the species listed in Woodward's catalogue (1889) added nothing new. None of these localities are known to have yielded Petrodus so the only deduction which can be made is that fish with palatal teeth occupied different ecological niches from those with dermal denticles and that they were probably both restricted in distribution.

Palaeoecology

The dermal denticles are found, as outlined above, in some 5 feet of beds of crinoidal limestone with shale-partings. The coarse clastic nature of the deposit with the larger fossils little if at all worn, indicate rapid deposition of material derived from a nearby source area. Exposures of reef limestones of bank, fore-reef and inter-reef facies within a few hundred yards suggest that the beds in the Steeplehouse Quarry were deposited close to a reef-complex, perhaps as a result of scour through an inter-reef channel with deposition resulting from a reduction in currents in the off-reef area.

Comparison with the other fish beds of Derbyshire suggests that these too were deposited in off-reef areas.

One problem remains - the denticles are dispersed through 3 feet of beds over a small area, but the species is rarely recorded elsewhere. Such an unusual concentration requires an explanation. It is unlikely that many thousands of denticles all came from one fish and that all the 3 feet of beds, both coarse clastic limestone and fine shales, were deposited during the decomposition of one carcase. It is possible, however, that a shoal of Petrodus inhabited the reefs and that the death of a number of these would yield such a deposit by winnowing and short distance transport over a period of a few months or years. The presence of brachiopods showing little sign of wear and of crushed but not dissociated crinoid calices indicate that transport was through a short distance without appreciable abrasion.

Two of Demanet's figures of the Belgian material (1941, Pl. VIII figs. 8 & 9b) suggest a comparable occurrence and thus palaeoecology, but he made no comment on either lithology or palaeoecology.

Acknowledgements

Thanks are due to Mr. A. G. Brighton for the loan of type specimens from the Sedgwick Museum and to Dr. L.B. Tarlo (University of Reading) for discussion of the association and identification of the teeth.

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GEOLOGY IN PROVINCIAL MUSEUMS

by

David A. E. Spalding

Summary

The changes in status of geology in provincial museums over the past century are discussed, and an assessment is made of the role of the provincial museum in this science at the present day. The necessity for interest and support by the amateur geologist is emphasised.

The latter half of the last century may in many ways be regarded as a golden age of natural history, that loosely defined group of natural sciences of which geology is a fundamental part. The exciting discoveries of amateur and professional naturalists at home and abroad, the dramatic impact of Darwinism on established beliefs, and the influence of great popularisers like Thomas Henry Huxley and Frank Buckland all produced a greater popular interest in the natural sciences than has been evident before or perhaps since. It was during this period that most of our provincial natural history societies were formed, and many of these in their turn were responsible for the foundation of museums. The Literary and Philosophical Societies in towns and cities all over the country accumulated collections which were augmented by material of varied importance from all over the world.

Towards the end of the century Local Authorities began to take on more and more of the educational and cultural functions of the provincial societies. At this period the existing collections were usually handed over to the Corporation as the nucleus of a public Museum. Most of the societies sooner or later ceased to exist, or modified their functions and survived in more or less reduced circumstances.

At the beginning of this century, the increasing number of Universities and the accelerating pace of research continued the process of scientific specialization already begun. The non-scientist was no longer able to keep abreast of scientific discovery, and Museums began to lose some of their popular support. Very few new ones were founded, and those that were tended to be the creation of one devoted man rather than the product of popular enthusiasm. (A fine example in the East Midlands is the thriving Museum of Scunthorpe which was for many years entirely the work of the late Harold Dudley, F.G.S., who was recently awarded the R.H. Worth Prize of the Geological Society of London.)

The twenties and thirties were for many museums a lean period. Inadequate staff on ludicrous salaries struggled to maintain impossibly large collections gathered from every corner of the earth. It was during this period that museums became known as "the Cinderella of Local Government", a description that is still painfully apposite in some cases. It is hardly surprising that amateur naturalists (including geologists) lost interest in their local museums. The important and valuable collections gathered by the pioneers were at best maintained, without being the subject of research, additions or up-to-date arrangement. Many were allowed to gather dust in cellars, where labels were lost, minerals damaged, and fossils allowed to decay unchecked. At worst, important collections were wantonly destroyed: in Yorkshire in recent years one has been used as road metal and another has been deposited on the Corporation tip.

These however are not typical. By strenuous efforts on the part of Curators, by the generosity of the Carnegie United Kingdom Trust, and by the support of enlightened Local Authorities, many museums are playing a more important part than ever before. Problems of space, equipment and staff are being resolved one by one, and more museums have properly organised education departments which work closely with schools. For the first time, after many years of struthionine blindness, the Government is beginning to appreciate that an adequate Museum service for the country is a matter of national as well as local importance. Through the recently established "Area Schemes", Museums within regions are beginning to co-operate in ways which have hitherto proved impossible.

All this is opportune. Television, increased leisure, improved mobility and better education are all factors which are leading to a renewed interest in the countryside. Educationists too are beginning to realise the narrowness of the existing syllabus, and to take field studies more seriously. It is up to museums to show that they can play a part in stimulating this new interest in the natural sciences as they have already done for archaeology and the arts.

The most frequent question asked of anyone in the museum profession is "What do you actually <u>do?</u>". The popular impression of the white-bearded curator gathering dust along with his collections is difficult to eradicate, but it could hardly be more inaccurate.

Geological material is fortunately proof against most destructive agents, but there are some exceptions to this rule. Mineral specimens and fossils which include iron pyrites in their composition are subject to the effects of "pyrites disease". The writer has seen a perfectly shaped pile of dust which was all that remained of a once fine Kimmeridgian ammonite. Pleistocene bones and teeth, too, are liable to fragment unless properly treated by modern techniques: for example, the author recalls being shown by an amateur geologist a portion of a mammoth tusk wrapped in brown paper, which entirely disintegrated when it was unwrapped. Most of the techniques of preservation currently in use have been developed in museums. Every geologist is well aware of the amount of work needed to make many fossils presentable, and in museums much time is spent with hammer and chisel, dentists' drill or vibrotool. The housing and arrangement of large collections is in itself an enormous task. Even if already properly stored in suitable cabinets with proper cataloguing and labelling, any collection requires regular revision to bring the classification and nomenclature up to date. Usually the existing system of cataloguing is inadequate and is in process of replacement. Card indexes are now standard, and new methods of information retrieval,such as punched cards,are being experimented with. No collection is final and complete, and many casual donations are made. The Curator must also take steps himself to fill in gaps in his collection, and probably combines this with research in the field and restudy of existing material. Most Curators now limit their attention to the area surrounding their Museum, but this is rarely adequate to provide answers to the many enquiries that come to them. The writer, in a midland Museum, has recently had to identify south coast fossils, Scottish sediments and igneous rocks from Vesuvius.

Directly and indirectly too, the Museum is concerned with education. As well as lecturing to children and adults and preparing material to loan to schools, the Curator must arrange cases in the galleries, which will arouse interest in the casual visitor and provide information to the more serious one. The preparation of catalogues of the collections and of guides to the displays and the local geology is another important activity, which has often perforce to be postponed in favour of more urgent work.

Of course, only the larger museums which have a qualified geologist on the staff are able at present to undertake much work of this kind, and many are unable to do more than maintain the existing collections. There are still a few museums more or less entirely run by local societies, which are doing their best under great difficulties. Many more small museums are, unaccountably, under the sole charge of librarians, who with a few exceptions have no qualifications and less enthusiasm for the important collections which are often to be found in their care. Many other small museums have only one or two professional staff, with no geological training, and the Curator will usually be aware of the shortcomings of his geological collection, but will be powerless to do much about it.

Whatever his local Museum is like, the amateur geologist should not hesitate to get in touch with the Curator to find out what services are available. Anyone seriously interested in fossils or minerals will usually be allowed to consult the reference collections which, although not on show in the galleries, are far the most important material in the museum. The staff may be able to help in identification or may know someone who can, and the library is likely to contain books and maps not easily obtained elsewhere. There may be an index of local exposures, a collection of photographs, or a biblography of local geology available for consultation, and useful publications are sometimes on sale. The amateur collector of fossils and minerals can obtain advice on the maintenance and housing of his specimens.

He should, in return, be prepared to keep all his specimens fully labelled in case they should be eventually offered to a museum. Many collections which have been the result of a life-time's effort have been rendered useless by neglect of this simple precaution. In other ways too the amateur geologist may be able to assist the Curator. The latter is inevitably tied to his office much of the time, and may welcome information about temporary exposures, particularly if accompanied by photographs and representative specimens. Other donations too, especially if they fill gaps in existing collections or result from detailed local field work, are usually much appreciated.

The part to be played by the science of geology in our museums in the future is as much dependant on sustained interest from the amateur geologist as upon the activities of the professional within the walls.

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CONDITIONS OF SEDIMENTATION OF THE CYRTINA SEPTOSA BAND IN THE LOWER CARBONIFEROUS OF DERBYSHIRE

by

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Summary

Fourteen localities of the *Cyrtina septosa* Band were studied in the shelf facies of the Carboniferous Limestone in North Derbyshire.

Tracings of brachiopod shells were recorded from each locality and percentages of disarticulation and orientation of values and size of shells were calculated. Grain sizes were also measured. It was found that there was a random pattern in the sedimentation over the shelf and that there were no significant changes as the reef-complex was approached.

Introduction

The Carboniferous Limestone Series of this country has been divided into a number of zones and sub-zones based on brachiopods and corals and are recognised by the letters K, Z, C, S and D after the fossil names. These zones were originally applied to the Limestone succession in the Avon Gorge, Bristol (Vaughan, 1905) which since that time geologists have zoned other areas of Carboniferous Limestone, including much of Derbyshire. It is not always easy to map these zones in the field, as often the index fossils are not present and the limestone facies may change from one area to another, thus making correlation of individual beds very difficult.

Many fossils are, however, found in the Carboniferous Limestone although often they are very scattered. There are certain horizons where numerous fossils are present and these act as important marker bands in mapping the geology of limestone country. The occurrence of such concentrations of fossils suggests that conditions of deposition must have been very favourable for their accumulation and it is probable that there was a considerable break in sedimentation at the time of formation. The bands are often separated by many feet of fine-grained unfossiliferous limestones much of which may have been chemically precipitated. It has been suggested (Broadhurst, 1964) that, in shales of the Coal Measures, sedimentation was very slow during the deposition of the fossil bands and faster when the thick inter-bedded unfossiliferous mudstones were laid down. It is possible that similar conditions were present during the Limestone formation.

One important fossiliferous horizon in the Carboniferous Limestone is the Cyrtina septosa Band, which was originally described by Garwood (1912) from the North West Province of the Lower Carboniferous where it can be traced for many miles at 80 - 100 feet below the top of D_1 subzone.

Cope (1936) recorded the Band from the standard (shelf) limestones of the Miller's Dale area where it occurs in the Chee Tor Beds 25 feet below the Lower Lava Flow and 150 feet below the D_1/D_2 boundary.

In 1958 Shirley described a fossiliferous band containing the brachiopod Davidsonina Cyrtina septosa (Phillips) near Grangemill and Wolfenden (1958) mapped the Band behind the reef-complex in the Earlsterndale, Snelslow Hill and Castleton areas of Derbyshire.

The Cyrtina septosa Band usually consists of light-grey, very fossiliferous limestones containing the brachiopods D. septosa, Chonetes papilionacea Phillips, Gigantoproductus maximus (M'Coy) and Daviesiella aff. comoides (J. Sowerby), the corals Lithostrotion irregulare (Phillips), L. junceum (Fleming), Palaeosmilia murchisoni Edwards and Haime, Dibunophyllum bourtonense Garwood and Goodyear and Syringopora sp.; the gastropod Bellerophon sp., and the algae Girvanella sp.; and Koninckopora inflata (de Koninck).

The total thickness of the Band varies from 1 to 7 feet. Sometimes there may be as many as four well-defined layers of fossils making up the Band. These are separated by fine-grained unfossiliferous limestones.

The Band is found only in the standard (shelf) limestone facies and as the reef-complex is approached brachiopods characteristic of the reef-facies begin to appear. There is no Cyrtina septosa Band as such in the fore-reef facies although occasional specimens of D. septosa can be found.

Method of Study

Thirteen localities of the Cyrtina septosa Band have been studied from an area within a 5½ mile radius of Buxton and one locality 4 miles west of Matlock (see Text-Figure 1), with a view to working out any lateral variation in the pattern of sedimentation at one particular horizon in the Lower Carboniferous.

At each locality the positions of at least forty brachiopods were noted by tracing the outlines of the shells directly on to sheets of paper placed against the rock face. In this way positions, size, disarticulation and orientation of the brachiopod shells were recorded accurately. The arrangement of the shells and their general alignment showed the presence or absence of any sedimentary features such as current-bedding or ripple marks.

The size, disarticulation and orientation of fossil shells are generally considered to be useful indices in helping to interpret the conditions of deposition. Well-preserved shells which are still articulated are probably in or near their original position of life, whereas shells which are abraded, fragmented and have their two valves disarticulated have probably been subjected to turbulent water (currents etc.) and are no longer in their life position. The valves may even be overturned so that the concave surface rests lowermost. This is considered to be a stable position of rest.

Valves which are not overturned but rest with their concave surfaces uppermost have probably accumulated in much quieter water (Shrock, 1948).

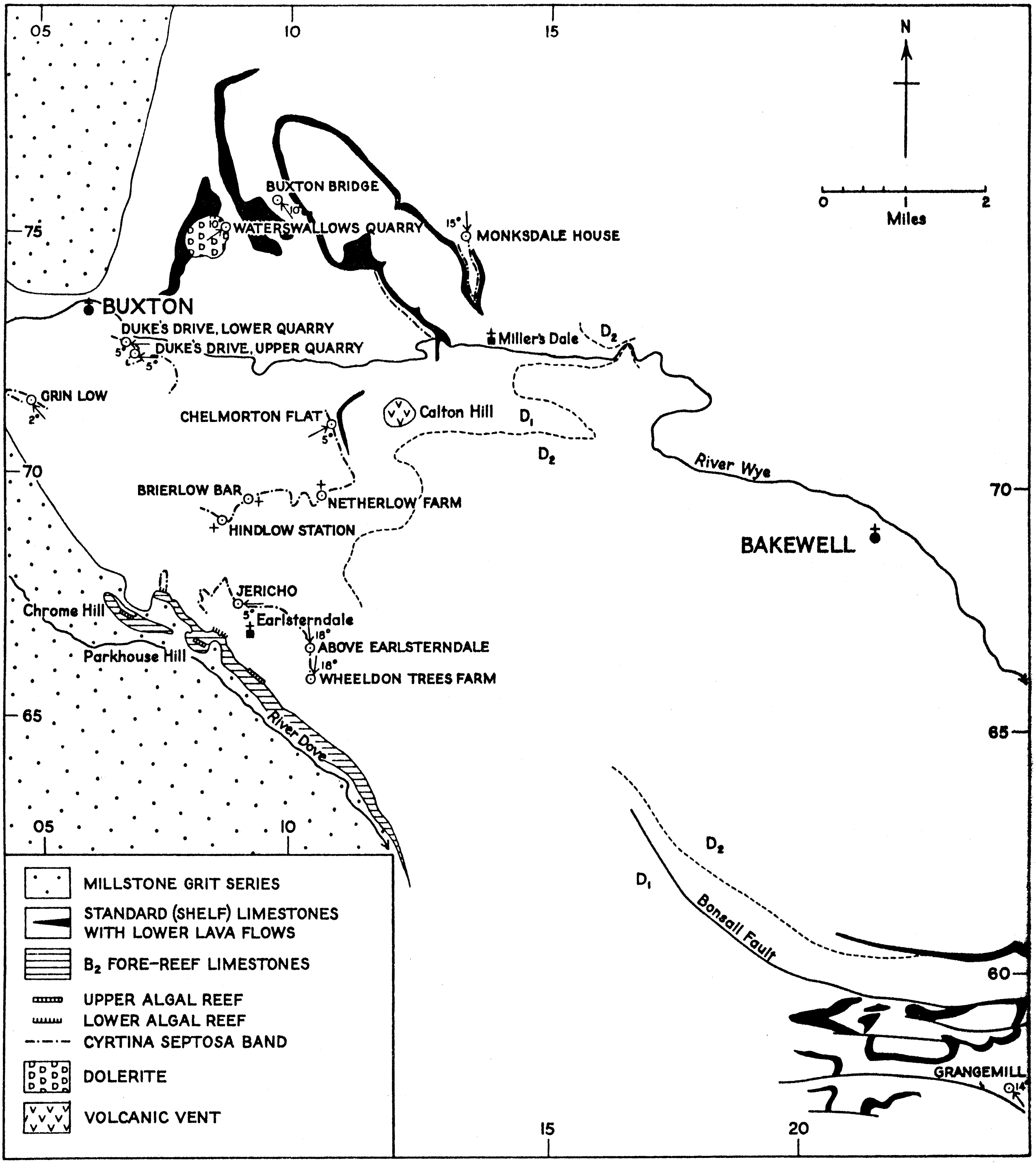

FIG. 1. Map to show the fourteen localities of the Cyrtina septosa band in Derbyshire which are described in the text.

An assemblage of disarticulated and overturned shell fragments is known as a death assemblage.

From these tracings percentages of (i) disarticulated shells, (ii) shells with their concave surface uppermost (iii) shells with their convex surface uppermost and (iv) size, were calculated. The shells were placed into three size groups, "small" (those less than 1 inch), "medium" (those between 1 and 3 inches) and "large" (those over 3 inches).

Thin sections were cut from specimens at each locality and acetate peels also taken in order to study the presence or absence of rounded and oolitic grains, and to measure the sizes of individual grains.

It was hoped to show from this study that the Cyrtina septosa Band showed obvious changes in sedimentation as the reef-complex or edge of the limestone "massif" was approached. It was expected that there would be evidence for an increase in the turbulence of water towards the reef-complex and a corresponding decrease in turbulence away from it, and that current directions, as shown by current-bedding, would indicate water flowing from the shallows of the shelf to the deeper water of the basin, or vice versa.

Results

From the results of the investigation it appears, however, that there is a random pattern in the sedimentation of the Cyrtina septosa Band.

Sedimentary structures such as current-bedding are only occasionally seen. They consist of piles of shell, crinoid and coral debris arranged in the form of current-bedding units such as those found in sandstones.

Fairly well preserved current-bedding can be seen at Grangemill in the south east corner of the area studied (SK 24115762). Here the current-bedding units appear to indicate currents flowing in a westerly direction, that is, at right angles away from the reef margin at Matlock.

Poorly developed current-bedding is also found at Jericho, near Earlsterndale (SK 08956750) where the units have a length of 15 inches and a height of 4 inches. They appear to indicate currents flowing in a west-south-west direction towards the reef-complex.

Very poorly developed current-bedding is also present at Brierlow Bar (08946968). In the upper band here, the currents probably moved in a westerly direction, while in the lower band there is no evidence for any current action at all. Conditions of sedimentation obviously changed in the period of deposition of the Band.

No other localities show any evidence of current-bedding though the occasional piling up of shells may indicate periodic flurries of water movement rather than a persistent current being present.

The most convincing evidence for turbulent water comes from Chelmorton Flat (10667130). In a small outcrop ¼ mile west of the farm a very fossiliferous outcrop of the Cyrtina septosa Band can be found. Here 97% of the brachiopod shells are disarticulated and 79% are found with their convex surface uppermost. Both these figures are high in comparison with the other thirteen localities,where disarticulation figures average 75% and orientation figures show approximately the same numbers of shells oriented with their concave and convex surfaces uppermost. Small limestone pebbles are present in the matrix and many of the coral colonies have been overturned. In thin section,many rounded grains are present and these often show canals left by boring algae on their surfaces. There is no current-bedding at this locality, such as might have been expected in a deposit formed in turbulent water. The accumulation of shell and crinoid debris behind a simple coral lying on its side may indicate, however, that currents flowed in a north-easterly direction.

Locality	Lithology and thickness of Band	Total number of shells counted	Disarticulation %	Oriented with concave side uppermost %	Oriented with convex side uppermost %	True Orientation unknown %	"Small" (under 1 inch) %	"Medium" (1-3 inches) %	"Large" (over 3 inches) %	Thin section description. Presence of current-bedding etc.	Distance from reef-complex or "massif" margin	Suggested water movement
Netherlow Farm (10456973)	Light grey, coarse calcarenite. 4 feet thick	109	78	53	28.5	18.5	37	63	0	No rounding of fragments. No current-bedding	2¼ miles from reef-complex	Fairly quiet conditions
Duke's Drive, Buxton (Upper quarry) (06907262)	Light grey, fine calcirudite	75	74.5	38.5	28	33.5	54.5	45.5	0	No rounding of grains. Very poorly developed current-bedding	1 mile from edge of "massif"	Some water movement but not very strong
Grin Low, Buxton (04907170)	Brownish grey, medium calcarenite. 7 feet	52	73	34.75	32.75	32.5	29	57.5	13.5	Grains well sorted in size. No current-bedding. No rounded grains	½ mile from edge of "massif"	Fairly quiet conditions
Wheeldon Trees Farm (10356620)	Light grey, coarse calcarenite. 1½ ft.	50	76	46	16	38	22	74	4	Rounded grains present. No current-bedding	½ mile from reef-complex	Considerable water movement but no constant current direction
Above Earlsterndale village (10256671)	Light grey, coarse calcarenite. 1¾ ft.	69	68	26	29	45	19	76.5	4.5	Some rounded grains. No current-bedding	¾ mile from reef-complex	Some water movement but no constant current direction
Grangemill, near Via Gellia (24115762)	Pinkish grey, medium calcarenite. 4 ft.	195	97	17	26	57	67.25	32.75	0	Oolitic rims round grains. Fairly good current-bedding. Shells oriented parallel to bedding	4 miles from reef knolls of Matlock	Fast moving currents
Jericho, near Earlsterndale (08956750)	Yellowish grey, coarse calcarenite. 1½ ft.	100	93	32	28	40	42	56	2	Rounded grains. Poorly developed current-bedding	½ mile from reef-complex	Considerable water movement with currents flowing off the shelf towards basin
Monksdale House (13207533)	Light grey, medium calcarenite. 7 ft.	41	75.5	14.5	48.75	36.75	29.5	68	2.5	No rounded grains. No current-bedding	4 miles from "massif" margin	Very quiet water conditions
Duke's Drive, (lower quarry) (06727277)	Light grey, coarse calcarenite. 2½ ft.	130	95	14	22	64	76	24	0	No rounded grains. No current-bedding	1 mile from edge of "massif"	Fairly quiet conditions
Hindlow Station (08556920)	Light grey, coarse calcarenite. 2 ft.	50	76	42	30	28	64	36	0	Same as previous locality	1¼ miles from reef-complex	Fairly quiet conditions
Brierlow Bar (08946968)	Light grey, fine calcarenite. 2 ft.	95	77.5	44.5	17.5	38	45.25	53.75	1	Some rounding of grains. Very poor current-bedding	1½ miles from reef-complex	Fairly fast moving water, currents flowing west
Buxton Bridge (09707562)	Light grey, coarse calcarenite. 4 ft.	50	78	18	50	32	24	76	0	No rounded grains. No current-bedding	1¾ miles from edge of "massif"	Very quiet conditions
Waterswallows Quarry (08667511)	Light grey, medium calcarenite 4 feet	112	95.5	28.5	37.5	34	48	52	0	A few rounded grains. No current-bedding	1¼ miles from edge of "massif"	Some water movement
Chelmorton Flat (10667130)	Light grey, calcarenite. 6 feet	100	97	8	79	13	43	57	0	Many rounded grains. Many shells overturned. Shells oriented parallel to bedding. No current-bedding	3 miles from reef-complex	Fast moving water but apparently no constant current direction

Table 1. Details of the disarticulation, orientation and size of the fossil debris, and presence of sedimentary structures with suggested water movement, in the Cyrtina septosa band of North Derbyshire.

There is very little variation in the grain size of the limestones in the Cyrtina septosa Band. They vary from medium calcarenites (0.25 mm) through coarse calcarenites to fine calcirudites (4 mm) (Folk, 1959). The finer grained types are found at Waterswallows Quarry, (08667511) Grin Low, (04907170) Grangemill, and Monksdale House (13207533) while coarse grained limestones were recorded from Duke's Drive (upper quarry), (06907262) and Brierlow Bar. The remaining eight localities which occur at varying distances from the reef margin or edge of the limestone "massif" were limestones of the intermediate (coarse calcarenite) grade. There appears to be, therefore, no increase or decrease in grain size of the limestones as the edge of the "massif" is approached.

From a study of thin sections it can be seen that rounded grains occur occasionally in limestones of the Cyrtina septosa Band. They include (i) composite and (ii) simple grains (Illing, 1954) together with foraminifera, crinoid ossicles, algal and shell fragments. Many of the rounded grains, particularly shell fragments and crinoid ossicles, show canals left by boring algae which have subsequently been infilled with very fine-grained calcite. Rounded grains are found at three localities just behind the reef-complex; Jericho, Wheeldon Trees Farm (10356620) and above Earlsterndale village, as well as at two localities well away from the reef-complex, namely Grangemill and Chelmorton Flat. Oolites are completely absent from any of the limestones, although oolitic rims round some of the skeletal grains are seen at Grangemill.

The presence of rare oolitic rims and of occasional rounded grains in limestones of the Cyrtina septosa Band suggests that,at the localities mentioned,there was evidence for fairly turbulent water movement in order that the grains might be rolled around and abraded as they lay on the sea-floor. The presence of canals left by boring algae suggests that there was a pause in sedimentation to allow the accumulation of algal filaments around some of the grains.

A random pattern in the distribution of the various sizes of shell debris is also seen. Most localities show relatively good sorting in size with approximately half the shells falling into the "small" group and half in the "medium" group. Very few "large" shells were recorded, the highest figure, 13.5%, being found at Grin Low.

At some localities, however, three quarters of the shells are found to fall in the "medium" group and only one quarter in the "small" group. Examples of these figures are seen at Wheeldon Trees Farm and Buxton Bridge (09707562).

Disarticulation figures show remarkable constancy. Generally where there is a higher proportion of the species D. septosa the percentages of disarticulated shells are slightly higher than at other localities. This can be seen at Jericho,where 40% of the shells are D. septosa and the disarticulation figure is as high as 93%. At Waterswallows Quarry 25% of the shells are D. septosa and the disarticulation figure is 96%. Other high percentages of disarticulation are recorded at Grangemill (97%) and at Chelmorton Flat (97%). It is likely at these two localities, however, the high disarticulation figures are due to fairly turbulent water,rather than to the presence of large numbers of D. septosa. At the remaining ten localities the percentages of disarticulation range only from 68% to 79%, except at Duke's Drive (lower quarry) (06727277) where 95% was recorded.

The orientation figures show a random pattern in their distribution. Seven localities have more shells resting with their concave surface uppermost and the remaining seven localities show a greater number resting with their convex surface uppermost. The figures vary from 53% with their concave side uppermost at Netherlow Farm (10456973) where water conditions were probably fairly quiet to 79% with their convex side uppermost at Chelmorton Flat where there is sufficient evidence to suggest water conditions were fairly turbulent.

Conclusions

From the localities studied, there does not appear to be any significant pattern in the sedimentation of the Cyrtina septosa Band in Derbyshire. As the reef margin is approached there is some evidence for an increase in water movement, while some of the localities well away from the reef margin, appear to show very much quieter conditions. Localities away from the reef margin where there is evidence for stronger water movement, may represent the sites of fairly fast-moving currents flowing over the shelf, possibly with tidal oscillation and change of direction, although there is no evidence for any submarine channels such as the one found by the author at Castleton (Sadler, 1964).

Fossils probably became concentrated at this particular horizon due to a break in sedimentation, which allowed many animals to live in favourable conditions with plenty of food and oxygen. The shells were probably not transported far from their life positions, but may have been moved around considerably on the sea-floor by the ebb and flow of tidal currents before their final deposition.

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AN OIL SEEPAGE NEAR TOTON LANE, STAPLEFORD, NOTTS.

by

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Summary

An oil seepage escaping from a dolomitic sandstone is recorded from a locality near Toton Lane, Stapleford, Nottinghamshire. An account of local Trias stratigraphy is given, supplemented by observations from recent exposures in adjoining areas. The sandstone is considered to occur at the junction of the Keuper Waterstones and Keuper Marl, in a group of grey-green siltstones and sandstones. From a consideration of adjacent Carboniferous outcrops, the oil is thought to have its origin in marine strata of Namurian age and to have accumulated in a reservoir immediately above the source rocks or possibly in a sandstone of Lower Westphalian age. The subsequent geological history of the area has allowed the oil to migrate upwards into Trias strata, possibly along the fault plane of the Chilwell fault.

Introduction

During routine examination of the excavations for the Stapleford - Sandiacre By-pass road (A.52) during May, 1963, a seepage of crude oil and bitumen was observed, escaping from a dolomitic sandstone which was found close to the footbridge which spans the road and links the grounds of the George Spencer County Secondary School. Information from adjacent areas is here used to determine the age of the dolomitic sandstone and the possible source beds for the oil.

Stratigraphy

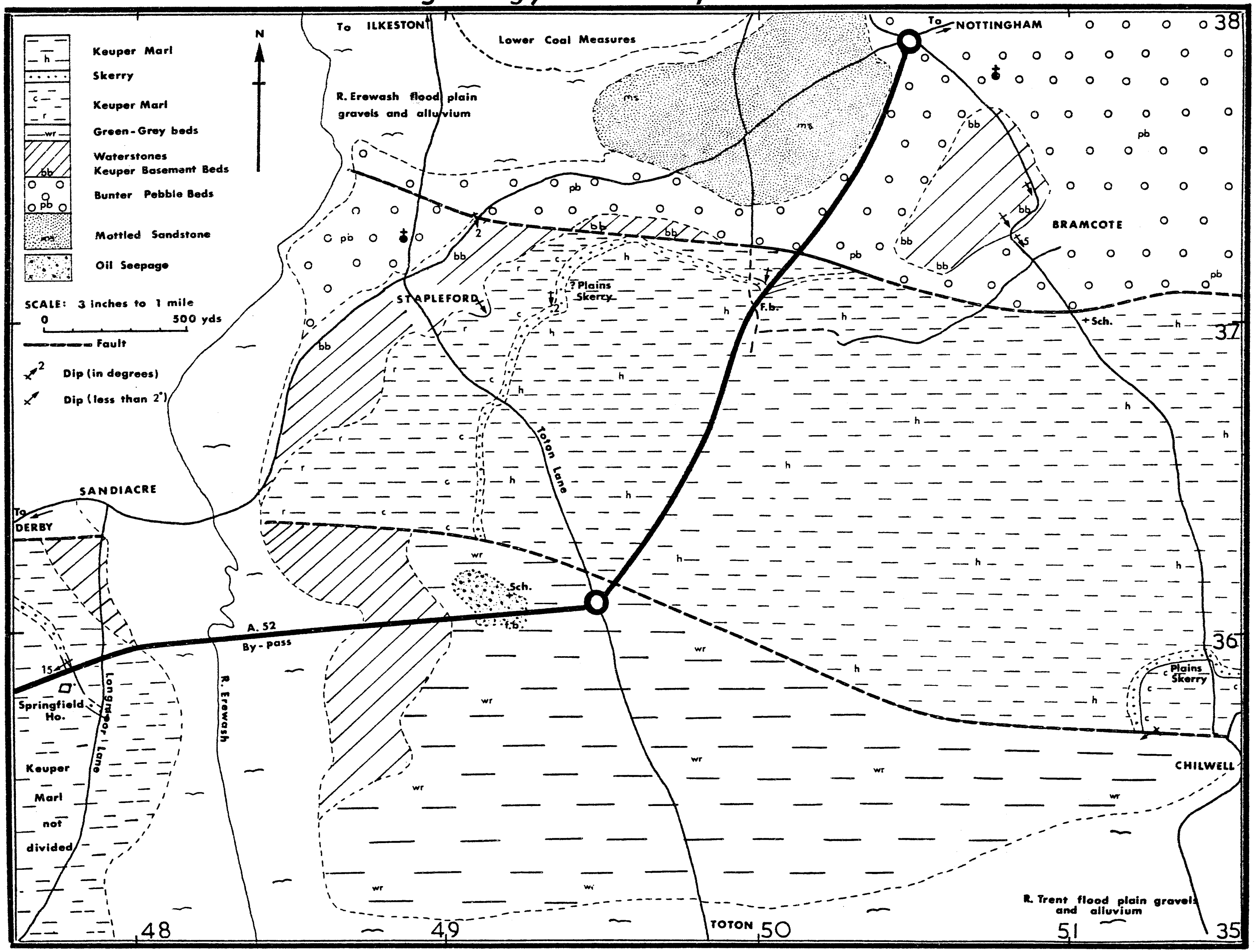
The geological sequence in the Stapleford - Sandiacre area has been determined as follows. The distribution of the rocks and important localities are shown on text-fig. 1.

	Lithological divisions	Thickness	Keuper Formations (after Elliott, 1961)
	Keuper Marl	30 feet plus	Harlequin
	Skerry Beds	10 to 25 feet	Plains Skerry
	Keuper Marl	45 to 55 feet	Carlton & Radcliffe
	Waterstones	40 to 50 feet	Waterstones
TRIAS	Keuper Basement Beds	0 to 15 feet	Woodthorpe
		Non-sequence	
	Bunter Pebble Beds	50 to 100 feet	
	Mottled Sandstone	0 to 50 feet	
		Unconformity	
		Kilburn Coal	
	Lower Coal Measures	Alton Marine Bed (*Gastrioceras listeri*)	
	(Westphalian)	Crawshaw Sandstone	
		Gastrioceras subcrenatum Marine Bed.	
		G. cumbriese Marine Bed	
		G. cancellatum Marine Bed	
CARBON-		Chatsworth Grit	
IFEROUS	Millstone Grit	*Reticuloceras superbilingue* Marine Bed	
		Ashover Grit	
	(Namurian)	*R. gracile* Marine Bed	
		Kinderscout Grit	
		Edale Shales	
	Carboniferous Limestone (Avonian) succession.		
		Unconformity	
PRE-CAMBRIAN	Charnian Beds		

Because of the absence of boreholes drilled below the base of the Trias in this area, the Carboniferous sequence is speculative. (See also Shipman 1891 and Lamplugh and Smith 1914).

The Keuper Marl. This division of the Trias outcrops extensively north of the Trent Valley in the Stapleford - Sandiacre area. It is composed of dark red siltstones and mudstones with a small amount of finely disseminated gypsum. Irregular patches or thin regular seams of green-grey coloured sediments are common. The green-grey beds are often dolomitic. In the lower part of the Keuper Marl succession (Radcliffe Formation), finely laminated beds are encountered. In the upper part (Carlton & Harlequin Formations), laminated beds are rare, the beds being uniform in character or "massive".

Triassic geology of Stapleford.



Explanation to text-fig. 1. Geological symbols:- h = Harlequin Formation, c = Carlton Formation, r = Radcliffe Formation, Wr = Green-grey beds at the junction of the Waterstones and Radcliffe Formations, bb = Keuper Basement Beds, pb = Bunter Pebble Beds, ms = Mottled Sandstones. Geographical symbols:- sch. = school, fb = footbridge.

The Skerry Beds. A series of hard green-grey siltstones occurs about 55 feet above the base of the Keuper Marl. The rocks are well cemented, very hard, and contain dolomite, calcite and gypsum. These evaporite minerals are frequently leached out of the rock, giving an exceedingly porous bed. In places grain size increases to sandstone grade. The fine grained beds often exhibit sedimentary structures, particularly ripples of which there are two sizes, large and small (miniature). Salt pseudomorphs and irregular nodules are common. The best exposure of these beds is at the Chilwell Brickworks (SK 513358). The presence of the above structures, the occurrence of "ramifying green patches with purple centres" (Elliott 1961 p. 207) in the red marl below, and the extent of this horizon suggests correlation with the Plains Skerry of the Nottingham area. An exposure of thin skerry beds was seen at the eastern end of the By-pass road (Text-fig. 1); these can be traced westwards by a feature, until it eventually meets the Chilwell fault. It would follow that the thin series of marls above the skerry would belong to the Harlequin Formation with the Carlton and Radcliffe Formations occurring below. Whilst it is possible to use the skerry as a mapping division between two Formations, the division between the Carlton and Radcliffe Formations was not considered sufficiently pronounced to draw on the map.

The Waterstones. The junction of the Keuper Marls with the underlying Waterstones is usually taken at the first fine-grained, micaceous, brown sandstone, usually only a few inches in thickness. (But see also Elliott, 1961, p. 216). The sandstones become more numerous at depth and two or three feet thick; they were excellently exposed recently in a mains drainage trench at the extension of Windsor Street, Stapleford (SK 492371), the upper part of the cutting revealing the Waterstones/Keuper Marl Junction.

On the By-pass (SK 492361), the junction appears to be rather different. The lowest beds seen are fine to medium-grained red sandstones. These beds grade upwards into 17 to 18 feet of green-grey siltstones and sandstones with interbedded thin dolomitic seams, one of which occurs about $5\frac{1}{2}$ feet above the base. A similar succession is seen in the mains drainage trenches on the nearby housing estate on the north side of the road (SK 491362). The rocks, other than the dolomite, contain abundant mica. The finer grained beds exhibit sedimentary structures. These include large and small (miniature) ripples and salt pseudomorphs, together also with irregular nodules apparently produced by differential sedimentation. The thick series of siltstones and sandstones and the presence of mica suggests that the beds belong to the Waterstones. The dolomitic beds, colour and sedimentary structures are more typical of the Keuper Marl skerry beds. On the map (text-fig. 1) these green-grey beds are shown separated from both the Waterstones and the Keuper Marl and indicated with the symbol "wr".

Keuper Basement Beds. The lowest beds of Keuper age are a series of thin beds of alternating dark red marl and light red or buff, fine to medium grained sandstone. The sandstones in part contain very small pebbles. These rocks are seen at the top of the Stapleford sand quarry (SK 493373); at the roadside near the Carr Fastener Works, Stapleford (SK 492373), these two exposures being separated by the Beeston fault; and at the top of the hill in Bramcote village (SK 508373). The rocks can be compared with the Keuper Basement Beds of Swinnerton (1918) and Smith (1912); or the Woodthorpe Formation of Elliott (1961). (See also Shipman 1891).

Bunter Pebble Beds. A layer of large pebbles usually underlies the Keuper Basement Beds. The presence of these pebbles has generally been taken to indicate an erosion, dreikanter pebbles being found. The Pebble Beds are made up of coarse sands, commonly red in colour but sometimes yellow or buff, as in the Sandiacre area. They are normally friable rocks with little cement but the Stapleford and Bramcote Hills are famous for their red sandstone with irregular barytes cement, i.e. the Hemlock Stone (SK 499387). Pebbles are scattered throughout the deposit, usually aligned either with the current bedding or with the true bedding planes. The Pebble Beds were encountered at the extreme eastern end of the By-pass, about 200 yds. east of the footbridge (SK 500371) taking Baulk Lane over the road and on to the end of the By-pass at the Sherwin Arms Hotel (SK 504379). The excavation for the main drainage sewer, cut in a northerly direction 800 yds. east of the footbridge, exposed the lowest division of the Trias, the Mottled Sandstone. The junction of the Pebble Beds with the Mottled Sandstone occurs at road level at this point.

The Mottled Sandstone. (Sometimes referred to as the Lower Mottled Sandstone). These oldest beds of Trias age are finer grained than the Pebble Beds and pebbles are absent. The rocks, poorly cemented show irregular buff and green patches and seams. The beds are either thinly bedded or more commonly current bedded. Towards the base of the sequence, the inclusion of a small amount of clay (approx. 10%) mixed with the fine grained sand renders the deposit suitable for use as a moulding sand. In the area under discussion, the junction of the Pebble Beds with the Mottled Sandstone is gradational. The pebbles first disappear with depth, giving a medium-grained, well bedded sandstone. The beds become finer in grain size, the change being accompanied by a change of colour to a darker shade of red. As mentioned above, beds of the Mottled Sandstone were exposed temporarily in a deep excavation at the eastern end of the By-pass road.

Pre-Triassic Stratigraphy. The Triassic rocks described above are either faulted against or are seen to overlie unconformably the Carboniferous rocks which outcrop to the north in the Erewash Valley. Both faults and unconformity tend to strike in a more or less east - west direction. The one inch to one mile map published by the Geological Survey, Sheet No. 125, Derby, indicates the occurrence of the "Rough Rock" of Namurian (Millstone Grit) age also striking east - west in the Dale - Sandiacre area. A fault separating Pebble Beds, dipping south, from the "Rough Rock", dipping north, is well seen north of the escarpment at Stoney Clouds, Sandiacre (SK 475377). In the Matlock area to the north, the Geological Survey has shown that the sandstone previously referred to as "Rough Rock" is of Coal Measures age and the equivalent of the Crawshaw Sandstone. It is probable that the Millstone Grit type sandstone in the Sandiacre area, previously stated to be the "Rough Rock", is also of Coal Measures age.

It follows therefore, that the Carboniferous rocks to be expected beneath the Trias begin at the base of the Coal Measures and continue through a sequence of Namurian and Lower Carboniferous strata. (See table p. 24).

The Oil Seepage

The oil occurred in the top beds of the green-grey siltstones and sandstones described above (p. 26) at the junction of the Waterstones and Keuper Marl. The known areal extent of the seepage is indicated on text-fig. 1. When the excavations were first made on the site of the By-pass, the more porous sandstones were completely saturated with bitumen and crude oil. In places cavities, up to 1" by ½" in size and lined with calcite crystals, were full of oil. The seepage occurred across the complete width of the road cutting and along the length of the outcrop made by the excavations, an area of approximately 2,500 square yards.

Recently the oil saturated rocks were seen in the excavations on the adjoining housing estate on the north side of the road, thus considerably increasing the known lateral extent of the oil contaminated rocks.

Oil continued to seep in the road cutting twelve months after the original discovery. Fine grained green or bluish-green marls and siltstones form the topmost beds of the section and no doubt formed the "cap rock" containing the oil below.

Structure

Faults. The present survey of the Sandiacre-Stapleford area has confirmed the presence, and fixed more accurately the positions, of two east-west faults. The first is the Beeston fault, which emerges from the Trent Flood Plain west of Beeston Post Office (SK 528368) and runs westwards, cutting Chilwell Lane, Bramcote, just north of the Alderman White County Secondary School (SK 510371). The fault was recently exposed here during water main pipe-laying operations. The fault then continues, cutting the By-pass approximately 200 yards east of the Baulk Lane footbridge. Throughout this part of its course, the fault separates Keuper Marl on the south side from Bunter Pebble Beds on the north.

The second fault, not so well exposed, is first seen at the Chilwell brick works. Near the chimney stack at the southern end of the quarry, green-grey siltstones and sandstones are separated from Keuper Marl on the north side. The green-grey beds appear to be the same as the oil bearing rocks seen on the By-pass road. The fault continues westwards cutting the By-pass close to the Toton Lane roundabout (SK 495361) (Text-fig. 1). Unfortunately excavations here failed to reveal whether or not exposed red marl was adjacent to or on top of the oil bearing rocks and so the exact position of the fault was not located.

Folds. The dip of the Triassic rocks in the Nottingham area seldom exceeds one or two degrees. Steeper dips usually indicate the proximity of faults. Thus the dip of 15° noted near Springfield House, Longmoor Lane (SK 477359) in Keuper Marl, suggested at first the possibility of a fault along the Erewash Valley. Whilst this is not ruled out at this stage, the presence of Waterstones and the base of the Keuper Marl on the hill to the east of the Erewash Valley may be the result of fold movements (anticlinal) bringing up the older rocks to the east against the Chilwell fault.

Source beds for the oil

Having noted the geological structure and sequence of the area, one can now speculate on the source of the oil. The classical theory for the origin of oil demands that it originates in marine strata from organic remains. The rocks which best satisfy these requirements are the marine organic shales of the Carboniferous.

Such beds can be found close to the Namurian Coal Measures boundary. The marine beds are those from the Gastrioceras cancellatum horizon to that of G. subcrenatum. There are more numerous marine shales in the lower parts of the Namurian Series, Stages E to R. Finally there are the marine beds of the Carboniferous Limestone, particularly the upper beds. The marine beds are thought to be the source beds for the oil found in the East Midlands oil field areas, i.e. at Eakring and Gainsborough (Brunstrom 1963; Falcon and Kent 1960 - these references list East Midland oilfield literature.) In these areas, geologists of the British Petroleum Company have shown that the oil reservoirs (oil sands) are the porous sandstones in the lower part of the Coal Measures (i.e. Crawshaw Sandstone) and in the Namurian strata (i.e. Ashover and Chatsworth Grits.) No records are available of commercial quantities of oil being extracted from sandstones of Keuper age in this country.

It is assumed that oil collected in the usual oil sands prior to the deposition of Trias sediments. The upper oil sands (i.e. Crawshaw Sandstone) may well have been eroded away in the area studied before the deposition of Trias sediments. After the long period of erosion and after the deposition of the Trias sediments, the oil migrated to its present position. In the absence of a thick series of Coal Measures sediments, the migrating oil had a relatively short upward passage to the green-grey sandstones of Keuper age.

The geological conditions outlined above for the Trias indicate why the oil accumulated in the green-grey beds. From surface investigations there is no indication of the characters of the hidden oil trap, whether this be anticlinal or controlled by faulting, or indeed if it exists at all. Movement along a fault (the Chilwell fault is conveniently placed) has allowed the oil to escape from the postulated hidden oil reservoir.

Further Investigations

The need for further geological search is indicated. Geophysical surveys would indicate possible hidden structures. A series of shallow bore-holes would help to complete the surface geology. A geochemical survey (cf. Evans et al. 1962) would indicate the extent of the seepage and possibly the centre of the reservoir. Comparative analyses of Eakring and Stapleford oils would provide further useful data.

Conclusions

The oil seepage at Toton Lane, Stapleford, Notts., is seen to occur in porous sandstones at the junction of the Keuper Waterstones and Keuper Marl. It is thought to have originated in underlying Carboniferous sediments and to have migrated upwards possibly along the line of the Chilwell fault. Only further investigations and a bore-hole can prove the presence of commercial quantities of oil which may still remain in a hidden Carboniferous oil sand.

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A RECENT EXAMPLE OF SOIL EROSION ON THE DERBYSHIRE LIMESTONE

by

Trevor D. Ford

Summary

The effects of a grass-fire on the limestone crags of Treak Cliff, Castleton, in the summer of 1959 are described. Observations on soil erosion and partial recolonization by vegetation during the ensuing four years are given and their significance discussed.

Introduction

The recent International Geographic Congress in Britain had as one of its sections a karst symposium concerned with the development of limestone landscapes. Unfortunately, the papers presented will not be published by the Congress but in view of the apparent interest in the subjects of the erosion of a limestone surface and the formation of soil covers, it is hoped that this short note will be of interest. Previous work on the subject in Derbyshire is limited to that of Prentice & Morris (1959) on screes in the Manifold Valley, and of Pigott (1962) on soil profiles and composition.

The site in question is the summit ridge of Treak Cliff, one mile west of Castleton, North Derbyshire, which rises to an altitude of just over 1,300 feet above sea level. (Nat. Grid Ref:- SK 135830) The ridge has a steep easterly slope but passes rapidly on to flat ground to the west. It is formed of Carboniferous Limestone of "reef" facies, with the fore-reef slope to the east. Most of the eroded area to be described is algal reef limestone with little or no sign of bedding, and a quite irregular pattern of joints.

Observations

During the dry summer of 1959 a series of grass fires broke out, and although the major flames were extinguished by beating, smouldering continued for a week afterwards. As a result of this an area along the summit ridge, roughly estimated as 250 yards long, and up to 100 yards wide, mostly on the easterly slope was denuded of all its vegetation, leaving only ash and bare soil, here a rendzina (a friable loamy soil with grains of the parent limestone in it),rarely more than six inches thick and generally much less. Following the frosts of the subsequent winter, there was a succession of easterly gales and these effectively removed, not only the ash, but also the greater part of the soil. This left an area of bare limestone, roughly estimated as between 5,000 and 10,000 square yards, where previously only small crags had projected through the turf, thus radically altering the appearance of the hill from the valley below.

In the four years since this stripping, observations have been made at intervals to see whether the soil and vegetation cover is being re-established, or whether the area of erosion is increasing. Up to the summer of 1963 it appeared that the area of erosion was slowly increasing in places, and also the newly bared limestone was suffering erosion. The processes appeared to be as follows: wherever soil patches remained in hollows a few inches deep and across, these were recolonized by scattered annual plants and a little grass, but during subsequent gales the soil again dried out, and on several occasions whole plants together with their clumps of turf were also seen to be torn off the margins of unburnt soil. This process has been augmented by sheep scrambling across and around the burnt area and loosening both soil and turf. The limestone itself, having been bared, provided a new surface for the attack of rain and frost, and much of it was very loose by the summer of 1963, and boulders had rolled down the hill to form the potential beginnings of a scree slope. This has again been assisted by sheep, and by geologists digging for fossils in the newly exposed rock! Up to the summer of 1963 the only definite recolonization was in a few more sheltered and damper places, where mosses and lichens had taken root.

Since the summer of 1963, considerable changes have taken place. The wet summer, the lack of easterly gales and the marked lack of frost (up to the time of writing in March, 1964), have together allowed much more extensive recolonization, and except for the most exposed places and the newly formed screes, moss now fills every joint, and the surface is very much more stable. Seedlings of several annuals have taken root in the moss and a few tufts of bent grass, sheep fescue and stone crop have become established. It remains to be seen whether these will survive the next gales, though the general impression is that they will do so over at least some of the area.

It thus seems that the fate of this burnt area is still in the balance. Taken to a logical conclusion, if the next gales again remove the vegetation, the ultimate effect of these grass fires will be to allow both chemical and physical erosion of the limestone downwards until a stable slope is established, with the accumulation below of a scree slope overlying the turf and soil lower down the hill. In a fossil soil profile this change would probably have been taken to indicate a climatic change! On the other hand, if the vegetation cover remains stable and gradually covers the area, little will be left as evidence of the grass fires, except the beginnings of scree lower down the hill being slowly buried in the grass, plus a more humic soil over the burnt area, with at least for a time a plant association dominated by annuals.

How the fires started in this case is not known, but it was probably the common effect of broken glass focussing the sun's rays. If so, the erosion may be ascribed to the hand of man, even if unintentional. An alternative natural cause is lightning which, whilst not observed in the case described above, has at other times been seen to strike the ground on Treak Cliff and to scorch the turf over a yard diameter patch. Several other grass fires took place on the gritstone country during 1959, and whilst there was some wind erosion of the peat thus exposed, the much greater depth of soil precluded complete baring of the rock and provided more favourable conditions for plant recolonization.

Conclusions

In conclusion one can only speculate how many accidental grass fires have resulted in the baring of limestone surfaces in the past, not only in Derbyshire, but also in the Ingleborough region and possibly in

Fig. 1. Treak Cliff before the grass fires of 1959. Note that the summit ridge of Treak Cliff (on left) shows little exposed limestone. (Photo by permission of H. Harrison)

Fig. 2. Treak Cliff after the grass fires of 1959. Note the white area of exposed limestone along the summit ridge.

Fig. 3. The newly exposed limestone surface photographed in 1963. The whole of this area was covered with turf before the grass fires of 1959, but is now bare rock or loose scree.

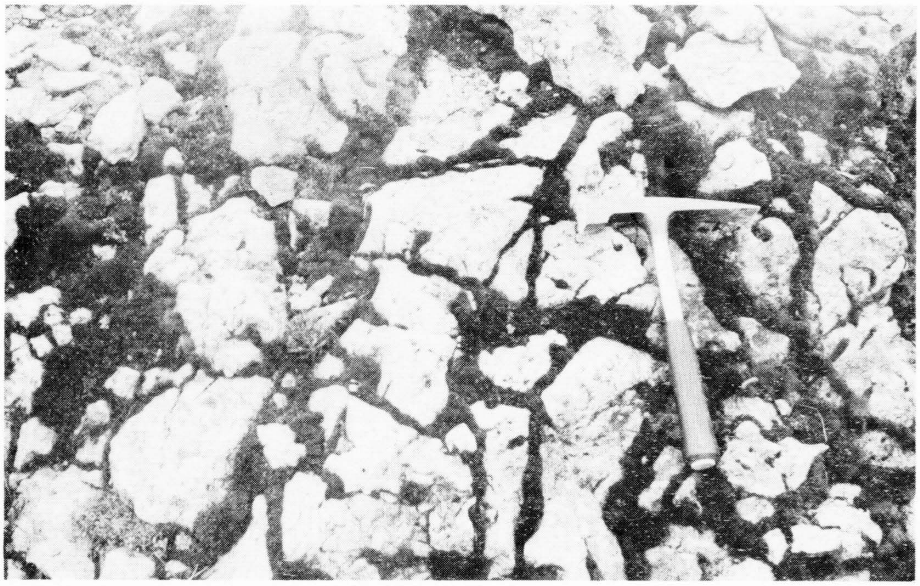

Fig. 4. Recolonization of part of the exposed surface by moss as seen in March 1964.

the Mediterranean countries,where the climatic changes and overgrazing have often been held responsible for the erosion of the former soil cover on the bare limestone hills so prevalent today.

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THE GEOLOGICAL SOCIETIES AND GEOLOGISTS OF MIDLAND ENGLAND

by

Robert W. Morrell and William A. S. Sarjeant

Summary

An account is given of the growth of geological societies in Midland England. Societies known to have had a geological interest are listed, together with brief summaries of their history, publications, and most notable members. The present condition of geological activity in the area is assessed.

Introduction

This article attempts to bring together all available information on the growth and development of geological societies, and societies having a geological interest, in Midland England. The Midlands are here defined as comprising the counties of Lincolnshire, Leicestershire, Rutland, Northamptonshire, Nottinghamshire, southernmost Yorkshire (the old county of Hallamshire), Derbyshire, Staffordshire, north Oxfordshire, Warwickshire, north Gloucestershire, Worcestershire, Herefordshire and Shropshire. It is recognised that this definition is quite arbitrary, but the Midlands are an ill-defined region and have no generally recognised limits.

Tracking the history of geological activity in this area has proved extremely difficult. It has necessitated extensive correspondence with Librarians and with Society secretaries: the majority of these replied courteously and fully, but a minority did not reply at all, which accounts for certain gaps in coverage. Published transactions and reports were consulted wherever available, and extensive studies have been made of general works on the geology of the area and of histories of major British geological organisations. Nonetheless, there are numerous gaps: the authors would welcome details of Societies with a geological interest, which have been omitted from this account; further details on societies incompletely covered; or corrections. School natural history or geological societies present a limitless field and have necessarily to be omitted from consideration: county Naturalist's Trusts are likewise omitted.

Beginnings

Perhaps the earliest work treating with the geology of the Midlands was "The Natural History of Staffordshire", published in 1686. This was compiled by Dr. Robert Plot, first Curator of the Ashmolean Museum, Oxford; it discusses the working of minerals and includes numerous figures of "formed stones" - minerals and fossils, the latter sufficiently accurately drawn to be readily named today.

At this time, the Royal Society, the first British scientific society, was only newly founded (c.1645); science remained largely speculative, with experimentation, and even accurate observation, scarcely begun. Following the formation of the Royal Society, however, science soon came to be regarded as among the proper pursuits of gentlemen. Individuals started to gather together to discuss scientific topics; from such gatherings emerged bodies such as the Spalding Gentlemen's Society, of which Isaac Newton was a member and whose collections were ultimately sold to Leicester Museum.

Perhaps the most important of the early scientific societies in the Midlands was the Lunar Society of Birmingham. This was formed informally about 1765 but did not adopt a name until 1776. Its members included many scientific notables, among them Erasmus Darwin, James Watt, and Joseph Priestley. Perhaps most active in geology was Josiah Wedgwood, whose concern with the study of earths, clays and minerals for pottery led to a general interest in rocks and to much experimentation; a letter written by him in 1767 to a fellow member includes an accurate sketch section of strata along the Trent and Mersey Canal, then in process of cutting. The Lunar Society faded as its original members aged; it ultimately dissolved about 1800.

By this time, a number of other bodies interested in science were in existence in various parts of Britain. The Philosophical Society of Edinburgh was formed in 1739; the Royal Irish Academy in 1785; and the Linnaean Society in 1788. No society yet existed concerned exclusively with geology. However, in March 1796, a group of "young men desirous...to improve themselves mutually by philosophical exercises" formed in London the Askesian Society: and a group of its members formed, on 2nd April 1799, the British Mineralogical Society with a membership limited to 20. This was relatively short-lived and was re-incorporated into the Askesian Society on 18th December 1806. These two societies formed a nucleus from which, on 13th November 1807, the Geological Society of London was formed. The Geological Society was originally formed as a dining club, but commenced publishing "Transactions" in 1810 and received a Royal Charter in 1825. This provided a focus and a stimulus for geological work: all other geological societies may be said in some measure to stem from it.

Early Scientific Societies in the Midlands

The early societies of the Midlands were, like the Royal Society, very broad in outlook, with an umbrella of interest covering all branches of scientific study. These early groups tended to be chair-ridden, any field work being undertaken rather by individual members than by the Society as a whole. They generally termed themselves "Literary and Philosophical Societies", following the French model of that time. The first was formed at Manchester in 1781: a second at Newcastle followed, in 1793: and subsequently similar societies were formed in Birmingham, 1800, and Leeds, 1819.

1804 saw the foundation of a "Society for the promotion of useful Knowledge" in Sheffield. Among papers read was one reflecting the great geological controversy of that time, "Observations on the opinions of the Vulcanists and Neptunists relative to the formation of the globe". The society seems to have faded out rapidly in 1805; but some of its members were among the founders, on 12th December 1822 of the Sheffield Literary and Philosophical Society. The society assembled a library and, among others a geological collection: and an early paper was "The best method of commencing our Geological Researches and arranging a cabinet of minerals", read by Mr. E. Barker. The most eminent of its members was

Henry Clifton Sorby (1826 - 1908), who was to prove one of the great scientific pioneers. He was the first to seriously apply the microscope to study of rocks and metals, thus virtually establishing the sciences of petrography and metallurgy, and he was to become a leading marine biologist in his later years. His other geological studies included fundamental researches into the origin of slaty cleavage; the structure of meteorites; and the processes of sedimentation. He was President of the Geological Society (1879 - 80) and played a leading part in the establishment of the University of Sheffield, which now has a Sorby Chair of Geology.

Sorby was elected to the Sheffield Literary and Philosophical Society in 1846 and read the first of very many papers to it, on "The functions of valleys, river actions and alluvial deposits in this neighbourhood", in 1846. In 1848 he was elected to its Council and remained there for life, his national standing as a scientist being of great advantage in attracting notable visitors to its meetings. The Society published annual reports, and a centenary volume in 1822: its existence came to an end in 1932.

Other societies came and went in Sheffield during this period. A short-lived Field Naturalists' Society existed in 1864 - 5, and published a single "Annual Report": from its remains was formed an ephemeral Sheffield Naturalists' Society in 1865. In 1870, the Sheffield Naturalists' Club was formed, with Sorby as first President: by now, field work figured large among its activities and there was an active interest in geology. Two volumes of "Proceedings" were published in 1910 and 1914. In 1877, the Sheffield Microscopical Society was formed: its first President was George E. Vine, a specialist of international renown on fossil Bryozoa, whose collections are now largely in Sheffield Museum. The two societies amalgamated with a third, the Sheffield Junior Naturalists' Club, in 1918 to form the Sorby Scientific Society. A Geological Section was formed in 1921: the results of researches into Millstone Grit sedimentation formed the bulk of the Society's single volume of "Transactions", published in 1928. As a result of gradual elimination of other interests, the Society changed its title in 1932 to Sorby Natural History Society. The publication of a journal, the "Sorby Record", was begun in 1958 under the Editorship of one of the authors (W.A.S.S.): both Society and journal continue to flourish.

The earliest geological society, as such, to be formed in the Midlands was the Dudley Geological Society, which came into existence about 1840. It was addressed by Sir Roderick I. Murchison on 17th January 1842: members are known to have included Henry Beckett, S.H. Blackwell, William Matthews and James Yates. The Society collapsed before 1860: in 1862, however, the cumbrously titled Dudley and Midland Geological and Scientific Society and Field Club was formed, taking over a collection assembled by the earlier Society. This new Society formed a Museum, which was originally housed in the Mechanics Institution. The Society survived into the present century, but is now defunct: its geological collections passed into the charge of the Borough and are shortly to be housed in a new geological gallery.

In Nottingham, as in Sheffield, natural history societies have come and gone. In 1837 there was formed a short-lived but long-titled Nottingham and Nottinghamshire Society for the Study and Cultivation of Natural History. This had a Curator responsible for geology, Mr. A.F.A. Greeves: it published a single report, consisting largely of a list of members. Its subsequent history, if any, is uncertain; a report issued by another Nottingham society, the Nottingham Naturalists' Society (founded in 1851 or 1852 according to conflicting references) suggests amalgamation at an undisclosed date.

The Nottingham Naturalists' Society displayed a strong leaning towards geology. James Shipman, by profession Assistant Editor of the "Nottingham Daily Express", was an exhaustive worker on Nottingham geology and was always on hand at any temporary exposure. He wrote many papers on this topic for the Society's "Report and Transactions" and his observations were incorporated in the Geological Survey maps of the area. The first Professor of Geology at Nottingham University College, Professor Herbert H. Swinnerton, was President of the Society in 1911. The Society succumbed to the 1914 - 18 War, its last publication appearing in 1916.

Two other transient Nottingham Societies may be mentioned. The Nottingham Working Mens Natural History Society was active for a number of years in the late nineteenth century. In 1881 there was a serious split in its' ranks over the propriety of meeting in public houses! The breakaway teetotallers formed the Nottingham G.R.S. Natural History Society (the significance of the initials is unknown): this was never strong and subsequently amalgamated with the Nottingham Naturalist's Society in 1884.

Perhaps the first geological society to be formed in the East Midlands was the Nottingham Geological Rambling Club, founded in 1889, developing out of the Nottingham Saturday Afternoon Rambling Club: Shipman was, naturally, among its early members. The geologists soon found that a number of botanists kept joining its rambles; their presence was recognised officially in 1895, when the Club was re-organised into two sections under the title Nottingham Natural Science Rambling Club. During its earlier days, its membership included a number of keen amateur geologists; notable among these was George Abbott (1844 - 1925), who purchased a quarry in the Magnesian Limestone, near Sunderland, from which he furnished type series of concretions to many leading museums. Although later residing at Tunbridge Wells, he remained interested in Nottingham and bequeathed an estate to furnish funds for geological researches at the University: his name is perpetuated in the Abbott Memorial Lectures. In 1915, the Club assumed its present title, Nottingham and Nottinghamshire Field Club: their interest in geology has declined with the years and recently even the office of Recorder in Geology has been left unoccupied.

Thirteen years after the formation of the Sheffield Literary and Philosophical Society, a similar society was formed in Leicester. Originally the Society was an all-male preserve; only after three years and many heated words were women admitted, and even then this was initially only by male introduction. The Society, unlike so many others of its kind, continues to flourish: it is divided into a number of Sections which have a large measure of independence, membership of a Section not necessarily involving membership of the main Society. Adam Sedgwick was an early guest: geological interest has always been strong and a number of important papers on this topic have appeared in the Society's annual "Transactions". In 1841, the Society founded a Museum of Geology, Natural History and Antiquities: eight years later, this was handed over to become the nucleus of the borough museum.

A Scientific Association of Leicester existed in 1881: details of this are not known - it is certainly long defunct. A third Leicester Society also deserves mention, which, although having no direct connection with geology or any other branch of natural history, has played an important, albeit controversial, role in interesting the general public in these sciences. This is the Leicester Secular Society, which still exists; it did much to pioneer the use of Sundays for meetings and excursions and, through its lectures on evolution, did much to introduce geology to many who would not otherwise have taken an interest in the subject.

The story of developments in Sheffield, Dudley, Nottingham and Leicester typifies the picture over much of the Midlands, with geology either surviving simply as one facet of the activities of a more generalised society, or succumbing altogether. Societies elsewhere in the Midlands will be dealt with in a later section.

Unions and Associations

In view of the large number of natural history societies flourishing in the Midlands during the late nineteenth century, it was natural that attempts should be made to achieve some measure of unity between them. The earliest such attempt was the foundation in Birmingham, on 28th August 1877, of the Midland Union of Natural History Societies by representatives of seven local societies; within a year, 22 Societies were members. Its prime initial function was publication of a journal, "The Midland Naturalist"; one of its two Editors was a geologist, W.J. Harrison. The Union's annual general meetings were held as follows:-

Year	Number of Societies in Membership	Venue
1877	7	Birmingham
1878	22	Birmingham
1879	24	Leicester
1880	24	Northampton
1881	27	Cheltenham
1882	25	Nottingham
1883	22	Tamworth
1884	23	Peterborough

The Union established a Darwin Medal to be awarded for work on "some subject connected with the Natural History of the Midlands: the adjudicating Committee included such notable geologists as Jethro Teall and Charles Lapworth. Its first award was to a Nottingham geologist, E. Wilson, for his paper on "The Permian Formation in the North-East of England." Publication of "The Midland Naturalist" continued till 1884, despite a growing concern with finances; later issues were directly subsidised by the Birmingham Natural History and Microscopical Society. The Union does not seem to have outlived its journal.

A more successful association of societies was the Lincolnshire Naturalists' Union, established in 1893. Its geological activities are to be the subject of a separate article in Number 2 of "The Mercian Geologist".

In the first year of the present century, there appeared at Alfreton, Derbyshire, a small journal entitled "The Derbyshire Naturalists' Quarterly". This was edited by a London clergyman, the Rev. C. Hincliff: it appears originally to have been quite independent, but in 1901 proclaimed itself as the official organ of three local societies - - the Bakewell and District Field Club, the Blackwell and District Scientific and Literary Society, and the Matlock Field Club. A number of articles on geological topics were featured. Financial troubles soon hit the journal: in 1902, it became "The Nottinghamshire and Derbyshire Naturalists' Quarterly", but the broadening of scope did not save it and no later issues have been traced.

A nation-wide body, which has done a great deal to encourage co-operation between societies, is the British Association for the Advancement of Science. A full discussion of this body is beyond the scope of the present article, but it may be of interest to list the meetings held in the Midlands, since in all cases these have produced reports and handbooks treating in part with local geology.

Date	Venue	Date	Venue
1839	Birmingham	1907	Leicester
1849	Birmingham	1910	Sheffield
1856	Cheltenham	1913	Birmingham
1865	Birmingham	1933	Leicester
1866	Nottingham	1937	Nottingham
1879	Sheffield	1950	Birmingham
1886	Birmingham	1956	Sheffield
1893	Nottingham		

The British Association is to meet for the fourth time in Nottingham in 1966.

(List of Midland Societies Interested in Geology)

Since a full treatment of the histories of all Midland societies having an interest in geology is impossible in the space of an article, a list follows of all such societies known to the authors. Dates of foundation and dissolution are given where possible, together with details of publications: fullness of treatment more accurately reflects information available than degree of importance. Societies dealt with more fully in the text are indicated.

ALFORD NATURAL HISTORY SOCIETY (Lincs.) Founded 1885; geological interest small. A component of the Lincolnshire Naturalists' Union (1893).

BAKEWELL AND DISTRICT NATURALISTS' FIELD CLUB (Derbys.) Formed pre-1890: existed till after 1902. William Storrs Fox, who did much work on Derbyshire bone caves, is believed to have been a prominent member.

BANBURYSHIRE NATURAL HISTORY & FIELD CLUB (Oxon). Formed 1872: long defunct. Showed a fair degree of geological interest.

BIRMINGHAM AND MIDLAND INSTITUTE SCIENTIFIC SOCIETY (Warwicks.) Founded 1872: defunct. Membership drawn mainly from the Institute.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' SOCIETY (Warwicks.) Formed from the similarly named Union at an uncertain date: still extant. No details known regarding degree of geological interest.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION (Warwicks.) Founded 1880; became Birmingham Microscopists' and Naturalists' Society subsequently.

BIRMINGHAM NATURAL HISTORY ASSOCIATION (Warwicks.) Founded in 1858: name changed in 1864 to Birmingham Natural History and Microscopical Society.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY (Warwicks.) Formed from the last-named society in 1864. Very active in geology, many fundamental researches into local stratigraphy being undertaken by members. Amalgamated with the Birmingham Philosophical Society c. 1895.

BIRMINGHAM NATURAL HISTORY AND PHILOSOPHICAL SOCIETY (Warwicks.) Formed in 1895 from the amalgamation of the last-named Society with the Birmingham Philosophical Society; still in existence. Publishes "Proceedings". Notable members have included W. Jerome Harrison, who made important researches into Midland glaciology, and Charles Lapworth, first Professor of Geology at Birmingham University.

BIRMINGHAM PHILOSOPHICAL SOCIETY (Warwicks.). Founded 1869; published "Proceedings", which contained a number of important geological papers, and maintained an investment fund for the endowment of original research. Amalgamated with the Birmingham Natural History and Microscopical Society in 1895.

BLACKWELL AND DISTRICT SCIENTIFIC AND LITERARY SOCIETY (Derbys.) Founded pre-1901; believed to have been in existence until after 1930. The Society received a large measure of support from Mr. J.T. Dodd, General Manager of Blackwell Colliery: a geologist, W.J.P. Burton, was President in 1902.

BURTON-ON-TRENT NATURAL HISTORY AND ABSTRACT SOCIETY (Staffs.) Believed extant and interested in geology; no details known.

BURTON-ON-TRENT NATURAL HISTORY AND ARCHAEOLOGICAL SOCIETY (Staffs.) Founded 1876; still flourishing. Published "Annual Reports and Transactions" between 1876 and 1939; these have contained geological papers by a number of authors, including C.O. Sullivan, H.T. Brown and G. Selkirk Hollister. Geological interest currently slight.

BUXTON ARCHAEOLOGICAL AND NATURAL HISTORY SOCIETY (Derbys.) Formed 1922: still extant. Geological interest subsidiary.

BUXTON FIELD CLUB (Derbys.) Founded 1947; flourishing. Considerable interest in geology.

CARADOC FIELD CLUB (Salop.) Formed pre-1877: amalgamated in 1893 with the Severn Valley Naturalists' Field Club. Had a high level of geological interest.

CARADOC AND SEVERN VALLEY FIELD CLUB (Salop) Formed in 1893 by amalgamation of the Caradoc Field Club and Severn Valley Naturalists' Field Club; still flourishing. Publishes "Transactions" annually, which reflect the high measure of geological interest manifested by the club.

CHELTENHAM AND DISTRICT NATURALISTS' SOCIETY (Glos.) Founded 1948: became the North Gloucestershire Naturalists' Society in 1956. Degree of geological interest small.

CHELTENHAM NATURAL SCIENCE SOCIETY (Glos.) Founded 1878: faded out during the Second World War. Its first President was Dr. T. Wright, a renowned specialist on ammonites.

CLEETHORPES AND DISTRICT NATURALISTS' FIELD CLUB (Lincs.) Extant. No details.

CORBY NATURAL HISTORY AND ARCHAEOLOGICAL SOCIETY (Northants.) Extant: no details.

COTTESWOLD NATURALISTS' FIELD CLUB (Glos.) Founded in July, 1846: still flourishing. Its "Proceedings" have contained many important geological papers, especially on the Jurassic, and reflect the Club's high level of interest in this subject.

DERBY NATURAL HISTORY SOCIETY (Derbys.) Formed in 1956 by change of name of the London Midland Region Natural History Society; flourishing. Has a Geology Section, Mr. P. H. Speed being its present leader.

DERBYSHIRE ARCHAEOLOGICAL AND NATURAL HISTORY SOCIETY. Formed c.1885 by an expansion of interests of the Derbyshire Natural History Society: ultimately became interested in archaeology to the exclusion of all else, "Natural History" being dropped from its title in 1961. Its "Journal" has contained a number of papers of great geological interest by such noted amateurs as A.T. Metcalfe, A. Leslie Armstrong (of Creswell Cave fame), and H.H. Arnold-Bemrose.

DERBYSHIRE NATURAL HISTORY SOCIETY. Formed pre-1878: temporarily faded out in 1882 but resuscitated in 1884, ultimately becoming the Derbyshire Archaeological and Natural History Society.

DUDLEY AND MIDLAND GEOLOGICAL AND SCIENTIFIC SOCIETY AND FIELD CLUB (Worcs.) Founded in 1862; defunct. Discussed in text.

DUDLEY GEOLOGICAL SOCIETY (Worcs.) Formed c.1842; defunct before 1860. Discussed in text.

EVESHAM FIELD NATURALISTS' CLUB (Worcs.) Founded 1873; believed defunct. Geological interest considerable; members included R.F. Tomes, a specialist on fossil corals, and T. J. Slatter.

GEOLOGISTS' ASSOCIATION: MIDLANDS GROUP (Brimingham, Warwicks.) Founded 1937. A local group of members of the Association, holding regular meetings advertised in the Associations' Circulars.

GEOLOGISTS' ASSOCIATION: NORTH STAFFORDSHIRE GROUP (Stoke-on-Trent and Keele, Staffs.) Formed 1949. A local group of members of the Association, holding regular meetings advertised in the Association's Circulars.

GRIMSBY AND DISTRICT ANTIQUARIAN AND NATURALISTS' SOCIETY (Lincs.) Founded 1886; still in existence c.1935 but believed since defunct. Degree of geological interest small.

HULL GEOLOGICAL SOCIETY (Yorks.) Founded 1889; still flourishing. Although outside the area under consideration, this Society deserves mention in view of its long-standing interest and activity in North Lincolnshire. The Society has published "Transactions"; its more notable members included Thomas Sheppard, who built up a fine geological collection in the town's museum, unfortunately destroyed by bombing during the Second World War.

KETTERING AND DISTRICT NATURALISTS' SOCIETY AND FIELD CLUB (Northants) Founded 1905; still flourishing. A Geolgoical, Archaeological and Anthropological Section was formed during its early days with "three active members" --- the geologist being Albert Wallis. There is still a Geological Section, but it has never been strong. In 1955, a history of the Society was published, "The first fifty years."

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Leics.) Founded 1835; still flourishing. Discussed in text.

LEICESTER SECULAR SOCIETY (Leics.) Founded late nineteenth century; still flourishing. Discussed in text.

LEICESTER UNIVERSITY GEOLOGICAL SOCIETY (Leics.) Founded in 1958; extant. Primarily an undergraduate society, membership is restricted to members of the University. Publishes a journal, "Petros", twice a year.

LINCOLNSHIRE NATURALISTS' UNION. Founded 1893; flourishing. Discussed in text.

LONDON, MIDLAND AND SCOTTISH RAILWAYS NATURAL HISTORY SOCIETY, DERBY (Derbys.) Formed in 1921, by change of name of the Midland Railway Natural History Society, on railway grouping, changed again, on nationalisation, in 1948. Thomas Gibbs was its leading spirit. Some interest in geology.

LONDON MIDLAND REGION (BRITISH RAILWAYS) NATURAL HISTORY SOCIETY, DERBY (Derbys.) Formed in 1948, by renaming of the L.M.S.R. Natural History Society; the railway connection was dropped in 1956 and the name changed to Derby Natural History Society. Some interest in geology.

LOUGHBOROUGH LITERARY AND PHILOSOPHICAL SOCIETY (Leics.) Founded 1874, dissolved 1881. Had some interest in geology.

LOUGHBOROUGH NATURALISTS' CLUB (Leics.) Founded 1960; extant. Owns a small geological collection and is affiliated to the East Midlands Geological Society.

LOUTH NATURALISTS' ANTIQUARIAN AND LITERARY SOCIETY (Lincs.) Founded 1884; extant. Associated with the Lincolnshire Naturalists' Union.

MALVERN FIELD CLUB. Existed 1882. No details known.

MATLOCK FIELD CLUB (Derbys.) Existed 1901; no details known.

MIDLAND RAILWAY NATURAL HISTORY SOCIETY, DERBY (Derbys.) Founded in 1906; name changed to L.M.S.R. Natural History Society, on railway grouping, in 1921. Originally formed under temporary official interest in stimulation of cultural activities; met at the Railway Institute. Degree of geological interest small.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES. Founded 1877; dissolved. c.1885. Discussed in text.

NORTHAMPTONSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB. Founded 1876; flourishing. Divided into nine section, including an active Geological Section formed before 1880. Publishes a "Journal", originally quarterly, now annually; this has contained much of geological interest, a notable contributor having been Beeby Thompson (whose papers and manuscripts are now housed in Northampton Public Library).

NORTH EAST DERBYSHIRE FIELD CLUB. Extant. No details known

NORTH GLOUCESTERSHIRE NATURALISTS' SOCIETY. Formed in 1948, by change of name of the Cheltenham & District Naturalists' Society; flourishing. Geological interest slight.

NORTH STAFFORDSHIRE FIELD CLUB. Founded 1866; flourishing. Divided into a number of sections, included a Geological Section. The Society's "Transactions", now supported by Keele University, have contained a large number of important geological papers, notably by John Challiner on aspects of the history of the subject; its medal, the Garner Medal, has several times been awarded for geological work.

NOTTINGHAM AND NOTTINGHAMSHIRE SOCIETY FOR THE STUDY AND CULTIVATION OF NATURAL HISTORY. Founded 1837; defunct c.1850. Discussed in text.

NOTTINGHAM AND NOTTINGHAMSHIRE FIELD CLUB. Title assumed 1915; extant. Discussed in text.

NOTTINGHAM GEOLOGICAL RAMBLING CLUB (Notts.) Founded 1889; title changed, 1895. Discussed in text.

NOTTINGHAM G.R.S. NATURAL HISTORY SOCIETY (Notts.) Founded 1881; amalgamated with Nottingham Naturalists' Society, 1884. Discussed in text.

NOTTINGHAM LITERARY AND PHILOSOPHICAL SOCIETY (Notts.) Founded 1865; dissolved 1882. Had some interest in geology.

NOTTINGHAM NATURALISTS' SOCIETY (Notts.) Founded 1851 - 2; dissolved 1916. Discussed in text.

NOTTINGHAM NATURAL SCIENCE RAMBLING CLUB (Notts.) Formed in 1895 by change of title of Nottingham Geological Rambling Club; title again changed in 1915. Discussed in text.

NOTTINGHAM TECHNICAL COLLEGE GEOLOGICAL SOCIETY (Notts.) Founded 1964; flourishing. Associated with the East Midlands Geological Society.

NOTTINGHAM UNIVERSITY GEOLOGICAL SOCIETY (Notts.) Founded 1944 by a group of Agricultural students interested in promoting field studies in geology: David Attenborough, of television fame, was a founder member. Changed its title to Swinnerton Geological Society (in honour of its first President, Prof. H.H. Swinnerton) on 15th March 1955.

OSWESTRY AND WELSHPOOL NATURALISTS' FIELD CLUB AND ARCHAEOLOGICAL SOCIETY (Salop). Formed pre-1877; believed defunct before 1900. Some geological interest.

OXFORDSHIRE NATURAL HISTORY SOCIETY. Formed pre-1880; ? defunct. A geological member was E.B. Poulton.

PEAK DISTRICT MINES HISTORICAL SOCIETY (Sheffield, Yorks.) Founded 25th April 1959; flourishing. Aim the preservation of records of, and conduction of research into, mineral working in the Peak District; one of the authors (W.A.S.S) was its first Chairman. Has published a "Bulletin" since 1959; also produces "Special Publications" - both are uniformly of geological interest.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC AND ARCHAEOLOGICAL SOCIETY (Northants.) Founded 1871; changed title to Peterborough Museum Society c.1930. Founded a geological collection. An early member was Dr. T. Wright, a specialist on Lias ammonites.

PETERBOROUGH MUSEUM SOCIETY (Northants.) Formed c. 1930 from the last-named Society; extant. No active interest in geology at present.

SCIENTIFIC ASSOCIATION OF LEICESTER (Leics.) Existed 1881; discussed in text.

SCUNTHORPE MUSEUM SOCIETY (Lincs.) Founded 1958; extant. Has only a limited interest in geology.

SEVERN VALLEY NATURALISTS' FIELD CLUB (Salop). Founded 1863; amalgamated with the Caradoc Field Club in 1893. Published "Transactions" which indicate a strong interest in geology.

SHEFFIELD FIELD NATURALISTS' SOCIETY (Yorks.) Existed 1864-5; discussed in text.

SHEFFIELD JUNIOR NATURALISTS' CLUB (Yorks.) Date of foundation uncertain; dissolved by amalgamation, 1918. Discussed in text.

SHEFFIELD LITERARY AND PHILOSOPHICAL SOCIETY (Yorks.) Founded 1822; dissolved 1932. Discussed in text.

SHEFFIELD MICROSCOPICAL SOCIETY (Yorks.) Founded 1877: dissolved by amalgamation, 1918. Discussed in text.

SHEFFIELD MUSEUM SOCIETY (Yorks.) Founded c. 1955; extant. Geological interest slight.

SHEFFIELD NATURALISTS' CLUB (Yorks.) Founded 1870; dissolved by amalgamation 1918. Discussed in text.

SHEFFIELD NATURALISTS' SOCIETY (Yorks.) Existed 1866; discussed in text.

SHEFFIELD UNIVERSITY GEOLOGICAL SOCIETY (Yorks.) Founded on 25th October 1946; flourishing. Primarily an undergraduate society, but open to graduates and academic staff. Former undergraduate members include Dr. Norman E. Butcher, a specialist on the Malverns, and Dr. Trevor D. Ford. Has published a "Journal" since 1951.

SHROPSHIRE AND NORTH WALES NATURAL HISTORY AND ANTIQUARIAN SOCIETY. Founded 1835; amalgamated with the Shropshire Archaeological Society in 1877. Published "Annual Reports": also formed a Museum, geological curators being Thomas du Gard and John Wingfield.

SHROPSHIRE ARCHAEOLOGICAL AND NATURAL HISTORY SOCIETY. Formed by the amalgamation of two existing Societies in 1877: flourishing. Publishes "Transactions" which have contained much of geological interest, despite a primary concern with history and archaeology. Maintained a museum, handed over to the Borough in 1884.

SMALLHEATH LITERARY AND SCIENTIFIC SOCIETY (Warwicks.) Founded pre-1879: dissolved 1881. Interest in geology slight.

SORBY NATURAL HISTORY SOCIETY, SHEFFIELD (Yorks.) Formed by change of title in 1932: flourishing. Discussed in text.

SORBY SCIENTIFIC SOCIETY, SHEFFIELD (Yorks.) Formed by amalgamation in 1918: changed title, 1932. Discussed in text.

STROUD NATURAL HISTORY AND PHILOSOPHICAL SOCIETY (Glos.) Founded pre-1878: believed defunct. Had a fair degree of geological interest.

SWINNERTON GEOLOGICAL SOCIETY, UNIVERSITY OF NOTTINGHAM (Notts.) Formed in 1955 by retitling of the University Geological Society: flourishing. Primarily an undergraduate Society, though with graduate and staff members. Two issues of an ephemeral "Journal" appeared in 1958-9.

TAMWORTH NATURAL HISTORY, GEOLOGICAL AND ANTIQUARIAN SOCIETY (Staffs.)
Founded 1871: believed defunct pre-1900. Some interest in geology: maintained a Junior Section with a prize offered for the best collection of Coal Measure fossils.

WARWICKSHIRE NATURAL HISTORY AND ARCHAEOLOGICAL FIELD CLUB. Founded 1854: ?defunct. Published annual "Proceedings". W. Andrews was an early geological member.

WARWICKSHIRE NATURAL HISTORY AND ARCHAEOLOGICAL SOCIETY. Existed 1880: no details known.

WOOLHOPE NATURALISTS' FIELD CLUB (Herefords.) Founded 1851; flourishing. Publishes biennial "Transactions" which have contained much of geological interest.

WORCESTERSHIRE NATURAL HISTORY FIELD CLUB. Existed 1882: no details known.

WORCESTERSHIRE NATURAL HISTORY SOCIETY. Existed 1882: apparently separate from the last-named Society. No details known.

WORKSOP NATURAL HISTORY SOCIETY (Notts.) No details known.

Formation of the East Midlands Geological Society

The above sketch of Societies in the Midlands indicates a high degree of activity over a long period: nonetheless, by the beginning of 1964 there was no single society in the whole Midland region exclusively, or even dominantly, concerned with geology. Certainly, there were two local groups of the Geologists' Association: certainly also, a number of Geological Sections existed within larger Societies, but that was all. The existence of a widespread enthusiasm for geology was made clear by the success attending courses in the subject organised by the Worker's Education Association and by University Adult Education Departments: but amateur geologists, having completed such courses, found no focus for continuance of their interest in the subject. Nor was there any common meeting-point for amateur and professional geologists.

During late 1963, interest and enthusiasm from two such evening classes, respectively in Matlock and Nottingham, caused serious consideration to be given to the idea of forming a new society to stimulate and focus interest in geology in the East Midlands. A preliminary meeting was held on 4th January, 1964, in the Department of Geology, Nottingham University, to discuss the idea. Nine persons were present - Miss F. I. Brindley and Miss Stewart representing two Nottingham Adult Education groups: Miss Palmer and Mr. Cobb representing the Nottingham and Nottinghamshire Field Club: Mr. & Mrs. R. J. A. Travis, representing speleological interests, comprising the amateur component, and Mr. P.C. Stevenson, of Nottingham Technical College, and Dr. F.M. Taylor and one of the authors (W.A.S.S.), of Nottingham University, representing the professional side. Discussion revealed considerable enthusiasm for the project.

Accordingly, a public meeting was arranged for Saturday, 1st February 1964, and duly held in the Adult Education Centre, Nottingham: over 55 interested persons attended, and the East Midlands Geological Society was born. Mr. Stevenson was elected first President and one of the authors (R.W.M.) first Honorary Secretary: a Committee was charged with formulating a programme and it was agreed that a journal be produced, to appear twice a year. The active life of the Society commenced on Saturday, 7th March, when Dr. F.M. Taylor lectured on "The Geology of the Nottingham Region" to an audience of 100: the first field excursion, to Dudley, took place next day. A full programme and a growing membership portray the success of the Society.

Although the Society has hitherto met largely in Nottingham, it is hoped to extend its scope and activities to cover the whole East Midlands area, by establishment of local groups able to organise, not only participation in the activities of the main Society, but also independent meetings as desired.

Affiliation by natural history societies interested in geology is invited, with a view to the development of joint activities: the estimulation of interest in geology at all levels: thus, museum displays, discussion meetings and social gatherings are visualised. A number of research projects are being launched and it is hoped, in addition, to encourage individual research by members.

The Role of the Regional Geological Society

In many sciences at this time, the high degree of specialisation attained, and the necessity for costly apparatus, render active participation by the amateur virtually impossible. This does not apply in geology. G.S. Sweeting (1958) has commented: "In the last century, a high proportion of geological research, especially in the fields of post-Palaeozoic stratigraphy and palaeontology, was done by amateur workers. Today that is no longer true, but amateurs continue to be authorities in many fields...Several of them are international authorities in their own particular fields of geology". Many examples can be quoted - W.S. Bisat, one of the foremost authorities on goniatites: C.H. Calloman, perhaps Britain's leading specialist on ammonites: Arthur W.G. Kingsbury, who has an unrivalled knowledge of topographical mineralogy: Nellie Kirkham, with her profound knowledge of all aspects of Derbyshire lead mining, are just a few of the names that come to mind. Certainly it is necessary today to adopt some degree of specialisation if work is to be worth-while - this applies equally to amateur, as to professional geologists. The amateur can, however, well specialise in a region rather than in a topic: he is ideally situated for repeated study of exposures and for observation of temporary exposures; this is but one possible way in which a spare-time interest can produce results of real scientific worth.

Regional geological societies fulfill an important role by providing a meeting-place for amateurs and professionals - to their mutual benefit. Geology is lamentably little comprehended by the public at large. Builders and architects still construct structures in complete disregard of underlying stratal conditions - and the structures suffer accordingly. School curricula rarely include any mention of this, literally, fundamental subject. Journalists are still so little acquainted with the subject as to announce with surprise that the finding of a fossil "indicates that this part of the country was once under the sea!". It is greatly in the interests of geologists that their subject should emerge from the shadows and come to be recognised, not only as significant and important on practical grounds, but also as a major factor in the cultural heritage of mankind.

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In addition, a large number of journals and transactions of local and national societies have been extensively consulted; these are mentioned in the text, where appropriate. Of especial value as sources were the "Midland Naturalist"; the "Reports of the British Association"; and the "British Union Catalogue of Periodicals".

PROBLEMATIC FABRICS IN THE CARBONIFEROUS REEF LIMESTONE OF DOVEDALE

by

Donald Parkinson

Summary

Fibrous and lamellar calcitic structures from the Lower Carboniferous reef limestone of Dovedale are described and it is concluded that they are indicative of reef-building organisms, including Collenia-like algal forms. These fabrics are discussed in relation to similar, though not identical, forms that have been described from the Clitheroe Limestone of the same age.

Introduction

In the so-called "knoll", "knoll reef" or "reef" limestone of Lower Carboniferous age in Lancashire, Yorkshire, Derbyshire and Staffordshire there are certain fibrous and lamellar constituents, which have attracted the attention of geologists since they were attributed by Tiddeman (1892) to tufaceous deposits in a growing reef. These structures are also found in the Lower Carboniferous of Ireland and Belgium and locally in Pembrokeshire.

The specimens of lamellar and fibrous calcite which are described in the present paper were all obtained from the Dovedale Limestone in the Upper Caninia Zone (C_2 or $C_2 S_1$) of the Lower Carboniferous, which forms the well-known crags and knolls extending alongside the River Dove on the Derbyshire-Staffordshire border from north of Lode Mill to Thorpe Cloud at the southern end of the dale.

The nature of these problematical structures is vital to an interpretation of the origin of the limestone knolls themselves. It has for long been my own view that the "tufa" bands and mosaics are a manifestation of reef-building activity, though I have not hitherto described any of them in detail either from Derbyshire or elsewhere.

However, this view is not generally held. In the re-survey of those parts of Lancashire and Yorkshire covered by the Clitheroe Sheet, it was concluded by the authors of the Clitheroe Memoir (Earp et al., 1961) that the limestone knolls of Clitheroe and Slaidburn, which had not yielded undoubted reef-builders, were not reefs, but lime-banks. My own view that these knolls are in fact reefs was based on other kinds of evidence, such as the possession of very high dips (first noted by Tiddeman) which diverge as much as 90% from the regional strike. The Survey officers confirm the high divergent dips, but attribute them largely to later compaction of the sediments. Now the Dovedale-Manifold Valley knolls resemble the Clitheroe knolls so closely that it would appear, if the Geological Survey is right, that they also are lime-banks rather than true reefs.

It is the purpose of this paper to try to show that some of the organisms in the Dovedale knolls were rock-formers of reef-building types, and it will be argued, as it was argued by Bathurst (1958, 1959) in the case of the Clitheroe knolls, that the original nature of the organisms, whether plant or animal, has been obliterated by diagenetic changes.

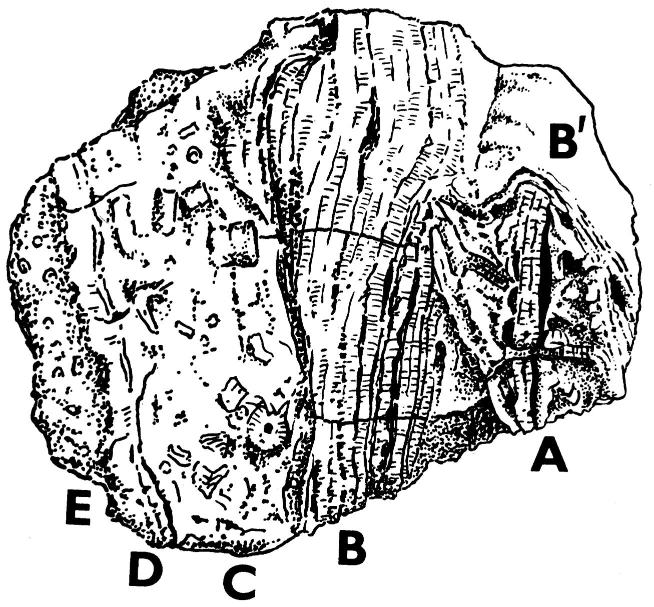
The term "diagenesis" has been recently excellently defined by Read and Watson (1962) as comprising "all those changes that take place in a sediment near the earth's surface at low temperature and pressure and without crustal movement being directly involved. It continues the history of the sediment immediately after its deposition and with increasing temperature and pressure it passes into metamorphism". (See also Taylor, 1964).

History of Research

R.H. Tiddeman (1892) after prolonged stratigraphical work on the Geological Survey in North-east Lancashire and the West Riding of Yorkshire suggested a tufaceous origin for certain laminar structures which are characteristic of the Clitheroe, Bowland and Craven knolls. He postulated (1892) that, where the reef was above water, sea spray or rain water dissolved carbonate from calcareous sand and redeposited it on drying. Similar structures in the Waulsortian (Lower Carboniferous) reefs of Belgium were ascribed by de Dorlodot (1911) to a growth of crystals on fenestellid flakes perpendicular to the surface of the flake. Dixon (1921) described structures in the Carboniferous Limestone of Pembrokeshire which he said could be matched with those of Clitheroe and Belgium; he noted that, where satisfactory examination had been possible, the thin laminae, consisting of calcite and dolomite crystals elongated normal to their length, bore the imprint of a fenestellid bryozoan on their sharp-cut under-surface. He pointed out that the upper surface shows the free faces of the crystals and suggested direct crystallisation from the waters of the Carboniferous sea as a likely explanation, a view substantially in accord with that of Tiddeman.

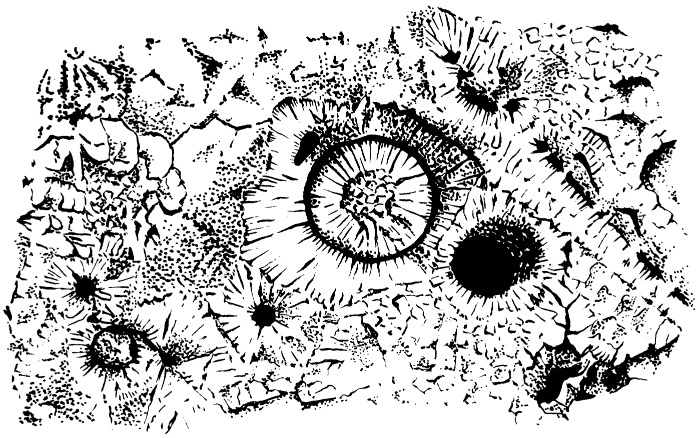
Between 1921 and 1951 different authors including Hudson, Parkinson and Bond made references to the "tufa" bands, without critically discussing their origin. W.W. Black (1952) in a detailed study of the "tufa" bands from knolls near Whitewell in Bowland adduced evidence against the view that they are primary structures and suggested that they are recrystallisations of the unbedded calcite mudstone which is a common constituent of the reef rock. Parkinson (1957) in a brief review of earlier work noted his own observations, which agreed with those of de Dorlodot and of Dixon to the extent that the fibrous bands are often associated with fenestellids. The researches of L.C. Pray (1958) stressed the importance of fenestrate bryozoans in the core facies of the Mississippian bioherms of the U.S.A.

The name Stromatactis was given by Dupont (1881, p. 268) to problematic structures in the Middle Devonian (Frasnian) reefs of Belgium which he suggested might be reef-building stromatoporoids. Lecompte (1937) described these structures in detail and (1938) noted their close similarity to the lacy networks of crystalline calcite in the Silurian (Niagaran) reefs of North America. He did not, however, believe them to be diagenetically altered stromatoporoids. Lowenstam (1950, 1957) considered the "Stromatactis-like forms" to play a part in the frame-building of the Niagaran reefs of the Great Lakes area. His view that



X3

FIG. 1 Bands of secondary fibrous calcite (which, it is thought replace problematical reef-builders) alternating with calcareous sediment of varying fineness of grain. Erosion surface between segments (A) and (B).



X5

FIG. 2 Calcite fibres rooted on crinoid ossicles probably by **direct** precipitation from sea water.

they are organic is based primarily on his observations that the "closely spaced thin laminae which make up the ribbons are separated by short, closely spaced, vertical pillarlike structures" (1950, p.439). He is non-committal about the nature of the organisms; stromatoporoids or algae are mentioned(1950, p. 439) and he later states (1957, p. 247) that unless the Stromatactis-like forms are algal the sole reef-builders were all coelenterates. Stubblefield remarks in a general review of the Palaeozoic sessile marine organisms (1960, p. 231) that the evidence that algae were rock-formers in these Silurian reefs "is still far from conclusive".

R. G. C. Bathurst (1958, 1959) has studied in great detail the "reef tufa" in two knolls of C_2 age (Bellman Quarry, Clitheroe and Hall Hill, Whitewell in Bowland) and has concluded that it has all the important characteristics of the Devonian and Silurian Stromatactis. His views of the nature and origin of the Carboniferous "tufa" differ from those of both Tiddeman and Black; he considers that it is drusy mosaic which has formed in post-depositional cavities, and states that the lower surface of the Stromatactis layer or irregular mass is commonly smooth and rests on the surface of "internal sediment" coarser in grain than the primary calcite siltstone of the reef. He points out, in agreement with the observations of Dixon and of Black, that the upper surface of the cavity is normally irregular, the overlying siltstone being untidily embayed by digitate coarse mosaic (1959, p. 509 and Plates 1 and 2). Bathurst does not consider that the Stromatactis is associated with bryozoans as sediment-binders or frame builders; specimens he examined (sectioned by Dr. Alan Lees) from Feltrim, Co. Dublin, he considers to differ from Stromatactis, "since sediment is a minor component and does not enclose drusy mosaic" (1959, p. 517). Finally he suggests tentatively that the primary post-depositional cavities may have been moulds of an organism which had decomposed after burial. He came to no conclusion on the nature of the supposed organism, but commented on the apparent absence of algae from the Clitheroe knoll reefs.

"Tufa" bands are among the examples of knoll limestone examined petrographically from the Clitheroe knolls (Earp, et. al., 1961). The conclusion is reached (p. 40) that "some at least of the clear coarsely crystalline calcite has been chemically deposited from solution on internal cavity walls." Later narrow veins (up to 0.25 mm. wide) were also found which traversed both the coarse calcite and the fine-grained sediment which occupied the cavities.

Layered Calcite Fabrics from Dovedale

In his work on the Manifold Valley rocks, Prentice (1951) noted the presence in the reef limestone of layered structures to which he ascribed an algal origin, but he did not describe these features in detail. The structure described below from the neighbouring Dovedale knoll reefs are of various kinds and some of them appear to be of an algal nature.

The types of layered and fibrous calcite found in these reefs may be divided into four kinds:-

(a) Bands of fibrous and prismatic calcite sometimes showing the characteristic flat under-surface and irregular upper surface, separated by limestone which in some cases is of the nature of a calcite mud or silt, but in others is of a detrital material of moderately coarse grain. The fibrous bands are often bent or contorted and frequent truncations of one set of layers by later ones are seen. (Text-fig. 1).

(b) Fibrous calcite growing radially from the surfaces of fossils usually in a broken condition. The organisms involved in particular are fenestellids, crinoids and brachiopods. (Text-fig. 2).

(c) Laminae much thinner than the usual "tufa bands. Many of them have a crinkled or corrugated appearance and others appear to consist of a mat of very short prisms. There are characteristically from five to ten layers in one millimetre. These structures suggest Collenia-like stromatolites and some of them encrust fossils (Text-fig. 3).

(d) Intergrowths or successions of the (a) and (c) type bands (Text-fig. 4).

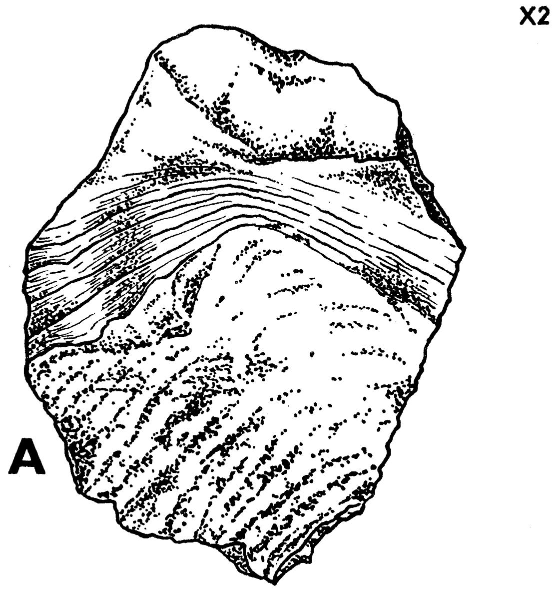


FIG. 3 Portion of Productus shell (A) encrusted by Stromatolite (?) (B).

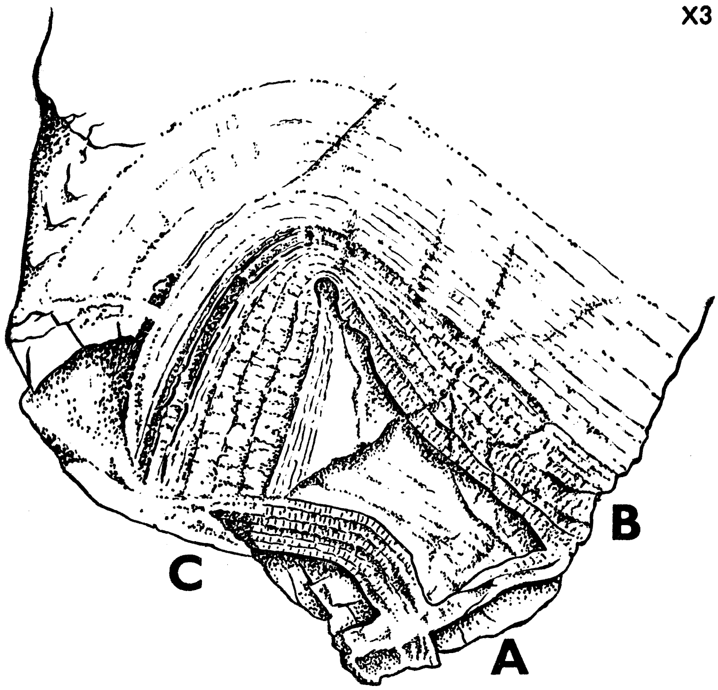


FIG. 4 Illustrating three stages of reef growth separated by two periods of erosion. Segment (A) and the upper part of (B) are of suggested algal origin. (C) and the lower part of (B) are thought to be secondary crystallisations occupying the sites of reef-builders.

It should be added that large portions of some of the knoll reefs, of which Thorpe Cloud may be cited in particular, are made of a porcellanous limestone which on close examination reveals a laminar texture.

The following remarks are based primarily on the examination of hand specimens and observations in the field, though some thin sections have been inspected. Well weathered hand specimens are in some respects more illuminating than micro-sections, since the structures can readily be observed in three dimensions.

Of the four types of texture enumerated above, (a) most nearly approximates to Stromatactis as interpretated by Bathurst (1959). In general the Dovedale-Manifold structures have a fresher appearance than the Clitheroe Stromatactis and the crystallisation is more obviously fibrous as seen in hand specimens, also the intervening lime silt is more transparent in thin section than in the Clitheroe-Bowland reefs. These particular mosaics resemble those described by both Black (1952) and Bathurst (1958, 1959) in being radial to depositional surfaces and in not encrusting organic material.

Both Black and Bathurst, though differing in their interpretation, state that the "tufa" bands are associated with the calcite siltstone which is a major constituent of the reef. In the Dovedale-Manifold country they are enclosed in sediment of from fine to coarse texture, as is shown in Fig. 1. This figure, like the others, has been drawn by a non-geologist with no preconceived ideas of what he ought to see and therefore no particular feature is exaggerated at the expense of the others, but not all that can be seen is shown. No attempt is made to orient the figures to indicate the original inclinations of the depositional surfaces.

The portion (A) of Fig. 1 is composed of fairly fine-grained crinoidal limestone traversed by a number of fibrous calcite layers; the largest divides into two, the divergent parts being evident in the diagram. The line running along the middle of the most prominent band is a deep groove from which the fibres radiate. A later generation of crystallisation is clearly shown by the thin prismatic layer crossing the area (A) and by the portion (B) which wraps round and truncates the edges of the portion (A). The rock has fractured along the surface of a fibrous band of the (B) generation in the area (B^1) which displays the "sugary" texture referred to by Black (1952, p. 196). The fibrous bands of (B) are not uniformly developed and are shown to thicken towards the top of the figure. The total thickness of radiating fibrous calcite in successive layers (which are not here separated from each other by primary or other sediment) is here about 13 mm. with one layer 4 mm. in thickness. The section (C) is a relatively coarse crinoidal limestone which is in contact with an irregular surface of (B). Along the upper surface of (C) is a band of fibrous calcite (D) of similar nature to those of (A) and (B). The portion (E) is a detrital limestone less coarse than (C).

It seems clear from the figure that (B) post-dates (A) after an interval, probably short, during which (A) suffered erosion. I consider that the bands of fibrous calcite crossing (A) are recrystallations of a small segment of the original framework of the reef and that the space between the frame-builders was filled by fine detritus. An alternative explanation is that suggested by Black, that the laminae are recrystallisations of the calcite silt. However, if these structures did in fact form before the influx of silt their configuration, if nothing else, indicates organic origin. The erosion surface between (A) and (B) which has a sharply bent and deeply indented profile, and the presence of a crack crossing (A), seem to indicate slight slumping during the erosion period. Lying on this surface the second generation of prismatic crystals forms the multiple band (B) and a thin fibrous layer penetrates the cavity in (A). There does not appear to be any essential difference between the (A) and (B) crystallisations. The thin band of fibrous calcite (D) is separated from (B) by a further influx (C) of detrital matter, mainly crinoidal, and much coarser than that filling (A). (D) is thought to be representative of a later frame-builder in the growing reef.

In the (B) type of structure the radial fibrous calcite grows direct from the surfaces of fossils, in particular fenestelloid polyzoans, but also crinoids, brachiopods and corals. In Fig. 2., the fibres are seen to radiate outwards from crinoid ossicles. In the same specimen, not shown in the figure, they are similarly associated with fenestellids. I agree with Bathurst that this type of structure is not Stromatactis. A specimen figured by Pray (1958, Fig. 4) from a Mississippian bioherm in Texas is interpreted by that author as consisting largely of sparry calcite which has grown inwards by open space crystallisation at a bryozoan frond which formed the wall of an original cavity in the rock. Pray's photograph resembles the type (b) material so closely that I have little doubt of the similarity of origin. In Fig. 2 of Pray's paper are coarse mosaics of a different type of structure which Bathurst compares with Stromatactis and comments on their flat bottoms and digitate tops.

Type (b) crystallisation is of common occurrence, though sporadically distributed, in the Dovedale reefs. I suggest that the radiaxial calcite was deposited directly in the voids of an original spongy network in the reef and that the voids were either in free communication with the sea and the calcium carbonate was precipitated from solution, or the precipitation was from evaporated water when the reef locally was above sea level. There seems no good reason why both operations should not have taken place, and therefore the tufa theory of Tiddeman might well offer the true explanation in some cases. Newell (1955) has argued that the bulk of the fibrous calcite in the Permian reefs of West Texas was deposited from solution in primary cavities "over the surfaces of frame-builders and older surfaces of calcarenite". He suggests precipitation from relatively clear turbulent waters in which all fine sediment remained in suspension...at a level a few inches below the surface of the growing reef" (p. 308).

The type (c) structure suggests an algal origin with some recrystallisation. The laminae form very thin sheets parallel to each other and to the depositional surfaces, they range from slightly undulating to crinkly. A fine-scale radial texture of very short prisms can often be seen in individual bands. In Fig. 3.,the banded material (B) which is suggestive of a stromatolite, encrusts the broken valve of a Productus shell (A). The dark lines of the illustration are shallow grooves which show up white in the rock itself. The details of the intervening texture are too fine to be shown in the figure.

Similar laminar textures to the one described above, but on a massive scale, cover large areas in the C_2 knoll reefs. In hand specimens some of them closely resemble the algal material reported by Wolfenden (1958) in the D_1 reef of Parkhouse Hill and elsewhere in West Derbyshire. Dr. F.W. Anderson, in a cursory examination of my material, recognised algal forms. He mentioned the difficulty of determining species because of the large degree of recrystallisation.

On the southern lower slope of Thorpe Cloud there is an outcrop many square yards in extent of an unbedded purply-blue porcellanous limestone which Dr. Anderson considered might indicate an algal origin.

Type (d) consists of alternations of the coarse fibrous Stromatactis layers and the fine stromatolitic-like layers, suggesting two kinds of organisms with much replacement of the original structure by secondary calcite. In Fig. 4. three generations of growth, separated by two periods of erosion, probably with some slumping, are recognisable. The first (A) is on too fine a scale for reproduction in the figure. It is finely lamellar, with the appearance of a gauze-like network. This could be of algal origin. The next generation (B) wraps round and trangresses the edges of (A). The lower (coarse) layers of (B) are radially prismatic, the higher ones, again suggestive of algae, not displaying much structure, though there is a suggestion as in (A) of a very fine network of short prisms normal to the boundary surfaces, some of which are straight and others slightly crinkled. The portion (C) is quite clearly seen to consist of six adjacent parallel prismatic bands which truncate (B) as well as (A), and in the specimen itself the first layer of (C) is seen to penetrate a narrow cavity in (B). The three generations of growth separated by two periods of erosion shown in this specimen are a common feature and as many as four have been noted.

An unusual deposit is seen in a small vertical exposure on Hamston Hill, Thorpe, consisting of a succession of parallel bands (of which 13 are visible) a few feet in length and for the most part straight, though some show undulations in the mass. Several occur close together to form one band and are separated from the next series of laminae by as much as an inch of detrital limestone. Some individual laminae display the characteristic corrugated texture and others appear to be finely punctate, the punctation being apparently a manifestation of short radial prisms. The appearance is suggestive of a succession of algal growths separated by influxes of calcite detritus in the growing reef.

It might be added that there are often seen in thin section innumerable tiny pellets, which though usually larger than the algal dust described by Wood (1941), could possibly be algal in origin. Their detailed investigation has not been attempted.

The Dovedale and Clitheroe Knoll Reefs ; Resemblances and Differences

The Dovedale-Manifold Valley knoll reefs resemble those of Clitheroe and Bowland in possessing depositional dips, much unbedded or obscurely bedded porcellanous limestone (siltstone according to Bathurst, 1959 and Earp et. al., 1961), a characteristic fauna and "reef tufa". The laminar "tufaceous" fabrics in the Dovedale-Manifold knolls are of greater variety and complexity than those in the Clitheroe knolls and are fresher in appearance, and in thin section the siltstone is more transparent. And whereas algae are not proved in the Clitheroe Limestone they are present (and may have been extremely abundant) in the Dovedale Limestone.

Now if the knolls of Clitheroe and Dovedale are of similar origin we should expect algae to be of importance in both regions. Although Bathurst suggested an organic origin for the Clitheroe Stromatactis he argued against an algal derivation. He stated (1959, p. 517) that the Derbyshire limestones are in the "same general state of diagensis as those near Clitheroe" in which algae are unrecorded. I would make the suggestion that the condition of the calcite mosaics in the Clitheroe reefs points to a somewhat more advanced state of diagenesis than those of Derbyshire, and I suggest further that this may possibly result-in part at least - from environmental differences between the reefs of the two areas. Those of Clitheroe were enveloped in basin rocks largely argillaceous, whilst the Dovedale reefs grew near the rim of the basin and the contemporaneous bedded limestone contains virtually no shale.

Whether or not algae were original constituents of the Clitheroe knolls, there is no doubt that in reefs where they are known to exist their skeletons are readily recrystallised. Newell and co-workers (1953, p. 109) refer to advanced recrystallisation of algal skeletons in the Pleistocene reefs of the Bahamas. The Silurian (Niagaran) reefs of North America provide an instance in ancient structures, now generally accepted as reefs, where the evidence of frame-building organisms is slight because of diagenetic processes, and as Black remarks (1954, p. 292) there are others in various parts of the world. Black, in fact, makes the interesting suggestion that the calcite mudstones (siltstones) of the Carboniferous reefs in the north of England might themselves be recrystallised algal skeletons. Although Bathurst (1959, p. 517) considers that the primary sediment was too coarse to provide algal precipitates, he does not altogether discount algal action.

In the Dovedale reefs there is much fine-grained unstratified limestone which on examination with a pocket lens reveals a closely spaced laminar texture. Other parts of the same apparently uniform mass of rock appear to be quite structureless. The general impression is one suggestive of an organism (probably algal) in progressive diagenetic change, which gives support to Black's suggestion. I believe with Bathurst that the Stromatactis-like structures were originally organic, but like him I have not proved their algal nature. However, in Dovedale some at least of the finer laminae, as distinct from the coarse mosaics, are apparently algal, and these often alternate with Stromatactis-like layers. The implication is that the Stromatactis-forming organisms decomposed more readily than the others. I suggest that in the Clitheroe knolls the diagenetic changes progressed so far as to obliterate completely not only the Stromatactis-forming organisms, but the more resistant finely lamellar algal frame-builders which are still preserved in the Dovedale reefs.

The diagenetic changes would appear to be of two main kinds; (1) decomposition of organic matter (Stromatactis) accompanying the formation of post-depositional cavities in which, as Bathurst believes, the drusy mosaics were precipitated, and (2) recrystallisation in situ of algal species different in character from the Stromatactis-like forms.

The view that a reef-builder,which decomposed rapidly,accompanied others with more resistant skeletons helps to explain why the calcite mosaics are often found to alternate rhythmically with fine-grained limestone (Bathurst's primary sediment) through a thickness of many yards, as can be seen for example in the dissected knoll of Knot (or Sugar Loaf) near Dunsop Bridge in Bowland, Yorkshire. The primary sediment itself would seem to have had to be supported originally by a frame-builder or sediment binder, otherwise it can hardly have contributed to the building of the reef. If it can be assumed that the reef-building in such circumstances was shared by algae and the problematic Stromatactis, the rapid disintegration of the latter would provide the sites of cavitation and account for the deposition of the coarse mosaics which, as Bathurst observes, would be precipitated not long after burial of the sediment in successive generations. Such a hypothesis is consistent with both Black's suggestion that the calcite siltstone of the reef consists in part of recrystallised algal skeletons and Bathurst's conclusion that the fibrous calcite itself is not recrystallised calcite siltstone as had been argued by Black. It should be added that Pray (1958, p. 265) considered that much of the lime mud in the American Mississippian bioherms was of algal origin, although distinct algal structures had not been recognised.

All this takes us a long way from Tiddeman's tufa and Dixon's direct precipitation from sea water and the common association of the tufa with fenestellids. There is, however, as noted in earlier pages, much evidence of direct precipitation in the Dovedale reefs of fibrous calcite on fossil surfaces, including fenestellids. Moreover, Pray (1958) considers the fenestrate bryozoans to be of major importance in the American Mississippian bioherms and there are other instances of bryozoan reefs. Bathurst shows that bryozoans are not associated with the structures he describes in the Clitheroe reefs, but in my view they were to some extent contributors to the reef framework both at Clitheroe and Dovedale. It is 40 years since I observed at Coplow, Clitheroe, before the knoll was levelled by quarrying, much fibrous calcite which in some cases was clearly rooted on a fenestellid; these observations were not followed up at the time. Fenestelloid polyzoans are common in the friable detrital calcareous mud (from which large numbers of crinoids representative of many species have been extracted) in the Coplow knoll, as well as in the surrounding shales. In contrast, bryozoans are apparently rare in the C_2 bedded cherty limestones in contact with the reef limestones of Dovedale and the Manifold Valley.

Conclusions

I consider that the evidence as a whole justifies the belief that reef-builders were present in the C_2 biohermal knolls of the North Midlands and the North of England. Of these organisms the fenestelloid bryozoans were subsidiary to the algal and Stromatactis forms. Algae may have been relatively less important in the Clitheroe limestone than in the Dovedale Limestone.

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(Manuscript received 13th March, 1964)

EAST MIDLANDS GEOLOGICAL SOCIETY

EXCURSION REPORTS, 1964

THE DUDLEY CANAL TUNNEL AND MINES, WORCESTERSHIRE

(Inaugural Excursion held jointly with the Peak District Mines Historical Society and the Swinnerton Geological Society, University of Nottingham).

Leader: Dr. W.A.S. Sarjeant — Sunday, 8th March 1964

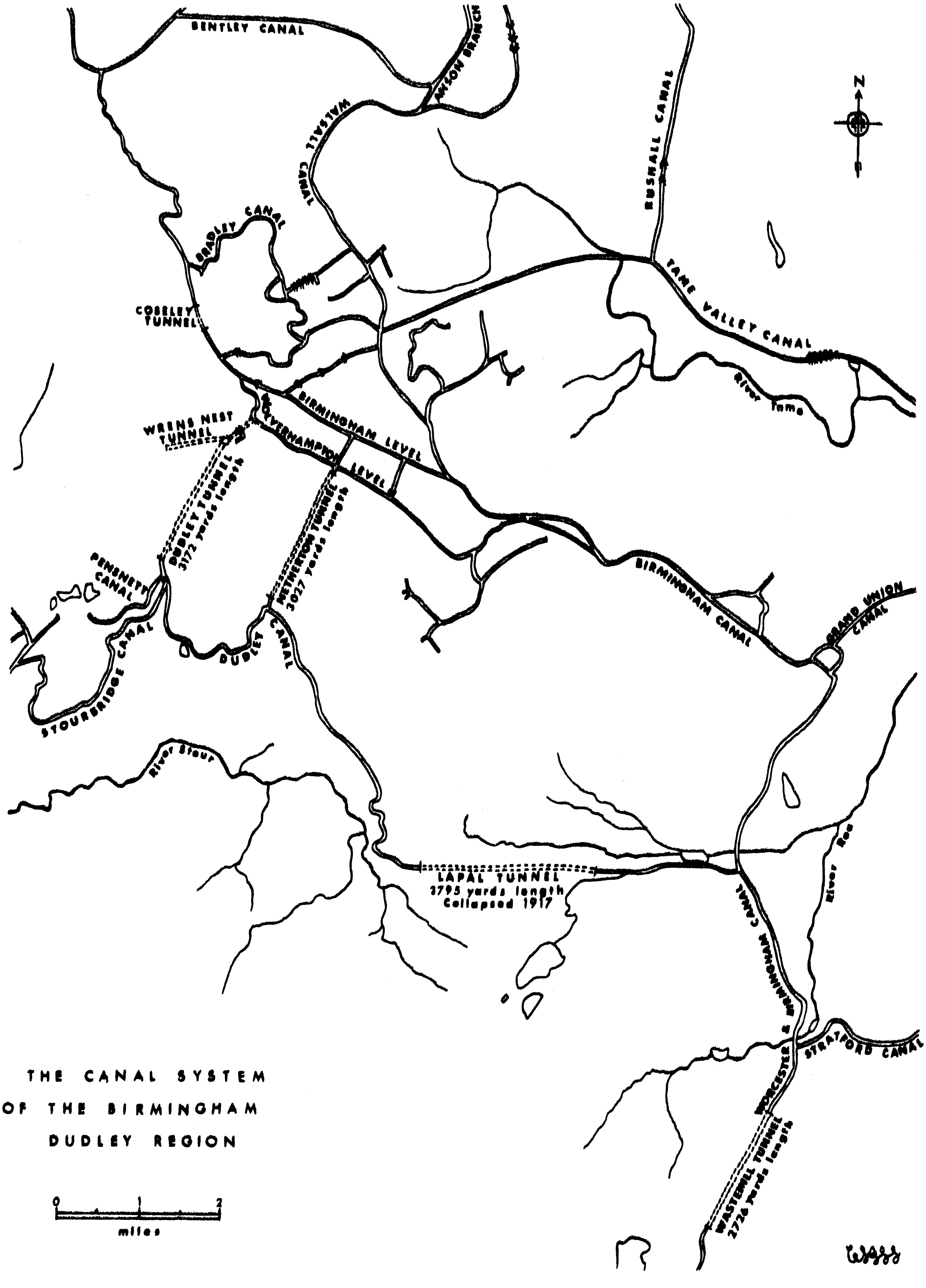
The twin hills of Dudley, Castle Hill and Wren's Nest Hill, are among the most famous of geological localities. They comprise two periclines, formed of Silurian limestone and shales, surrounded by an unconformable cover of Middle Coal Measures; as such, they have for long been extensively quarried as a source of lime, the lime being used as a flux in the ironworks of the Black Country. The limestones are richly fossiliferous, one trilobite, *Calymene blumenbachi*, occurring in such numbers as to be known as the "Dudley locust". A flourishing sideline among nineteenth-century quarrymen was the sale of fossils to collectors: complete trilobites fetched a better price than mere headshields or pygidia, and the writer has seen specimens in which a wholly artificial body has been carved and added to render a headshield more saleable!

In 1769, the Birmingham Canal, surveyed by James Brindley, was cut, passing Dudley on the north side. An extension was constructed to the limestone mines and collieries of Dudley Castle Hill by their owner, the Earl of Dudley: this involved the building of two short tunnels (Tipton Tunnel and Castle Mill Tunnel) leading to a Canal basin where boats were loaded. In 1779, a second canal was built from Park Head, south west of Dudley, to Black Delph to link up with the Stourbridge Canal and to form an alternative outlet for locally-produced iron ore and limestone.

In 1784, the proposal was made that these two canals should be joined by the building of a canal tunnel, the idea being to short-circuit the journey from Park Head to Birmingham, which at that time involved a lengthy circuit through Stourbridge and Wolverhampton via the Staffordshire and Worcestershire Canal. The necessary Act of Parliament was passed in 1785, John Pinkerton being appointed contractor and Abraham Lees, chief engineer. By the next year, engineering difficulties necessitated a re-survey, which was duly made by Thomas Dadford, a leading engineer of his day. Even this second survey did not prove satisfactory, errors being made in the driving headings, and a third survey was made by Lees, in association with one Richard Aston. Josiah Clowes, a Cirencester engineer, was called in to take charge of the completion of the work and the work was finished in January, 1792, despite that fact that Messrs. Brown and Green, who replaced Pinkerton as contractors, had in the meantime gone bankrupt. The original junction from Castle Mill to the Birmingham Canal was found unsatisfactory, so a shorter waterway was cut: with its opening on 6th March, 1792, the Dudley Canal Tunnel was completed. The length of the tunnel itself is 3,142 yards: its waterline width is generally 8 ft. 5 in., with a headroom of 5 ft. 9 ins. (See Text-figs. 1 and 2).

Josiah Clowes was associated with the construction of all four of Britain's longest canal tunnels - the Standedge Tunnel (3 miles 158 yards); the Sapperton Tunnel (2¼ miles): the Lapal Tunnel (2¼ miles): and the Dudley Tunnel (1¾ miles). The first three of these are now no longer navigable.

The Dudley Tunnel continued in active use, both as a through route and as an outlet for



THE CANAL SYSTEM
OF THE BIRMINGHAM
DUDLEY REGION

FIG. 1

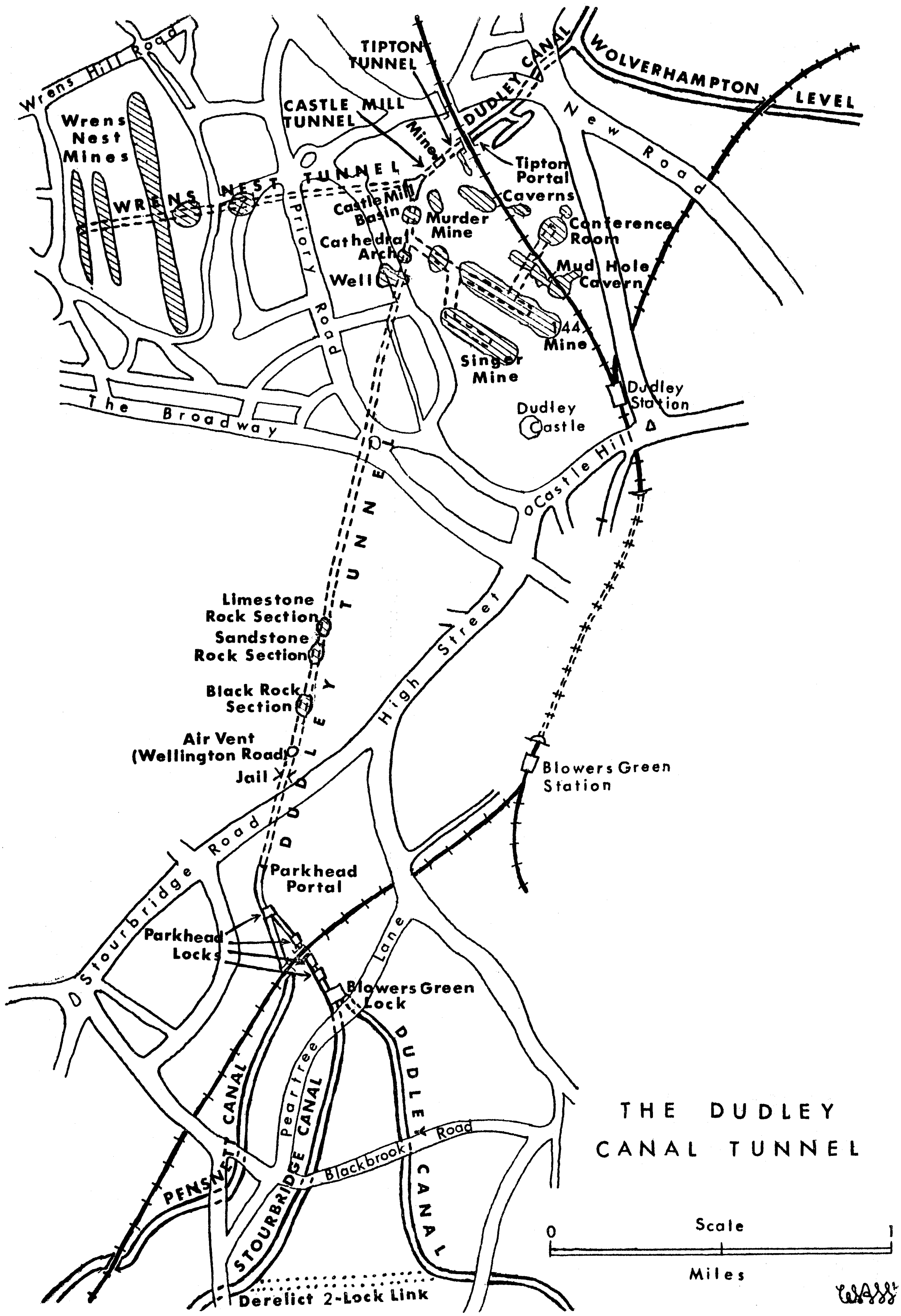

TIPTON TUNNEL
CASTLE MILL TUNNEL
DUDLEY CANAL
WOLVERHAMPTON LEVEL
Wrens Hill Road
Wrens Nest Mines
WRENS NEST TUNNEL
Mines
Tipton Portal
Caverns
Castle Mill Basin
Murder Mine
Conference Room
Cathedral Arch
Mud Hole Cavern
Well
144 Mine
Singer Mine
Priory Road
New Road
Dudley Station
Dudley Castle
The Broadway
Castle Hill
DUDLEY TUNNEL
High Street
Limestone Rock Section
Sandstone Rock Section
Black Rock Section
Air Vent (Wellington Road)
Jail
Blowers Green Station
Stourbridge Road
Parkhead Portal
Parkhead Locks
Blowers Green Lock
Lane
Peartree
PENSNETT CANAL
STOURBRIDGE CANAL
DUDLEY CANAL
Blackbrook Road
Derelict 2-Lock Link
THE DUDLEY CANAL TUNNEL
Scale
0
1
Miles

FIG. 2

local mineral products, for over 150 years. In 1845, the great Scottish geologist, Hugh Miller, visited Dudley Castle Hill and comments in his "First Impressions of England and its People":-

> "The recesses of the hill, like those of the Wren's Nest, are threaded by a subterranean canal, which, in passing under the excavation of an ancient quarry, opens to the light; and so in a thickly wooded walk, profoundly solitary, when one is least thinking of the possibility of such a thing, one comes full upon a wide and very deep chasm, overhung by trees, the bottom of which is occupied by a dark basin, crowded by boats. We may mark the boatmen emerging from out the darkness by one chasm, and re-entering it by another."

The tunnel continued in use till 1950, the last boats regularly using it being those of the Harts Hill Iron Co. Its closure was threatened in 1960, but temporarily staved off by a mass cruise through by over 50 boats, organised by various canal associations. The threat was renewed in 1963: it was proposed that the railway viaduct over the Tipton portal be replaced by an embankment, construction of which would block the tunnel entrance.

A society, the Dudley Tunnel Preservation Society, was hastily formed to combat this threat. Following a broadcast by the author on the formation of the East Midlands Geological Society, the Secretary of the Preservation Society, Mr. Richard G. Amott, wrote to invite any interested geologists to visit the tunnel while it remained open. In view of its historical interest and of the fact that it affords a section, albeit incompletely visible, through the rocks of the Dudley anticline, a visit seemed well worth while. The tunnel was due to be blocked in April: an excursion, to be held jointly with the Peak District Mines Historical Society and the Swinnerton Geological Society of Nottingham University, was fixed for Sunday, 8th March.

Over 80 members of the East Midlands Geological Society attended this first excursion, joining some 30 members of the other participating Societies at Tipton Green bridge (Ordnance Survey One-Inch Sheet 131, grid reference 951918). Here the party boarded two narrow boats for the journey through the tunnel. The boat was poled to the northern (Tipton) portal: progress through the tunnels was by legging, bow hawlers and leggers being provided by the Dudley Society under the charge of its red-bearded Chairman, Dr. John Fletcher.

The first short section, the Tipton Tunnel, opens into a small basin which connected with the Earl of Dudley's Tipton Colliery: few traces remain of the latter. This section of the tunnel is extremely shallow: the narrow boats were therefore of extremely shallow draught. A second short section, the Castle Mill Tunnel, leads through into Castle Mill Basin, an open basin surrounded on three sides by cliffs of Lower Wenlock Limestone. On the west side of the basin is the entry to the tributary Wren's Nest Tunnel, 1,227 yards long, which formerly led through to an extensive system of limestone workings under Wren's Nest Hill, but which is now impassable. Entries to two limestone mines are seen on the eastern side of the basin.

The boats crossed the Basin to enter the Dudley Tunnel proper, on the south side. The greater part of the Tunnel is brick-lined, particularly its southern section where it traverses Coal Measures rocks otherwise too insecure for bargees' comfort: but in the northern section there are a number of unbricked portions exposing Silurian limestones, often coated by stalactic flow, where hammers were busy. The canal passes through a number of small caves, one of which, "The Well", affords a glimpse of daylight overhead. At the "Cathedral Arch", the canal is joined from the east by a tributary canal leading into the extensive limestone mines under Castle Hill: although now partially blocked by roof falls, this is still traversible. Towards its southern end, the tunnel passes through its narrowest section, "The Jail" (7 ft. wide): shortly after, the tunnel ends above Park Head Locks.

Here the party dispersed for lunch. Afterwards, a rather more hilarious return journey was

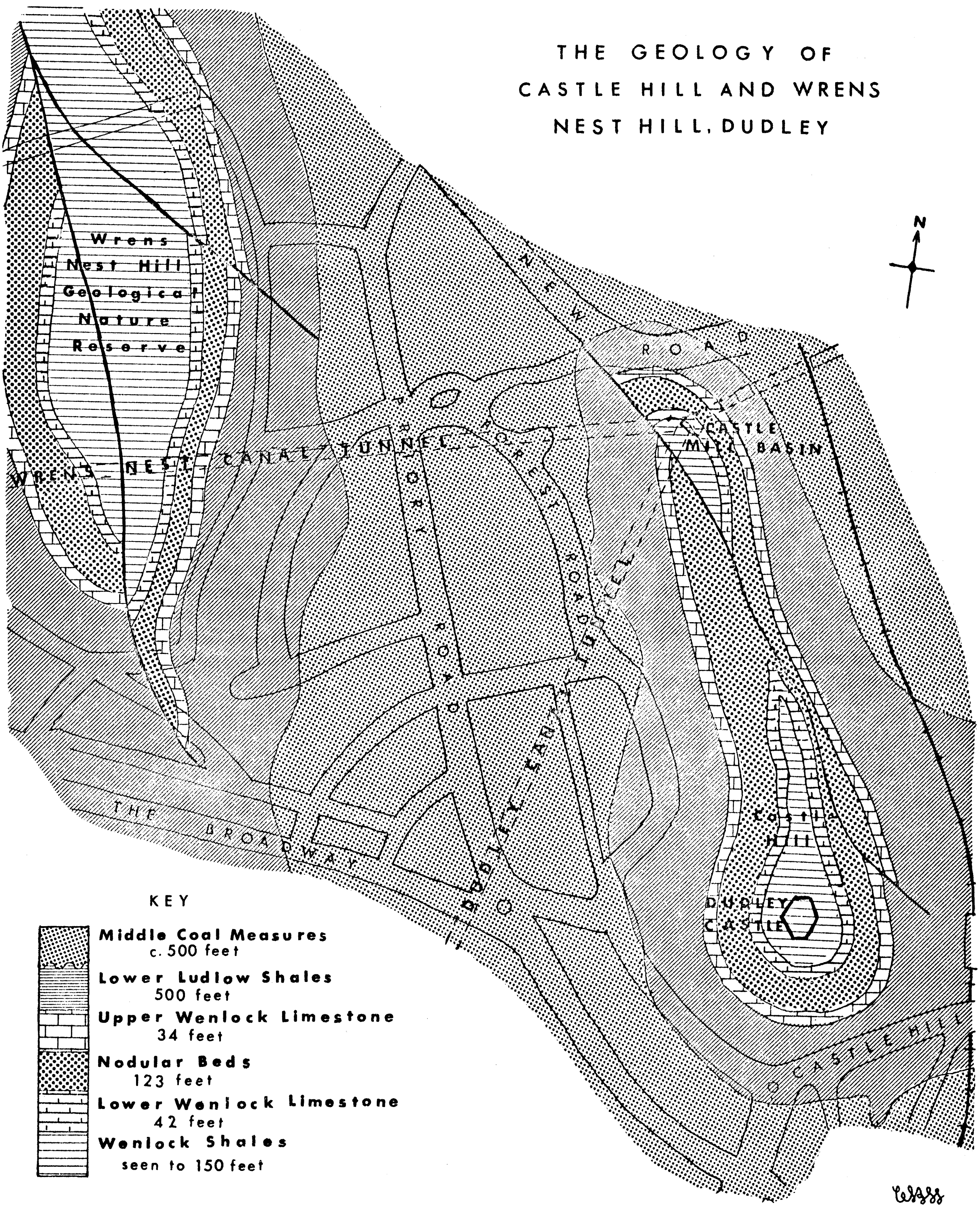

THE GEOLOGY OF
CASTLE HILL AND WRENS
NEST HILL, DUDLEY
N
Wrens
Nest Hill
Geological
Nature
Reserve
WRENS NEST CANAL TUNNEL
NEW ROAD
CASTLE MILL BASIN
TUNNEL
THE BROADWAY
Castle Hill
DUDLEY CASTLE
CASTLE HILL
KEY
Middle Coal Measures
c. 500 feet
Lower Ludlow Shales
500 feet
Upper Wenlock Limestone
34 feet
Nodular Beds
123 feet
Lower Wenlock Limestone
42 feet
Wenlock Shales
seen to 150 feet

FIG. 3

made, some members attempting community singing and even trying "legging". At Castle Mill Basin, the narrow boats were left for a while and the party climbed the hill to examine exposures of Wenlock Shale and Limestone. Some members made the descent of "144" Cavern: others examined the overgrown quarries. (The geology is shown in Text-fig. 3). A large number of fossils were collected, courteously identified by Drs. F.M. Taylor and I.D. Sutton as follows:-

Tabulate corals - Favosites gothlandicus, Palaeofavosites asper, Thecia swinderniana, Coenites linearis, C. seriatopora, C. juniperinus, Heliolites intertextus, Alveolites sp., Syringopora reticularis, and the chain corals Halysites catenularius, Cystihalysites westwoodensis, C. blakewayensis, and Schedohalysites sp.

Rugose corals Phaulactis cyathophylloides and Ketophyllum sp.

Stromatoporoids

Trilobites - Calymene blumenbachi and Dalmanites sp.

Brachiopods - Atrypa reticularis and Leptaena rhomboidalis

The party then rejoined the boats and ultimately disembarked again in dwindling light at Tipton Green Bridge, the E.M.G.S. component travelling straight back to Nottingham after a most unusual inaugural excursion.

The attempt to preserve the Tunnel has met with a fair measure of success, as a result of the efforts of the Preservation Society. Formation of a company is proposed with the aim of developing the tunnel commercially: this would be under the patronage of the Earl of Dudley and would have the name "Dudley Canal Company Ltd.", like its 1774 predecessor. Negotiations are in progress with British Waterways, with the aim of acquiring the lease of the Canal and Tunnel: but, owing to the recent change of Government, these negotiations remain uncompleted. At the time of writing, the Tipton portal remains open: but the future of the Dudley Tunnel remains uncertain.

W.A.S.S.

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Fig. 1. East Midlands Geological Society, inaugural excursion to the Dudley Canal Tunnel. The first of the narrow boats is here seen approaching the Tipton portal. Closure at the tunnel has been threatened, as a result of proposed replacement of the railway bridge by an embankment.

Fig. 2. The entrance to the Wren's Nest Tunnel in Castle Mill Basin. This tunnel, now blocked, formerly led to an extensive series of limestone mines. An exposure of Lower Wenlock Limestone is seen at right.

Photos: W.A.S. Sarjeant

GEOLOGICAL TOUR OF THE EAST MIDLANDS

Leader: Dr. F.M. Taylor   Sunday, 3rd May 1964

About 55 people attended this second field excursion to be held by the East Midlands Geological Society. The excursion was concerned with the establishment of a general picture of the geology of the East Midlands area, rather than with details which would be filled in with later excursions. The programme was ambitious - to make a transect of the Mesozoic rocks from Nottingham to the coast at Skegness. The geology of the route was described as the coach travelled over the outcrops and selected quarries were visited.

The route can be followed by use of Ordnance Survey One-Inch maps Nos. 112, 113, 114, 104, and 105 and the $\frac{1}{4}$ inch to 1 mile Geological Survey Maps Nos. 11 and 12.

The first part of the journey followed the A.60 to Mansfield, passing through Harlow Wood. In this locality there are a number of old quarries in Bunter Pebble Beds; but the beds were in fact examined at a road side exposure on the southern boundary of Mansfield.

The underlying Permian beds were encountered north of Mansfield, and the Red Mansfield Sandstone, a red sandy dolomite, was examined in the Chesterfield Road (A.617) Quarry. The Magnesian Limestone was traversed to Mansfield Woodhouse (along B.6033). At the junction with the Mansfield - Warsop road (A.60) the Trias beds are again seen, beginning with the Mottled Sandstone, passed over quickly as the road climbs the escarpment onto the Pebble Beds.

The journey to Edwinstowe, along B.6033, passes through some of the old parts of Sherwood Forest, following the outcrop of the Bunter Pebble Beds. In order to see the Eakring Oilfield the bus made a detour via Edwinstowe (B.6034) and the Rufford Estate (A.614). Collieries sunk through the Trias were seen and their geology explained by Mr. R. E. Elliott. The journey continued eastwards for a short time along A.617, climbing up the Waterstones escarpment just west of Kirklington. The pumping wells (nodding jennys) were seen on the minor road leading to Eakring village, skirting Dukes Wood. The road northwards through Wellow to Boughton (east of Ollerton) crosses and re-crosses the Keuper Marl/Waterstones junction. At Boughton a quarry, situated just off the Boughton-Laxton road, is being excavated in the lowest beds of the Keuper Marl. Some of the sandstones from the quarry were tipped close to the road and sedimentary structures, including very large salt pseudomorphs, evoked considerable interest.

The Keuper Marl outcrop was followed through Laxton (3 - field systems and first Lincolnshire Limestone church) and Egmanton to Tuxford. Features indicate the positions of Skerry Beds. The A.1 was crossed and the Trent Valley reached (via A.611 and A.57) at Newton-upon-Trent. East of the Trent there are extensive sand and gravel deposits which extend towards the Lincoln Gap. There was plenty of visible evidence of the working of these deposits, which cover the Trias/Jurassic boundary.

Approaching Lincoln, excellent views were obtained of the Lincoln Gap, an old overflow channel cut in the Lincolnshire Limestone escarpment. It had been intended to make a slight diversion to see the Upper Lias Clays at Bracebridge, but as we were a little short of time, the Lincolnshire Limestone (Inferior Oolite) escarpment was climbed immediately and lunch eaten close to Lincoln Cathedral.

From Lincoln the party drove across the extensive clay vale formed by the Great Oolite, Oxford and Kimmeridge Clays. Little can be seen of the harder beds of limestone,(the Great Oolite Limestone, the Cornbrash and Kellaways Rocks.) The route chosen passed through Wragby (A.158) to Hainton (A.157). From this village the coach took the minor road to North Willingham. This road skirts the escarpment of Lower Cretaceous rocks, notably the Spilsby Sandstone. This sandstone was examined at a roadside exposure (A.631) just east of North Willingham.

Continuing along the A.631 to Louth, we were fortunate to see a recently ploughed field whose colours clearly indicated the outcrop of the Red Chalk and its junction with the overlying white Chalk. Comparisons were made concerning the vegetation and agriculture of the Chalk areas with the Clay areas east of Lincoln.

From Louth the coach travelled southwards (via A.157, B.1373 and A.1104) to Alford. This route took us along the Pleistocene outcrops, east of the chalk which forms the extensive area to the coast at Sutton and Mablethorpe. Tempting though it was to continue to the coast, we followed instead the old chalk cliff line, passing through it just prior to Alford.

The journey westwards now commenced, following the A.16 to Spilsby. A number of rivers have excavated below the chalk, so that the road is a bit of a switch-back, dropping down on to Lower Cretaceous deposits and then climbing back on to the Chalk. Just before leaving the Chalk for the last time, near Dalby, we had a glimpse of the first Chalk quarry to be seen on the route chosen.

Lower Cretaceous deposits (particularly Spilsby Sandstone) were crossed in the Spilsby area, although the village itself is in a valley cut through into underlying Kimmeridge Clay. The main outcrop of this division is met along the A.155 at West Keal and it continues to Tattersall. On the south side of the road is the extensive area of the Boston Fen. At Tattersall there is a 15th century tower (remains of a fortified manor) from the top of which panoramic views can be obtained of the Fen country to the south and east, the chalk escarpment, (recently traversed) in the north east and westwards to the Lincolnshire Limestone escarpment.

The northern part of the Fen is crossed between Tattersall and Billinghay and those with a discerning eye noticed the change of level when the Upper Jurassic Clays were crossed near Anwick.

The route from Sleaford to Grantham (A.155 and A.607) passes through the Ancaster Gap. This physiographic feature is similar in origin to the Lincoln Gap. The Great Oolite Limestone was noted in a quarry near Quarrington: and the Lincolnshire Limestone was seen in a roadside quarry close to Ancaster. Sands and gravels associated with the channelling of the gap were noticed at the western end of the overflow channel.

The road from Grantham to Nottingham (A.52) begins in beds of the Middle Lias. Excavations for the Grantham By-pass (A.1) cut through the Marlstone Ironstone and examples of it could still be seen on the various approach roads. The Marlstone Ironstone in this area makes an excellent escarpment, increasing in height southwards. Nothing was seen of this escarpment on the outward route, since the Ironstone thins out northwards. The basal Lias (Hydraulic Limestones and Rhaetic) escarpment, which was crossed at Elton on the homeward journey, was also not crossed on the outward, since it is concealed by the sands and gravels in front of the Lincoln Gap.

And so back on to well known Trias with the Keuper Marl of Bingham and Radcliffe-on-Trent, the coach crossing Trent Bridge, Nottingham, in failing light. A successful type of excursion for the touring geologist.

F.M.T.

THE GEOLOGY OF CHARNWOOD FOREST

Leader: Dr. T.D. Ford Sunday, 7th June 1964

The party, some 35 in number, met at Mountsorrel granodiorite quarry (SK 577149) and the variation in colour was demonstrated to have an apparent association with the hydrothermal effects of the Carboniferous dolerite dyke intrusion. Numerous basic xenoliths were seen, as well as occasional aplite dykes. The early pneumatolytic molybdenite mineralization of joints was also seen, but the late pyrite-dolomite-bitumen veins were found only in the debris.

Lunch was taken at the Forest Rock Hotel, Woodhouse Eaves, conveniently situated outside the Woodhouse Church Quarry (SK 531140) with its faulted contact between Woodhouse Beds and Brand Grits. Examination of the xenoliths in the Mountsorrel granodiorite cross above the quarry was interrupted by a hailstorm.

Moving onto the Beacon Hill (SK 540148) the structure and lay-out of Charnwood Forest were explained, to the accompaniment of a violent thunderstorm. Current bedding was observed in the hornstones.

In the grounds of Charnwood Lodge (SK 464158) the pyroclastic deposits of the Felsitic Agglomerate and the Bomb Rocks were examined, and considerable argument ensued as to the nature of the latter - were they true "volcanic bombs" of porphyroid lava, or were they a beach boulder bed of the same rock type?

After rain the party moved to High Sharpley (SK 448170) to see the sheared and cleaved Peldar porphyroids, now generally believed to be lavas.

At this stage further heavy rain set in and the party dispersed.

T.D.F.

THE VOLCANIC ROCKS OF THE WIRKSWORTH AREA, DERBYSHIRE

Leader: P.H. Speed — Sunday, 5th July, 1964

A party of 37 members and friends attended this field meeting and in brilliant weather were conveyed by coach from Nottingham to Middleton-by-Wirksworth.

The purpose of the meeting was to investigate the characters of the igneous Rocks associated with the Carboniferous Limestone between Wirksworth, Ible and Bonsall.

The locality was described by Sir Archibald Geikie (1897), who was conducted over the area by H.H. Arnold-Bemrose (1894, 1907 and 1910). Bemrose received his first instruction in geological mapping from Geikie in the area around the Grange Mill Vents.

The Wirksworth area is part of the Matlock District described by Bemrose (1907).

The Leader pointed out that there are two prominent series of lava flows outcropping in the area, but that many of the wayboards of clay which would be seen in some of the limestone outcrops might be of volcanic origin. The Upper Lava is about 150 feet below the top of Limestone - Shale boundary at Matlock Bridge and outcrops between Matlock and Matlock Bath, to the east of the area to be visited.

The Lower Lava, which outcrops around Middleton Moor, in Via Gellia and between Bonsall and Elton Common, is about 100 feet below the Upper Lava.

The group left the coach at the northern end of Middleton-by-Wirksworth and took the lane westwards to Hoptonwood Quarry. The feature formed by the Lower Lava was noted. The springs which emerge from the junction between the lava and limestone had for many years provided the water supply for this part of Middleton, the stone troughs and sinks at the top of the lava outcrop still being in existence.

Hoptonwood Quarry (National Grid reference SK 262557)

The easterly extension of the surface workings in this quarry had ceased owing to the large amount of overburden, in the form of the Lower Lava, which is, in parts, about 40 feet thick, it was observed that the southern part of the quarry had also stopped for what appeared to be the same reason; an east-west fault having brought the lava, on the downthrow side, to surface level, this throw it was estimated to be about 50 feet.

The lava is a highly vesicular olivine basalt and in a fresh specimen some phenocrysts of olivine and augite were present, the vesicles are frequently filled with calcite. After lunch the party travelled to

Ible (SK 253568)

A sill of ophitic olivine dolerite outcrops to the south and east of Ible village. A large amount of the rock has been worked for road metalling, but the workings were abandoned some years ago.

The series of stone troughs used for collecting the village water supply from the limestone above the sill were still overflowing with water.

Grange Mill

From Ible the road was followed to Grange Mill passing the outcrop of Tuff, or bedded volcanic ash, the Shothouse Spring Tuff of Bemrose (1907). A section showing the relationship of this tuff with the

Grange Mill Vents is shown by Edward and Trotter (1954). The tuff is basaltic, purplish, turning to brown on weathering and is composed of glassy lapilli in a matrix of volcanic dust. The most interesting group of vents at Grange Mill was next visited, they form two dome-like hills rising about 200 feet above the valley and present a distinct contrast to the surrounding limestone country.

A small quarry in the southern vent, on the eastern side of the Grange Mill - Winster road (SK 245579) provided an excellent section from which fragments of olivine dolerite, limestone and a red quartzite pebble were obtained.

Two small dykes of dolerite, which appeared to traverse the southern Vent, were seen in the road section opposite the houses just south of the quarry.

East of the Vent a well marked escarpment of limestone was traced northwards to Shothouse Spring (SK 240591) where the bed of laminated tuff was again seen. The tuff here is reported to be about 90 feet thick and composed of fine and coarsely laminated bands of lapilli in a calcite cement. It was noted that the limestone above the tuff is nodular and contains numerous minute green lapilli to at least 15 feet above the ash.

The coach was rejoined and a journey made via Bonsall Moor to Moorlands Lane.

Bonsall

The outcrop of the Bonsall Sill from Salters Lane to Upper Town (Approx. SK 280588) was crossed and some very fresh specimens from which slides have been made show it to be an ophitic olivine dolerite.

Numerous springs rise from the surface and parts of the ground was very swampy despite the dry weather of the previous weeks. The dolerite on the south-east boundary of the outcrops was much decomposed, but a slide made from some of the material collected shows the olivine to have been replaced by a quartz mosaic. Much of the limestone near this dolerite-limestone boundary was also found to have been replaced by a quartz rock.

An extension to the excursion was made, via Low Farm, noting the outcrop of the Lower Lava, to Messrs. Derbyshire Stone's extensive opencast fluorspar workings, between the Upper and Lower Lavas and extending from the Heights of Abraham to just south of Salters Lane opposite Jughole Wood (SK 288593).

Some discussion took place as to the mode of deposition and the solution like boundaries between the limestone and the mineralised areas observed.

P.H.S.

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THE GEOLOGY OF THE AREA WEST OF NOTTINGHAM

Leader: Dr. F.M. Taylor   Sunday, 6th September 1964

The object of this excursion, attended by 49 members and friends, was to study the Permo-Trias rocks west of Nottingham. The route included a number of localities shown on the text-figure accompanying the paper on the oil seepage at Toton Lane, Notts. (p. 25)

The excursion commenced at the Nottingham Castle Museum, SK 569394, which is built on the high bluff of Bunter Pebble Beds, overlooking the confluence of the Leen and Trent Valleys. The Bunter Pebble Beds are yellow or buff in colour, ill-cemented, current bedded coarse sands, containing pebbles arranged in layers or scattered throughout the deposit. Fragments of marl are not uncommon. Exposures of these beds can be seen at intervals along the length of Castle Boulevard.

Sandstones underlying the Bunter Pebble Beds, the Mottled Sandstone, were seen in the grounds of Nottingham University (SK 540384). These rocks are finer in grain size than the Pebble Beds, are devoid of pebbles, and are red in colour. Irregular patches of yellow or green sediment are present. Harder beds said to contain dolomite occur near the base of the section located behind the Maths-Physics building. At the level of the road above this locality is the junction with the Pebble Beds, which can be seen close by in the grounds of Wortley Hall.

Between Hugh Stewart Hall and the Biology Departments runs the Clifton Fault. This can be seen as it crosses Cut Through Lane, where exposures of Mottled Sandstone, adjacent to Pebble Beds in turn juxtaposed against Keuper Marl, indicate the position of the two parts of the fault. The fault was traced again at the back of the Biology Building.

West of the Trent Building Bunter Pebble Beds form a fine lake-side exposure. The lithology is identical to that at previous localities; structurally, however, it is on the south side of a second (University) fault and past exposures have shown it to separate Bunter Pebble Beds on the south side from Keuper Marl on the north.

The party then travelled to the Chilwell Brick Works (SK 513358: see p. 26). The main part of this quarry is in the Lower formations of the Keuper Marl. Mr. R.E. Elliott demonstrated the sedimentary structures which led him to conclude that the thick skerry beds at the top of the quarry were the equivalent of the Plains Skerry of the Nottingham area. These structures included ripple marks, salt pseudomorphs, irregular nodular shaped structures and a bed containing irregular ramifying purple patches with green centres. The greater part of the quarry is made up of dark red marl and fine grained red siltstones. The beds possess uniform lithology and are not laminated. By contrast, the southern part of the quarry showed a series of green-grey sandstones and siltstones. Many of the beds contained abundant mica whilst others were dolomitic or contained calcite. The Keuper Marl on the north side is separated from the green-grey beds by the Chilwell fault.

The party next examined exposures made by the road cutting at the top of the hill at Bramcote (SK 510370). The position of the Beeston Fault was pointed out just north of the Alderman White School and the upper part of the Bunter Pebble Beds were seen on its north side. Although similar in lithology to previous exposures, the beds here are red in colour - the more usual colour for Bunter Pebble Beds. The overlying Keuper Basement Beds, a group of alternating red marls and buff sands, yielded at least one very small pebble.

After lunch, the party walked along the eastern part of the Sandiacre-Stapleford By-pass (SK 503375). At the eastern end, the first rocks encountered are the lower part of the Bunter Pebble Beds.

The junction with underlying Mottled Sandstones is almost at road level here; the beds seen were well bedded, without pebbles, but still coarse grained. A trench cut to a deeper level has been seen to pass into typical Mottled Sandstone lithology with depth. About 200 yds. east of the first bridge, the position of the Beeston fault was located. A skerry bed within Keuper Marl on the south side of the fault was thought to be the same as the bed located in the Chilwell Brick Works quarry. After crossing Toton Lane, an oil seepage in green-grey beds was examined near the footbridge (SK 492361). These beds, similar to the ones on the south side of the Chilwell Brick works quarry, are thought to be situated on the Waterstones-Keuper Marl boundary.

Attention was next concentrated on the nature of the junction between the Trias and Carboniferous. It was first seen at Stoney Clouds, Sandiacre (SK 475376) where Bunter Pebble beds are faulted against Coal Measure Rocks.

After the drive across the Erewash Valley the party climbed Stapleford Hill, Bramcote (SK 498387). The path ascends from the south-east side, passing the stack of red Bunter Pebble Beds known as the Hemlock Stone. In common with the greater part of the Stapleford and Bramcote Hills, the stack contains barytes as a cement. It could well be an ancient quarry remnant composed of harder rock and not easily removed, compared with the surrounding friable rock but, as the name suggests, it is locally considered of supernatural affinity. It is now being actively eroded by wind, which has etched out the softer beds.

From the top of the hill a panoramic view of the surrounding country can be obtained. The relationship of Trias to Carboniferous, in part faulted, elsewhere unconformable, was pointed out. The region of Permian rocks to the north, sandwiched between Carboniferous and Trias outcrops, was appreciated.

The remaining exposures were concerned with Permian strata. At Strelley (SK 505423), the quarry near the church exhibits a sandy littoral facies of the Magnesian Limestone.

The base of the Permian is seen at Kimberley, in the old London Midland Railway cutting (SK 503453). The basal Permian breccia rests on discoloured Carboniferous shales. Dolomitic flagstones containing plant remains are found above the breccia. These beds have been correlated with the Marl Slate of the Yorkshire area. As the Marl Slate is considered to be of Zechstein age, the Nottinghamshire Permian is also of Upper Permian age.

The topmost Permian beds, the so-called Middle Permian Marls and the mineralised top surface of the Magnesian Limestone can be seen at Bulwell, in the old quarry of Sankeys Ltd. (SK 533450).

The last quarry visited was Wilkinson's Quarry, to the north of Bulwell (SK 535460), to see the character of the Magnesian Limestone which occurs in the area between Mansfield and Nottingham. It is a coarse dolomitic limestone with only a trace of detrital silica. One or two horizons made up of the casts of lamellibranch shells were found.

F.M.T.

THE LOWER JURASSIC OF SOUTH NOTTINGHAMSHIRE AND ADJACENT PARTS OF LEICESTERSHIRE AND LINCOLNSHIRE

Leader: P. C. Stevenson Sunday, 4th October 1964

(Map references refer to the Ordnance Survey One-inch Sheet No. 122, Melton Mowbray)

A party of forty-six society members left Shakespeare Street, Nottingham at 9.40 a.m. Passing eastward along the Grantham road, the Director indicated that first, alluvial gravels and then the subdued topography of the Keuper Marl would be crossed. Any rising ground seen was formed by the harder skerry bands in the Marl.

The bus turned south off the Grantham road at 725393 and, going by way of Granby, made a brief stop at 739359, where the Director pointed out the low escarpment formed by the Rhaetic rocks. This formation, though of considerable interest, was poorly exposed throughout the Midlands, and he hoped that since the railway cutting was now abandoned, the society might take an interest in excavating an artificial section at that point.

A minute longer in the bus took the party to the Barnstone Pit of Messrs. G. & T. Earle, in the Hydraulic Limestones of the Lower Lias (740350). Here the lowest member of the Lias succession, about 25 feet of an alternating sequence of grey clays and impure limestones was seen dipping south at about 5 degrees. The zone ammonite, Psiloceras planorbis, was soon found as well as specimens of Caloceras and the lamellibranchs Lima, Modiola, and Gryphea. Before leaving, the party noted the thin drift gravels overlying the Lias in the wall of the pit, and the way in which the highest beds of the Lias had been 'rucked up', presumably by the friction of ice passing over them.

The bus then took the party south again through Plungar (768340). The Director remarked that little of the seven hundred feet of the lower Lias was exposed, that it was composed of clays with thin impersistent limestones, and that the village of Plungar was built on a ridge formed by one of these. This particular limestone was ferruginous and appeared to be at the same horizon as the Frodingham Ironstone of north Lincolnshire.

The next stop was at Denton Park, where a pit owned by Stewarts and Lloyds Minerals Ltd. was working the Middle Lias Marlstone ironstone (855316). The Marlstone itself was seen to be a green sandy rock, but was difficult of access as the pit was being worked. Loose blocks of weathered marlstone yielded the brachiopods Tetrarhynchia tetrahedra and Lobothyris punctata, the belemnite Passaloteuthis and some lamellibranchs. The shales overlying the marlstone had been removed as overburden and contained Harpoceratids, more belemnites, and some hand-sized pieces of jet, all of which were recovered from the spoil heaps.

The party then moved to the Hungerton pit of Stewarts and Lloyds Ltd., where a face over half a mile long was working the Northampton Sand Ironstone (895302). The full succession seen here was:-

Lincolnshire Limestone, here rubbly and shattered, and sometimes gullied by drift-filled channels.

Lower Deltaic Series, about 16 feet of brown and white sands and sandy clays.

Northampton Sand Ironstone, about 20 feet, here being a sandy facies and showing 'boxstone structure'.

Upper Lias grey shales occasionally visible under the ironstone.

Mr. Jones, the Surveyor to the owners, was present to describe the working of the pit.

The Northampton Sand ironstone was seen again in the next exposure, the Sproxton pit belonging to the Park Gate Iron and Steel Co. (860252), where the Lincolnshire Limestone was noted as more massive. The main interest at Sproxton was devoted, however, to the glacial channel containing layers of sand and boulders which replaces the whole visible succession over some three hundred yards of the working face and has caused abandonment of the pit in which it appears. The Director said that several members of the Society had been attempting to determine the origin of the channel, but had not yet come to a firm conclusion. The Surveyor to the owners, Mr. Newman, accompanied the main party in the pit, while an engineer showed a smaller party over one of the large walking excavators.

The last exposure of the day was at Holwell (743238) where the Marlstone was seen again. As the pit was not being worked the ore bed was more readily accessible and in addition was oxidised, so that fossils were more readily extracted. These appeared to be the same as at Denton Park, with the addition of groups of echinoid spines.

The party returned to Nottingham along the A.606 noting the strong features formed by the Marlstone at Broughton Hill (715241) and by sandy shales and thin limestones in the upper part of the Lower Lias at Upper and Nether Broughton in the region of 705265, arriving back at Shakespeare Street about 7.40 p.m.

P.C.S.

Plate 5

Photo: J. Eyett Mr. P.C. Stevenson, President of the East Midlands Geological Society, addressing members during a visit to the Sproxton pit at Park Gate Iron & Steel Co. The section shows Lincolnshire Limestone overlying Lower Estuarine Clays, with Northampton Ironstone Sands at base. A glacial overflow channel truncates the section at left.

Secretary's Report for 1964

If the formation of the East Midlands Geological Society demonstrates anything, it is that geology is very popular in the area. The formal inauguration of the Society took place in Nottingham on February 1st 1964; the Inaugural Meeting decided to hold the first public meeting of the new Society on the first Saturday in March, the speaker for the meeting being Dr. F.M. Taylor who took as his subject "The Geology of Derbyshire." The meeting could not have been more successful, the hall being packed to capacity.

The Inaugural Public Meeting was followed the very next day by our Inaugural Field Excursion, held in conjunction with the Swinnerton Society (Nottingham University) and the Peak District Mines Historical Society. This attracted over 85 people, the leader being Dr. W.A.S. Sarjeant, F.G.S. The excursion was well worth while and geologically very rewarding; a notably jovial spirit prevailed.

Our next meeting was the last of the indoor meetings and took the form of a "Collectors' Evening," the venue being Nottingham Technical College. The meeting consisted of displays contributed by members of the Society; in order to give some idea of its diversity, details follow of the displays and the members contributing them. Over eighty people attended the meeting.

Members name/s	Display
P.C. Stevenson (President)	Synthetic diamonds. Pseudo-geology
Mr. A. Beach	Selected fossil, mineral and rock specimens. Hand-made thin rock slices.
Miss F.I. Brindley	Rock specimens from the Lake District, North Wales and Shropshire.
Mr. J.P. Clarke	Problematica.
Mr. R. Cousins	Mineral and fossil specimens.
Mr. R.E. Elliott	Conditions of sedimentation, with particular reference to the exhibitor's work on the Trias.
Dr. T.D. Ford	Barytes; its nature and occurrence in Derbyshire.
Mr. & Mrs. P.M. Hanford	Reptiles from the Lias.
Mr. P. Hopkins	Gems, natural and artificial.
Mr. R.S. Jackson	Varieties of quartz. Display of ammonites.
Mr. G.M. Kershaw	Problematica.
Mr. & Mrs. R.A. Naylor	Rock, mineral and fossil specimens from Cornwall and Devon. Coal measure plants.
Miss M.C. Stewart	Rocks from Scotland.

Mr. J.H. Sykes	Fossils from S.E. Derbyshire.
Dr. F.M. Taylor	Trilobites from St. David's, Pembrokeshire. Dibunophyllum from Crossdale Mine Quarry, Derbyshire. The Rhaetic Bone Bed at Aust, Bristol.
Mr. & Mrs. R.J.A. Travis	Ornamental rocks from the Carboniferous Limestone of Derbyshire.
Mr. A.H. Walker	Nailhead spar with pyrites. Septarian nodules from High Hazel Seam, Gedling Colliery.

As mentioned above, the 'Collectors' Evening' closed the indoor season and, in view of the fact that the Field Excursion leaders are giving the reports of their excursions themselves, I will say little about them, except to point out that in all cases they were great successes - we continually had to change the original coach booked for a larger one and in only one instance was an excursion marred by rain. Of course the factual reports of the excursions do not tell of their lighter moments, for example the time we "lost" the bus, our efforts to discover it leading to the stopping of a number of motorists - the look of fear on one driver's face as his car was approached on a bend in the road by a prominent member of the Society wielding a hefty hammer will remain in my memory for some time! Perhaps there was no significance in the fact that another car on approaching us halted, reversed and sped off three times as fast as it came......

Our indoor session commenced in November, a few days after these lines have been penned, with a talk by Dr. F. Howitt on "Techniques of Oil Exploration." A report on this will have to await the next issue, as will a report on projects. Before concluding it is perhaps well to recall our close co-operation with another newly formed Society, the Nottingham Technical College Geological Society. On Thursday, October 8th we held a joint meeting, the purpose of which was to see two films; the result was an all round success, so many people turned up that about fifty extra chairs were taken into the hall and still there were people outside. The only answer to this was to scrap the showing of the supporting film, and to show the main feature Harsun Tazieff's film on "Volcanoes", twice. Yes, to conclude on the note I commenced with, geology seems very popular indeed.

R.W. Morrell.

Papers treating with any aspect of Midlands geology will be welcomed for consideration for publication by the Editorial Board. (Authors need not be members of the East Midlands Geological Society). Format should follow that adopted for papers included in this number.

Manuscripts should be addressed to:-

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NOTTINGHAM

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