Geology

In Northern Ireland

NO. 2 OCTOBER 1979 30p

CONTENTS

News

The Planetarium

Mr. Terence Murtagh has been lent two very interesting sets of specimens by NASA for the next few months. These are representative samples of meteorites which fell in N. America and some lunar rock samples collected by the Apollo astronauts.

These will be made available at the Planetarium for study by visiting school parties, and some **written** material is being prepared to describe the specimens and explain their significance. Mr. Murtagh hopes to initiate a competition linked to these specimens. Anyone interested should contact the Planetarium now.

The lunar samples consist of soil collected from three localities, basalt from the Mare Imbrium, breccia from Hadley Rille and Anorthosite (feldspar) from the Descartes Region.

The meteorite samples include two stony Chondrites, a Stony Achondrite, a Stony Iron Pallasite, an Iron Octohedrite and a Carbonaceous Chondrite. The last of these is part of the Allende meteorite, probably the largest recorded fall in history.

Belshaws Quarry

Planning permission has been sought for a Golf course adjacent to this valuable teaching quarry. The Conservation Branch has made representations to ensure that the quarry is not disturbed in any way.

Limestone Lodge Quarry

This is close to Belshaws Quarry (on the Glenavy Road, north of Lisburn). The Irish Hare No. 3 (the Newsletter of the Ulster Trust for Nature Conservation) states that preliminary discussions have taken place with Lisburn Borough Council regarding the possibility of the site being acquired by the Council with the UTNC sharing in its conservation management. This quarry is similar to Belshaws in geology, but is bigger and has a rich flora and fauna.

The Palaeogarden

Professor Wright of Q.U.B. Geology Department has for some time been planning a garden to demonstrate plant evolution. Enterprise Ulster has completed the work on the site between the Geology Department and the Students Union, and a variety of plants had been put in last spring. Unfortunately, the Palaeogarden made the front page of the Belfast Telegraph when some of the rare and unusual varieties were stolen by someone who attempted, over three nights, to remove the lot!

Replacements have been ordered and when all is complete, including labels and discriptive pamphlets, schools and other institutions will be informed.

Thanks

Grateful thanks are due to the Geology Department, Q.U.B. for defraying costs of producing issue No. 1. The Geological Survey kindly included it with one of their circulars which minimised postage costs. Miss Lillian Grigg of the Ulster Museum typed the final manuscript of this issue.

Subscriptions, etc.

I have no copies of No. 1 left (although small quantities could be reprinted at about 40p each). Subscriptions are, at the moment, £1.15 for three issues (January, May and October) including postage. Teachers are invited to buy extra copies for their pupils at 30p each post free. It is hoped that this newsletter will always be not only intelligible but interesting to school children studying 'O' level and 'A' level courses.

Next Issue

This should appear in January. It should contain further articles on the Teaching of Geology, Fermanagh, from the Institutions, and one on the Mourne Mountains.

Letters on any subject will be very welcome.

Ian S. Johnston,
Geology Department,
Queen's University,
Belfast.

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The Belfast Geologists' Society — Winter Programme

Winter Meetings are held on alternate Thursday evenings at 8.00p.m. in the Lecture Theatre, Department of Geology, Q.U.B., Elmwood Avenue.

October	18th	Annual General Meeting.	
November	1st	Field Exhibition and Tea.	
November	15th	Summer Highlights.	
November	29th	Geology in South Africa.	Dr. T.R. Mason.
December	13th	Tertiary Igneous Geology of Rhum.	D.E. Kitchen, B.Sc.
January	10th	Volcanic Landscape Forms.	H.S. Black, M.A.
January	24th	Geology of Oklahoma.	Dr. D.J. Sanderson.
February	7th	Oil and Mineral Exploration.	Dr. D. Naylor.
February	21st	The Presidential Address.	
March	6th	The Precambrian of Eastern Bolivia.	Dr. W.I. Mitchell.
March (Friday)	14th	Etna - Activity and Prediction.	Dr. M.K. Wells.

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Q.U.B. Geological Society — Programme of Lectures, Field Trips, 1979/80

Michaelmas Term

Fresher's Night — Wednesday, 10th October, 8.00p.m. in the Geology Department, Queen's University.
An introduction to the Society: Film and slide show, exhibits of rocks, fossils and minerals. Tea & Biscuits.

Fresher's Field Trip to Co. Louth. Friday 19th - Sunday 21st October.
To Omeath Youth Hostel. Visit to the Kingscourt Gypsum Mine, and the Carboniferous rocks of the Boyne Valley, etc.

Lecture by Professor D.L. Dinely, Bristol University. Wednesday, 15th November. Geology Department, Q.U.B. "Geology in China".

Geological Society Disco. Senior Common Room, Q.U.B. Date to be arranged.

Lecture by Dr. Tom Mason. University of Natal, Durban. Date to be arranged.

Field Trip to the Wicklow Mountains. Friday, 23rd to Sunday 25th November. This includes a trip to Avoca Mine.

Hilary Term

Field Trip to Crohy Head, Co. Donegal. Friday, 1st to Sunday 4th February, 1980.

Lecture by Dr. Juan Watterson. Liverpool University.
Tuesday, 26th February, 1980. Geology Department, Q.U.B.
"Non-rigid plates: Greenland & China".

Lecture by Dr. Paul Mohr. University College, Galway. Tuesday, 5th March, 1980.
"Tertiary Basalt intrusions in Connemara".

Trinity Term

Annual Dinner and Field Trip to Co. Donegal or Co. Sligo.
Friday, 25th to Sunday 27th April. Location to be arranged.

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GROUNDWATER IN NORTHERN IRELAND

Peter Bennett

Clean wholesome water supplies from wells and natural springs have fulfilled an important but unobtrusive role for the population of Ireland for thousands of years. These are the most readily available sources of the enormous volumes of groundwater which occur below ground in a wide variety of porous materials such as sandstones, fissured limestone, sand and gravel.

By about 1875 industry in the Belfast area had begun to drill boreholes down to depths of as much as 200m to pump water from the underlying Sherwood and Permian Sandstones. The heyday of this groundwater source came in the early 1930's when the total quantity of water being abstracted was probably about 33 megalitres per day (Ml/d) or 7.2 million gallons per day. Most of this water was used as boiler feed for steam engines which generated electricity, so when mains electricity became available the boreholes rapidly fell into disuse. Today industrial abstractions in the Belfast area are confined to three mineral water companies, one of which will sell the water (bottled and aerated) to you and Arabs in the Middle East, taking 2 Ml/d at most from the sandstones.

Up to 1947 the only people offering geological advice concerning the siting of boreholes into suitable rocks were the staff of the Geological Department of Queen's University, notably Prof. Charlesworth and J.J. Hartley, who took a keen interest in 'hydrogeology', as the science of groundwater has come to be known. The staff of the Geological Survey of Northern Ireland (GSNI) began to advocate development of groundwater supplies to the Rural and Urban District Councils who were responsible for public water supplies in the years following 1947 when the Survey was established.

The first public borehole supply in Ireland had been established at Lisburn in 1934. This 120m deep, 350mm diameter, hole in Sherwood Sandstone is still yielding 1.5 Ml/d and is now only one of several in the immediate area, the last of which was completed in 1945. The public sector put down very few other holes for another decade until Newtownards Borough Council began using the Sherwood Sandstone between Newtownards and Comber, as well as a superficial sand/gravel aquifer in the drift deposits along the River Enler. During the investigations necessary for these schemes the area of Permian Sandstone shown on the 1:250,000 geological map of N.I. at Comber was discovered - it does not actually outcrop anywhere in the area but itself now yields 4.9 Ml/d.

By 1964 groundwater from sources other than springs was contributing 9 Ml/d to the public water supply province wide. There followed a period when most new groundwater schemes were based on sand/gravel aquifers in river valleys, where large diameter (up to 600mm) bored wells could be constructed at low cost because depths were never much more than 10m. Yields of more than 3 Ml/d have been obtained in this way, but often only by inducing flow through gravel from adjacent rivers.

The hydrogeological work of the GSNI gained impetus when the water supply industry was re-organised in 1973, creating a single 'Water Service' of the DoE responsible for all public water supply (and the quality of our surface water systems and groundwater) throughout the province. The DoE now funds the hydrogeological work of the GSNI, including my own post (bless its soul), so we are now able to undertake investigations on a more regional scale than was feasible when working to local councils.

This allows us to establish the role of groundwater in any particular catchment where new abstractions are contemplated. The relationships between infiltration, groundwater flow and discharge, and surface flows are usually complex and vary continuously throughout the year in response to the prevailing weather conditions. It is essential to elucidate these factors in order that the effects of a proposed groundwater abstraction can be predicted with a reasonable degree of certainty and used to avoid possible disadvantageous consequences. At one extreme a borehole abstraction could dry up spring discharges which sustain river flows in drought conditions and so cause pollution problems, while at the other extreme it is not impossible for groundwater to be completely sealed within the ground and such a source would eventually be completely exhausted if drawn upon.

Investigating underground flow regimes and their inter-connections with surface hydrology is the difficult part of modern day hydrogeology. We now have to drill observation holes to map the natural water table surface in an aquifer and to monitor seasonal fluctuations, often for several years, before constructing production holes. This information, together with chemical studies of groundwater samples and the results of carefully controlled pumping tests during which the effects of pumping on the water table are monitored in observation holes, is used to determine the rate of natural recharge to the aquifer which can be intercepted by a production hole and hence set the abstraction rate to balance. We also have a rough, but very useful, indicator of the age of groundwater nowadays. When nuclear tests commenced in the early 1950's tritium (H^3), a radioactive heavy isotope of hydrogen with a half-life of 12.4 years, was released into the atmosphere in large quantities reaching a very distinct peak concentration in 1953. Water samples can be sent to AERE, Harwell, where tritium content is measured to a level of one part in 10^{18} (at a cost of nearly £100 a time!). If groundwater contains no tritium it must have infiltrated into the ground before 1953, whereas if it does contain tritium there is at least a component of post-1953 rainfall present.

The distribution of our aquifers and the more important borehole abstractions are shown on the two accompanying sketch maps. Most of the abstractions shown are for public supply, which took 28 Ml/d in 1977, along with 23 Ml/d from springs, and 585 Ml/d from surface sources. Various borehole schemes under development

FIG. 1 SOLID ROCK AQUIFERS (CHALK OMITTED)

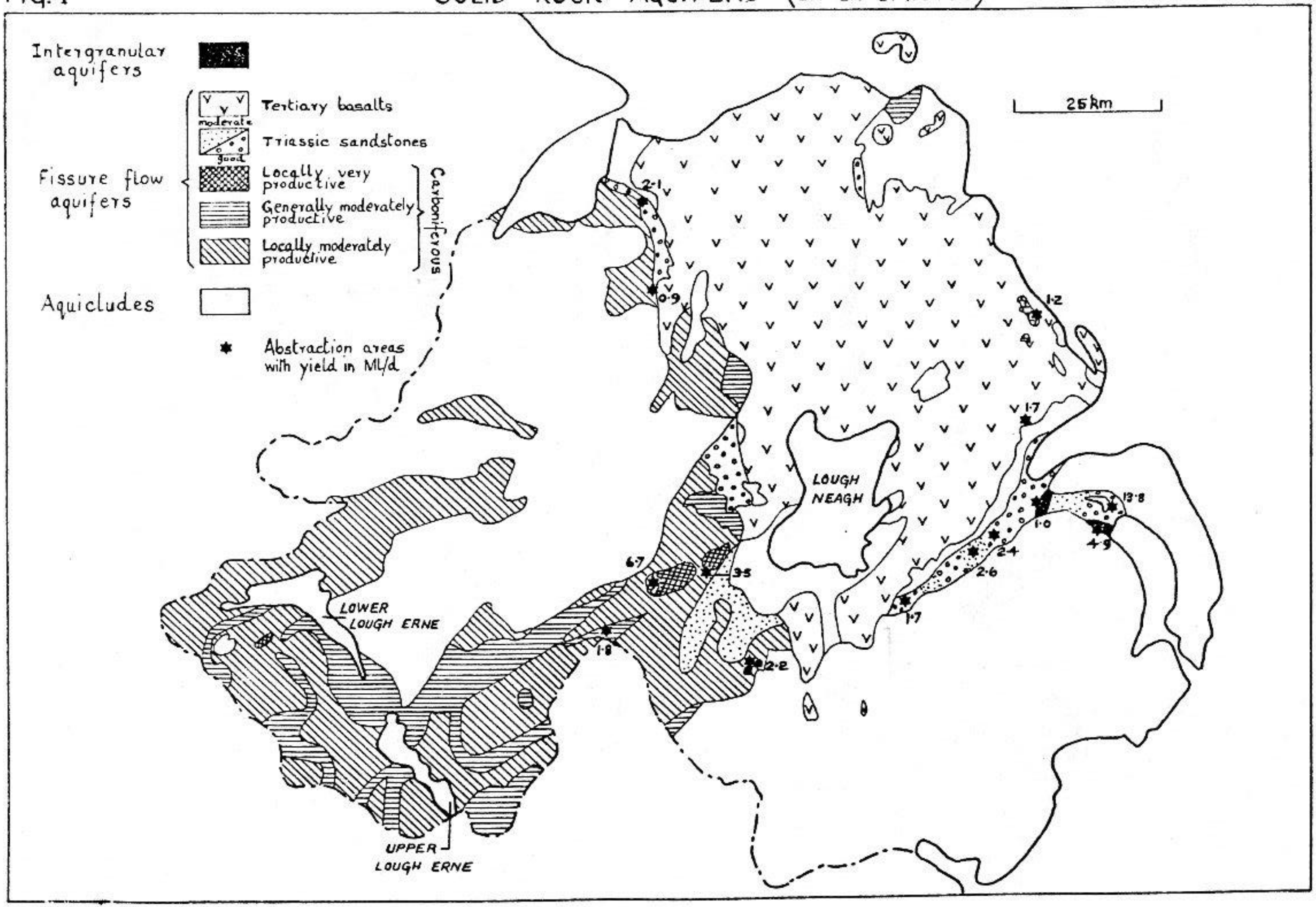
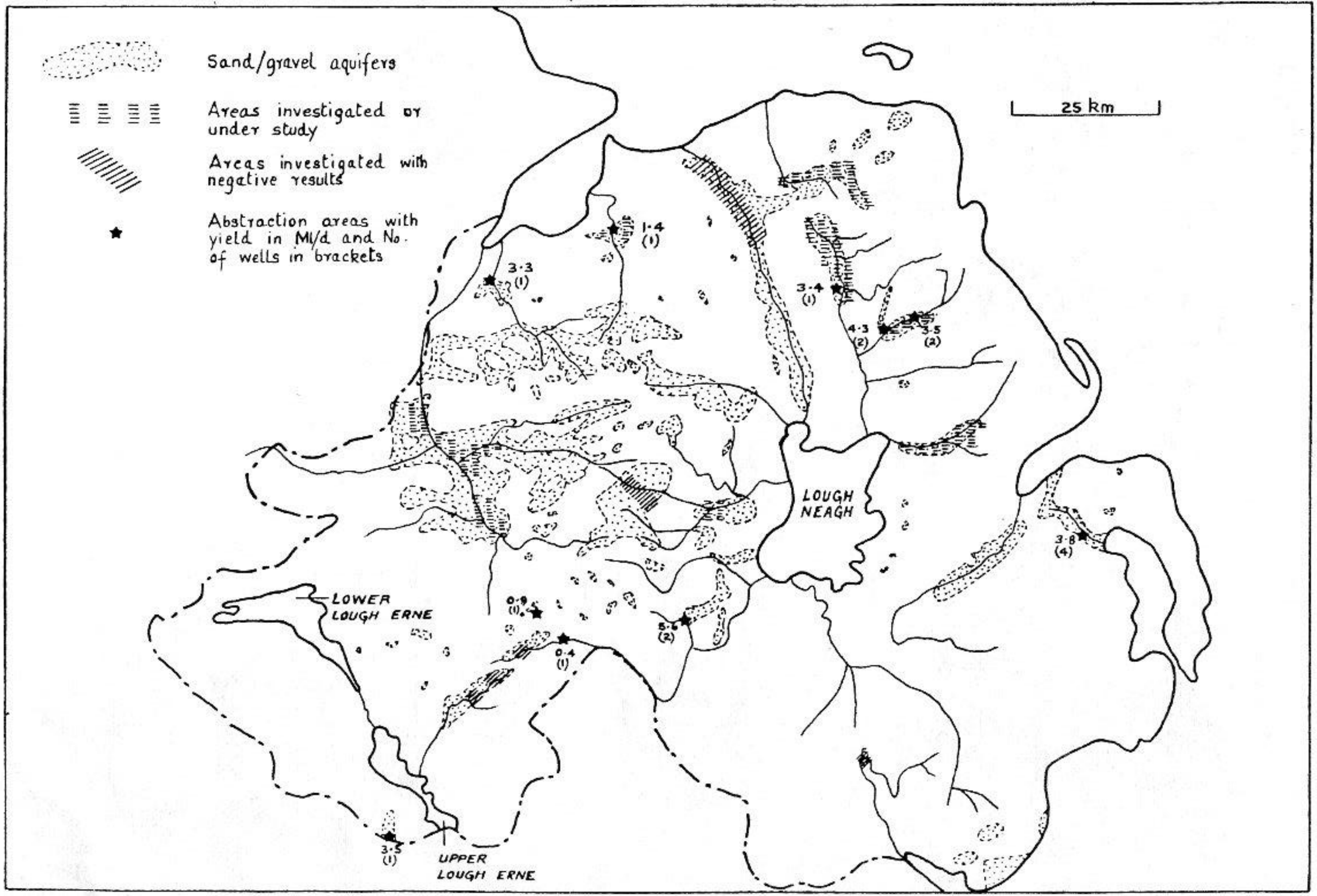


FIG. 2 UNCONSOLIDATED QUATERNARY AQUIFERS



at present are expected to at least double the total groundwater contribution within the next few years. The largest of these is in the area underlain by Sherwood Sandstone between Lisburn and Belfast, where individual borehole yields of about 2.5 Ml/d can be obtained. Another is based on a very open (porous) Carboniferous sandstone outside Armagh city, which was not even known about until 1976 when a mining company drilled small diameter holes during a search for base metals and consistently encountered strong artesian flows from the sandstone layer which is up to 100m thick and occurs within a predominantly limestone succession.

A very prolific sand/gravel aquifer in the upper reaches of the River Main has been investigated and tested in recent years with a view to supplying extra water to the Ballymena area. This fluvioglacial deposit which is up to 15m thick, transmits and stores enormous volumes of water and a single production hole has yielded 3.4 Ml/d, as much as any in Northern Ireland. However, a proportion of this yeild would be at the expense of river flow since spring discharges from the aquifer are reduced by pumping from the borehole, so it has been agreed through a public enquiry that extra boreholes will be constructed and used to pump groundwater directly from the aquifer to the river during dry summer periods, which are the only times when the effect on the river will be significant.

Groundwater abstractions are not licensed here so there is no requirement for industrial concerns to provide returns of their groundwater usage. A large number of companies do still operate their own water boreholes, often to be safe from periodic restrictions on mains supplies in times of drought, but also in some cases where a very pure supply or one with very constant chemistry is needed for a particular process. It is thought that at least 25 Ml/d is abstracted by private industry for on-site use.

Although usage of groundwater is growing steadily in Northern Ireland it will never reach the 30% proportion of the total water supply which pertains in England and Wales. However, the greater mix, as far as type of supply is concerned, which is coming about will allow greater flexibility to meet unusual circumstances. This is a comforting thought if the current predictions by some leading climatologists, that the rather extreme weather conditions we have suffered over the last few years herald the onset of a changed climatic pattern, are true.

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THE GEOLOGY OF SCRABO

G.A.W. Hutchinson

Describing the Ardes Barony of Co. Down in 1683 Wm. Montgomery refers to "the high hill of Scrabo, formerly and now intended for a Deer Park, and therein is the quarrey of the best freestone that may be seen anywhere, if either durableness or smoothness and variety of green veins therein (when pollished) be considered, ye stones whereof are well known in Dublin, and taken thither and elsewhere in great abundance".

Scrabo Hill is one of the most outstanding natural features in the North Down landscape and the Tower on top of the hill emphasises this landmark even more strongly.

The quarries, now disused, together with the hilltop and Killynether Wood are currently being developed by the Conservation Branch of the D.O.E. as a Country Park. Much of the property is included in an Area of Scientific Interest and is of particular interest to the student geologist.

Scrabo Hill consists of a thick sequence of massive-bedded, medium grained, Permo-Triassic sandstones, gently dipping to the N.E. A Tertiary sill of dolerite caps the hill and numerous minor intrusions penetrate the sandstones below. The hill stands out as a positive feature from the surrounding country largely because of this protective igneous rock which has also toughened and metamorphosed the sediments below. The shape of the hill has been modified by glacial action from an E.S.E. direction and as the glacial ground moraine now flanks the lower slopes of the hill. The hill together with the long ridge of glacial deposits on its south-eastern side constitute a well-developed crag and tail feature.

The glaciers were also responsible for the smoothed and polished dolerite surfaces at the hill summit with good ice striae. (See fig. 1).

The sandstone quarries around the hill expose the rotted base of the dolerite sill and several of the transgressive sills below. There are many geological features very well displayed in the South Quarry to the S.E. of the Tower. This provides a 60m section of Bunter sandstone in pale red and pink. It is uniform, medium grained and shows fairly massive cross bedding with about nine thin, dark, red, fine mudstone intercalations. The base of the major sill can be observed at the top of the quarry face. Points of interest for the student are:

1. Cross bedding: this is very well developed and shows a current direction and therefore, sand origin from the south.

2. Ripple-marks: can be seen on sandstone surfaces, particularly on large loose blocks on the quarry floor.

3. Sun-cracks: these structures, both large and small, are well developed in the several thin mudstone beds. The cracks have been filled with sand from the bed above.

4. Dykes: two vertical dykes, dolerite dykes, 1m and 3m thick, cut through the sandstone. They exhibit an advanced stage of sphaeroidal weathering characteristic of such intrusions.

5. Slickensiding: several east to west near vertical joints display highly slickensided surfaces.

6. Contact metamorphism: the effect of contact metamorphism is clearly shown in the quarry. The pink sandstone becomes hard and grey adjacent to the sills and the red mudstones become green, indurated slates.

In addition a volcanic agglomerate, composed principally of sandstone fragments up to several feet across, is exposed high up in the north-west corner of the quarry (see fig. 2). Several small bodies of dolerite have invaded the soft brecciated rock. The margin of this agglomerate-filled vent is well exposed as a steep, north-westerly dipping surface. The bleached sandstone of the vent wall is partly undisturbed but at a few localities it is broken into a coarse breccia. The rock fragments appear to have developed in situ. At two points fine pulverised sandstone has been transported along open joints and left as tuff-dykes. Preston (1962).

Minor intrusions of dolerite cut the agglomerate. The main sill of Scrabo lies undisturbed above the vent.

The vent-wall shows brecciation of the sandstone and similar structures are visible in the quarry wall at other localities. The best example projects from the north face and is bright red due to introduction of ferric oxide.

Two unusual sandstone dykes radiate through the sandstone wall of the vent. One of bright red colour, is closely associated with an explosion breccia. The other

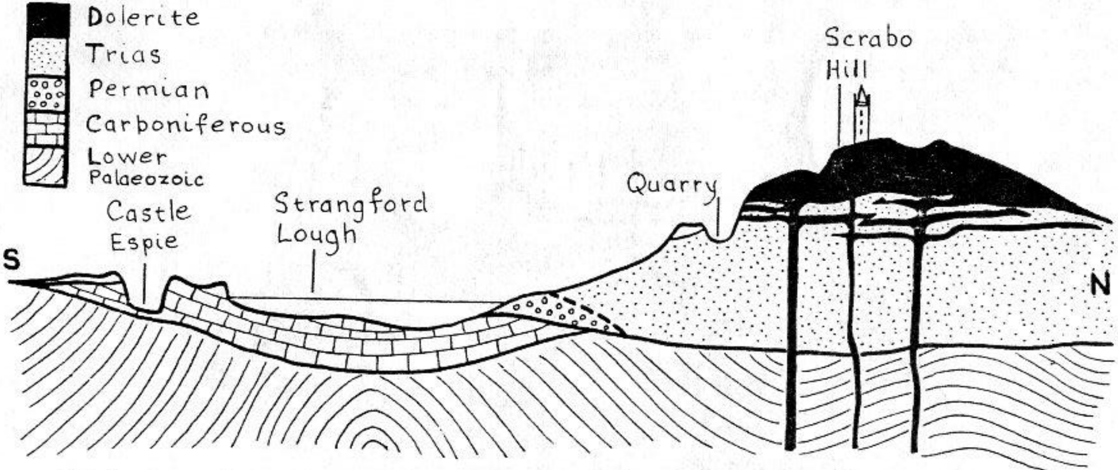

Fig. 1. DIAGRAMMATIC SECTION OF SCRABO HILL AND DISTRICT

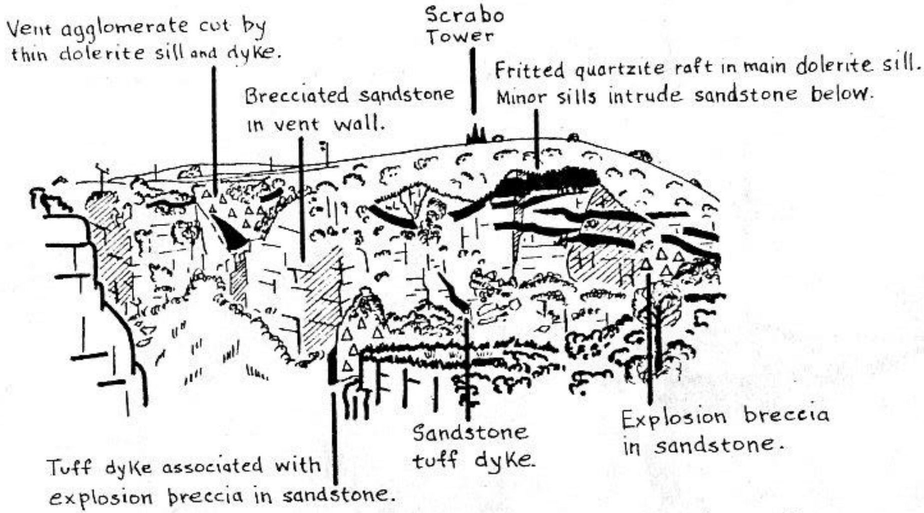

Fig 2. View of the NORTH FACE of the South Quarry in Scrabo Country Park.

fills an open joint several metres to the north (see fig. 2). This is 10cm approximately thick and almost identical in appearance with the wall rock.

The explosion breccias and tuff-dykes are the earliest phases of explosive volcanic activity (Preston 1962, p.50). Individual examples can be proved to be older than the agglomerate. The minor sills and dykes of dolerite were injected at a distinctly later date as they cut and are strongly chilled against the vent agglomerate.

It is interesting to note that an exploratory borehole at Ballyalton, 1 mile to the N.W. of Scrabo South Quarry, showed that the Scrabo Sill Complex is known to be one of the thickest - almost 90m - recorded in the United Kingdom.

The Trias sandstones of Scrabo have been extensively worked to provide building stone, the more massive beds being easily worked. It is easily cut and dressed, making it popular with stone masons. The sandstone is variable in colour and quality and various grades - Scrabo White, Scrabo Pink and Scrabo Red - are recognised in the building trade. Scrabo sandstones have been used, for example, in the Albert Memorial, Belfast, we well as churches throughout the city. The Cistercian monastery at Greyabbey provides an early example - 12th century - of the use of the stone for carving and dressing. The west doorway is a fine example of a late Norman-Pointed Recessed Arch. Several cargoes of the sandstone were shipped to North America - Lewis' Topographical Index (1837). The quarries were working at the time of the 1904 geological resurvey but have since closed due to the competition of the Scottish sandstones.

Development work at Scrabo Country Park has advanced (with the construction of footpaths and two car parks) to enable the public to have access to the area. Scrabo Tower is currently being restored to house a small interpretive centre dealing with geology, local history and land use.

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'A' LEVEL GEOLOGY FIELDWORK

Sam Magowan

The Northern Ireland 'A' Level G.C.E. in Geology was first introduced in 1974. Since its inception a field report written by each candidate and marked out of 20% of the total marks, has been an integral part of that examination.

Fieldwork is an essential part of Geology and therefore requires careful consideration by the teacher upon introducing it to his or her pupils. These are some of my own ideas on how to tackle this problem.

I believe the qualities we are trying to test in fieldwork are four-fold.

The ability:-

1. to observe
2. to record accurately features observed
3. to interpret what one has recorded
4. to recognise further projects necessary to solve an encountered problem.

These abilities tend to be found in most science subjects under the umbrella of the "scientific method". Therefore in any geological field report I would expect the following five points to be found.

1. A mapping exercise - the recording of the geology of an outcrop whether it be horizontal, vertical or dipping.

2. Evidence of fieldwork skills - these would include:

   (i) accurate and relevant observation, collecting of specimens and recording of information.

   (ii) the proper and discriminate use of equipment, e.g. hammers.

3. Evidence of accurate measurements and analysis including:

   (i) the logging of successions

   (ii) the measuring of angles, e.g. strike and dips, joints, crossbedding, thickness, etc.

   (iii) the statistical analysis of data e.g., mean, standard deviation, stereograms, matricies, etc.

4. Evidence of accurate description and analysis including:

   (i) the relationship between geomorphology, vegetation and geology.

   (ii) annotated field-sketching.

5. Careful interpretation and neat presentation including:

   (i) the interpretation of the data from No. 3 above.

   (ii) the use of appropriate sources of information.

After returning from the five consecutive-day field trip stipulated by the G.C.E. Board, I encourage my own pupils to pick a location for their own individual fieldwork project. They should try and select an area:-

near their own home, or

near a relative's home, or

a reasonably accessible site.

Having attempted to select an area several warnings might be given:-

1. Do not be too ambitious - it is better to do accurate logical work than to rush senselessly around a large area to find an "original" result.

2. Do not choose too small an area.

3. Try not to choose an area which often appears in the literature - if you do, treat it in a different way.

The candidate, in attempting a geological investigation should set her or himself five successive goals.

STAGE 1

Decide upon the aims and objectives, if possible, of the report. In most cases the aim will be to study the geology of an area whilst the objectives may be smaller, more defined projects within the main area.

STAGE 2

Draw a geological map or section of the area. The candidate should move from one rock outcrop to the next recording the strike and dip (if sedimentary) of the rocks. Recordings should be taken every 2 or 3 metres along the bedding planes as well as up and down the succession. At each location the rock type and structures should be described, possibly using a previously prepared set of questions. If the same rock occurs at the next location state "same" and move on.

From the information gathered, the map, including rock boundaries, unconformities, fault planes, etc., may be drawn.

STAGE 3

Describe in detail the major rock types, succession, folding, faulting and other structures, geomorphology and geological history.

STAGE 4

Having been across the area in detail, the candidate should be prepared to select some part of the geology for further investigation. (Pebble counts; mineral counts; sorting; pebble shape, roundness or sphericity; orientation of particles, planes or fossils; crystal size and shape; distribution of amygdales; etc).

STAGE 5

The report should then be assembled including a contents page which might read as follows:-

1. Aims and objectives of the report.
2. Location of field area.
3. History of geological study in the area chosen.
4. Geological map.
5. Description of the geology of the area.
6. Description of a particular topic or problem investigated.
7. Results obtained.
8. Display of results and/or statistics carried out on them.
9. Conclusions reached.
10. Bibliography.

These are some important points which I hope will encourage a scientific approach to the preparation of 'A' Level field reports in Geology. At least, I trust, they will increase the enjoyment of the study of the subject.

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THE HISTORY OF GEOLOGY IN NORTHERN IRELAND

Norman E. Butcher

Ever since the emergence of modern Geology at the beginning of the 19th century, it has been characteristic of geologists, professional and amateur alike, to organise themselves into local societies in which most of their communication, verbal and printed, has gone on. Thus the first four geological societies to be established in the British Isles, were, perhaps not surprisingly, those in London (1807), Penzance for Cornwall (1814), Dublin (1831) and Edinburgh (1834). At the present time, in the plate-tectonic era of Earth Sciences, we still see the setting up of new societies, filling in geographical gaps and embarking, as are the established societies, on new activities to cater for the increasing thirst for geological knowledge.

I therefore readily accepted an invitation to write a short article for this new venture of Northern Irish geology, because one has only to make one or two visits to Ulster to realise what a wealth of geological interest it contains. This is summarised in spectacular form in the 1:250,000 Geological Map of Northern Ireland published by the Survey in 1977. But interest is not confined to the field, nor to present-day laboratory work and publications. Already, the first issue of this newsletter reveals what a wealth of material resides in the Ulster Museum and a glance at the Bibliography in the Regional Geology of Northern Ireland (1972) shows the range of the literature over the years. Naturally, in more modern times, attention has focussed on particular topics such as the glacial geology or the Tertiary lavas and intrusions, to name but two, and it is interesting to see the association of particular names with such topics.

But I would like to concern myself here more with the early days of geology in Northern Ireland and the immediate question which arises: can one recognise an Irish School of Geology, in the way that there seems to have existed rather distinctive English and Scottish schools, as argued by Roy Porter in his book, The Making of Geology (1977). On the face of it, it seems rather curious that, despite the many wonderful features to be seen, no particular Irish school seems to have developed.

One of the first accounts of the geology of Northern Ireland is that of J.F. Berger, published in London in 1816 in the third volume of the Transactions of the Geological Society. Berger was a native of Switzerland who seems to have accomplished in Northern Ireland what L.A. Necker, also a Swiss geologist, did in Scotland. Thus we see in this volume, albeit on a smaller scale than Necker's map, the first geological map of the whole of Northern Ireland. The map, forming Plate 9, shows the geological connection between the west of Scotland and the north-east of Ireland and on it five divisions are recognised by different colours:- 1. Granite. 2. District in which Mica Slate prevails. 3. District in which Greywacke prevails. 4. District occupied by the Coal formation and Sandstone and Limestone formations associated with it. 5. Floetz trap.
A larger scale map forming Plate 8 is notable for showing so clearly the edge of the Antrim lava plateau and the outcrop of the underlying Chalk. Berger's notes, which were read to the Society on April 15th, 1814, were added to by Conybeare who, with Buckland, made a tour of the coastal sections in the summer of 1813. Hence we see the famous Murlough Bay section beautifully shown on Plate 10.

Undoubtedly, of course, the greatest figure in Irish geology in the first part of the nineteenth century was Richard John Griffith (1784 - 1878) and I see from the first issue of this newsletter that the Ulster Museum possesses three editions of his great Geological Map of Ireland. So far as I know, only in the Department of Geology of Imperial College in London is it possible to see, framed and mounted on a wall, all three of the great pioneer geological maps of the British Isles - William Smith's (1815) map of England and Wales, with part of Scotland, John Macculloch's (1836) map and Scotland and Richard Griffith's (1839) map of Ireland. Of course, Smith's map was unique in its method of colouring, but Griffith's map, too, is of considerable cartographic interest. The recent detailed study in Imago Mundi (1977) by Professor Gordon Davies of Trinity College, Dublin, of the various issues of Griffith's map between 1839 and 1855 should lead to a much greater appreciation of this very fine map. It is interesting that uncoloured copies of the 1855 version could still be bought at the original 1839 price of £1.00 until the 1930's! Griffith's monumental work in Ireland arose largely out of his duties as a mining engineer and Commissioner of Valuation.

When I was searching for material to include in an exhibition on the history and development of geological cartography, mounted in the University Library at Reading in 1967, I was forunate to come across a small item in the library of the Institute of Geological Sciences in London. This was a printed 'Table of Letters and Colours by which the Rocks and Strata of most ordinary occurrence will be expressed' and was signed by Lt. Col. Thomas Colby, Superintendent of the Ordnance Survey, and dated April 9th, 1830. Of course, this pre-dates the earliest work of De la Beche in south-west England which led to the formation of the Geological Survey of Great Britain in 1835, so that it probably relates to the much earlier work in Ireland. Indeed, Gordon Davies has shown that Colby inaugurated an Ordnance Geological Survey of Ireland as early as 1824, the first official geological survey in the British Isles.

From 1826, the Irish work was directed by Capt. John Pringle whose successor, Capt. Joseph Portlock, revived the work in 1830 after a two-year lapse. Although some maps and sections from the earlier years have survived, undoubtedly the most famous work resulting from this Irish Survey is the classic Report on the Geology of the County of Londonderry, and of parts of Tyrone and Fermanagh by Capt. Portlock, published in Dublin in 1843. Until the 1950's, it was still possible to buy copies of this great volume of 784 pages, with its many plates of fossils and marvellous hand-coloured map and sections, for the remaindered price of just two shillings from a bookseller in Belfast!

Inevitably, the Report invites comparison with De la Beche's Report on the Geology of Cornwell, Devon and West Somerset (1839), also a monumental work. Both, as frontispiece, include an Index to the Ordnance Geological Maps, hand-coloured and printed by the same lithographer in London, Standidge & Co. The Index map to Portlock's work is admittedly on a larger scale, but it is altogether a vastly superior map from a cartographic point of view. One notable feature, which so far as I know is unique at this time, is that the actual positions of exposed rocks are indicated within the area of outcrop of each stratigraphical formation or other rock type. The map and sections are the work of Portlock's chief assistant and draughtsman, Thomas Oldham, who later in life was to become Director of the Geological Survey of India.

In conclusion ,then, it would seem that it was in setting high standards of mapping and general geological survey work that geology in Northern Ireland made its most notable contribution in these early days. An appreciation of this pioneer work helps us to see our present endeavours in the field and laboratory in true perspective, and stimulates us to search our libraries and museums, too, for gems of earth science.

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THE CARBONIFEROUS ROCKS OF WEST FERMANAGH - A FIELD ITINERARY

Tom R. Mason

The mountains and lakes of west Fermanagh provide an attractive recreational area. The visiting geologist can combine business with pleasure as the region is also one of the best in Ireland for the study of Carboniferous rocks.

The purpose of this article is to provide information on where the best localities are to be found and to provide ancillary data for further study and description of the Fermanagh rocks. Prospective visitors will find the one-inch Ordnance Survey sheets 4 and 7 helpful when planning their trip. The localities described are shown on the sketch map (fig. 1) and an itinerary may be constructed to suit the part concerned. As it is likely that most visits will commence from Enniskillen the localities are given in order, with those closest to Enniskillen being described first. Two recent papers are given as references, and they contain the most up to date information on the geology. One of the papers also contains a geological map of west Fermanagh.

Locality 1. Carrickreagh Bay.

Quarries by the roadside, on the southern shore of Upper Lough Erne, approximately six miles from Enniskillen. The oldest limestone in the rock sequence, the Ballyshannon Limestone, is found here. It is well bedded, poorly fossiliferous (Syringopora, Pustula), and stylolites are common. It contains no chert.

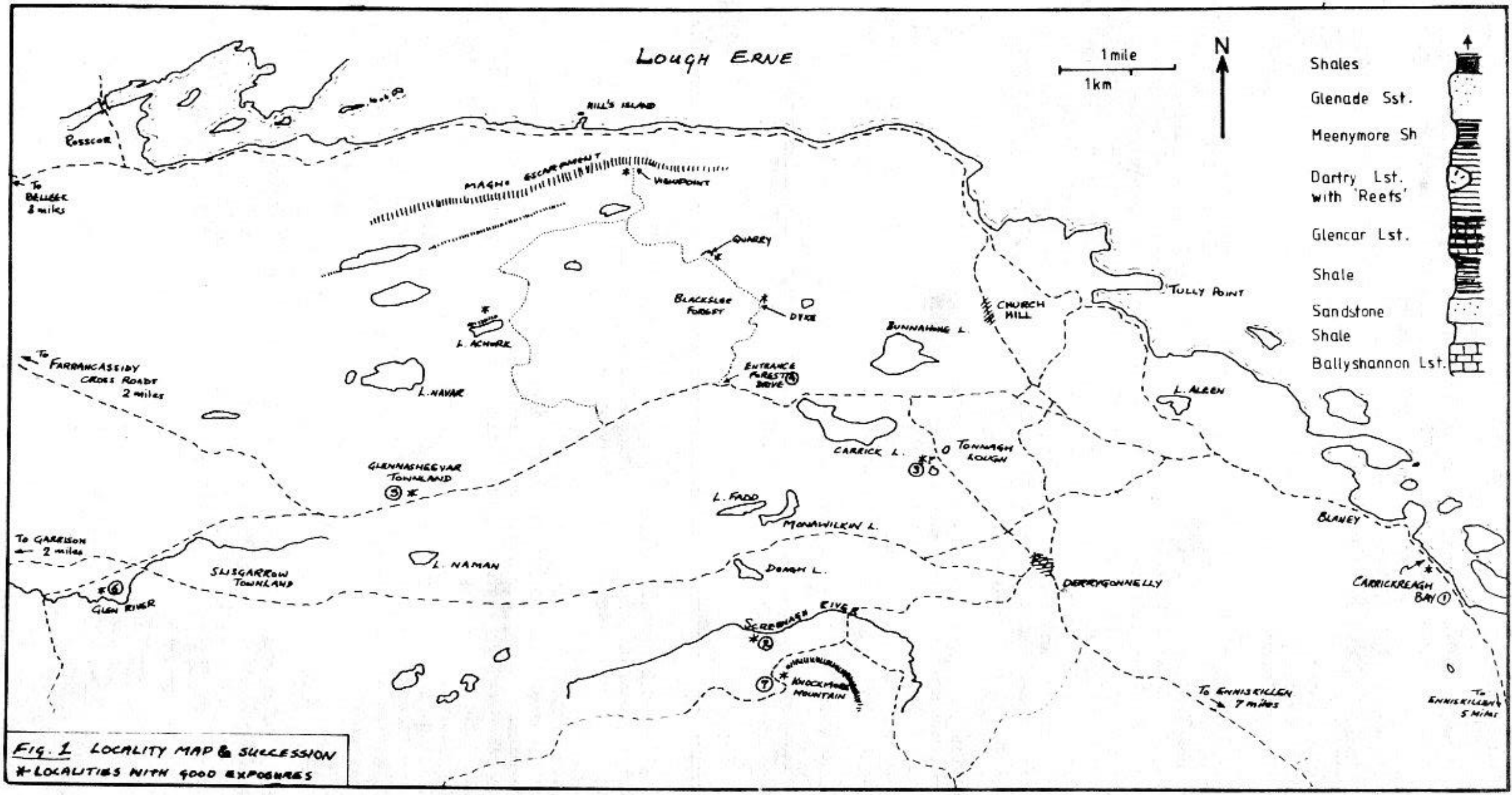

Fig. 1 LOCALITY MAP & SUCCESSION

* LOCALITIES WITH GOOD EXPOSURES

Locality 2. Screenagh River.

It is suggested that this be an optional stop for those parties primarily composed of the young, fit and enthusiastic. In Buggan Townland the Screenagh River cuts a gorge through the Dartry and Glencar Limestones, and produces the best exposures of the Glencar Limestone in west Fermanagh. A strenuous walk is necessary to see the outcrops in the river. Typical limestone-shale alternations are well exposed and fossils are relatively common. (As an alternative to this locality, those parties having more time at their disposal should try to visit the Sligo coastline from Streedagh Point southwest to Drumcliff Bay. Glencar Lough is also sited in the midst of spectacular limestone mountains of Glencar and Dartry age.)

Locality 3. Tonnagh Lough.

About two miles west of Derrygonnelly village a fault has brought Dartry Limestone 'reef' facies to the surface. Carboniferous 'reefs' were actually mud mounds on the sea floor, stabilised by a varied fauna dominated by bryozoans (Fenestella), brachiopods and crinoids. The rock is well exposed in a small quarry south of the road. Samples of calcite may be collected from cavities in the 'reef' limestone. Note the poorly developed bedding and the general lack of stratification which is typical of this facies.

Locality 4. Blackslee Forest and the Forest Drive.

This subdivision of Lough Navar Forest is found near the entrance to the Forest Drive which is on the north side of the road from Blaney (H144536) to Glennasheevar. The Forest Drive passes excellent exposures of a composite Tertiary dolerite dyke. The dyke is intruded along a fault and is associated with small scale faults and contact metamorphic effects. It is best seen at H080557. Further along the drive the road turns sharply west and nearby there is a large quarry in the Dartry Limestone. This quarry is intermittently worked by the Forestry Division and access may sometimes be restricted. It contains good exposures of the cherty facies of the Dartry Limestone. Small pyritised chonetid brachiopods and the genus Spirifer are common.

The Forest Drive eventually leads to a viewpoint on top of the Magho escarpment. Most of the west Fermanagh succession is visible from this point. On the escarpment itself, the gentle slopes along the Lough Erne shore are on the poorly exposed Benbulben Shale while the steeper cliffs above are formed from the Glencar and Dartry Limestones. Turning around to the south various sandstone escarpments of the Glenade Sandstone form prominent features and the more rounded shapes of Carrick Reef and Knockmore are formed by Dartry 'reef' Limestones.

The Magho is also impressive when viewed from the lough shore road, and immediately below the viewpoint there is a small roadside car park from which it is possible to climb to the top of the escarpment. The car park is near Hill's Island (H055585).

Leaving the Forest Drive entails passing numerous sandstone escarpments. They are deltaic sandstones of the Glenade Sandstone and the easiest access is at Lough Achork. (N.B. The Forest Drive is one way traffic from the entrance to the exit at Glennasheevar.)

Locality 5. Glennasheevar.

Glennasheevar Townland is mostly poorly drained boggy grassland reflecting the change in the underlying rock type. The suggested stop here shows, within a small area, a variety of different rocks. Vehicles should be parked in a roadside quarry on the north side of the road (H035532). A low hill north of the quarry is formed by an outlier of the Garrison Sill. Contact metamorphic effects may be seen at the base of the sill. A larger exposure of the main crop of this sill occurs in a quarry at Slisgarrow (H015516).

South of the Glennasheevar road a stream forms a waterfall over sandstone. The same sandstone is exposed in the quarry where the vehicles have been parked, and it contains cross bedding and other sedimentary structures. Below the sandstone various limestone and shaly units are found and they are part of the shaly Meenymore Formation. Occasional fossils may be found in the shales. Lower in this sequence a fine grained limestone contains fossil cephalopods. Goniatites are difficult to extract from this rock and teachers are asked to ensure that their students do not use their hammers on the outcrop. This is generally applicable to most geological sites as the pressure on them from field parties increases. It is easier to see features on naturally weathered surfaces than on small chips of rock debris randomly removed from the outcrop. Fossils are usually best collected from that material which has already fallen from the outcrop due to natural weathering.

Some of the limestones in these exposures exhibit flat laminations characteristic of algal sedimentation.

Locality 6. Glen River.

From Glen Bridge (G991521) downstream towards Lough Melvin, scattered outcrops of shales and limestones of the Meenymore Formation occur. Some of them contain euhedral iron pyrites crystals. In addition, some of these rocks show evidence of the former existence of evaporites with irregular cavities in the rock filled with replacement minerals such as quartz. The best locality to see these features is on a bend on the river less than one mile from the road (H987517). High water may hinder collection at this site.

Locality 7. Knockmore Reef.

This locality is worth an entire day's visit. Knockmore Reef forms a prominent landmark to the southwest of Derrygonnelly village and roads lead up to it on two separate sides. The route leading up to the northerly face is recommended as it enables easier access to the central part of the complex.

Features which may be observed around the reef include: karst weathering features, clints, grykes and limestone pavement; reef breccia, reef core, reef cover, coral colonies in growth position (Lithostrotion), and abundant fossils of many different phyla. The reef is dissected by faults and both chert and reef facies of the Dartry Limestone are present.

Two references are given which describe the geology of the west Fermanagh area and discuss its relationship with the surrounding areas.

BRUNTON, C.H.C. & MASON, T.R. Palaeoenvironments and correlations of the Carboniferous rocks in west Fermanagh, Ireland. (1979). Bull. Brit. Mus. (Nat. Hist.) 32, 2, p.91 - 108.

BRANDON, A. The Meenymore Formation - an extensive intertidal evaporitic formation in the Upper Visean (B_2) of north-west Ireland. Rep. Inst. Geol. Sci. 77/23 14pp.

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THE ULSTER MUSEUM GEOLOGICAL SITE RECORDING IN NORTHERN IRELAND

P.S. Doughty

"North-west of Rhone Hill a quarter mile, near the crossroads, is the quarry, now filled up, so well known for its exceptional yield of Palaeoniscus catopterus. These were obtained from the lower-most beds in the quarry, the slabs in most cases completely covered with the perfect remains of these fishes. When first discovered they were highly prized as ornamental objects or "curiosities", and a good-sized slab would readily bring £5." So it was that E.T. Hardman described one of Ulster's most famous quarries in 1877. It is now extremely difficult to be certain whether the hummocks in the field corner represent the locality or not. We do not know the fish bed's exact horizon in the Triassic and without extensive new cutting in the area we never shall: there is now no outcrop.

In 1843, in Portlock's Report a mineral called doranite was described with an analysis conducted by Dr. T. Thomson. "This Zeolitic mineral from Antrim, Dr. Thomson has dedicated to Mr. Patrick Doran, formerly one of the collectors of the survey." That is all the locality information given, and the reference to the enigmatic Mr. Doran is of little further help because Doran was a man of humble origins and there is no surviving archive linked with his name. The soundness of this species is now challenged but where do we collect more?

Caninia benburbensis is a Lewis species published in 1927 and it is one of our commonest and largest Irish Lower Carboniferous solitary corals. Uncharacteristically Lewis's description of the type locality is particularly loose. "In Ireland, the species, including the holotype, occurs in beds of unknown horizons at Benburb (Co. Tyrone)." I now believe that we can attribute a stage and assemblage zone to his material but we do not know at what level the holotype was collected.

These are just three examples off-the-cuff, of situations known and well understood by almost all practising geologists, and much time and energy goes into attempting solutions to the problems created by these kinds of imprecise data. Alas, in most cases there is no answer.

On the other hand, had these localities been better localised and the information broadcast more widely, would they have survived the onslaught of several generations of school parties, amateur and professional collectors and undergraduates? It is not intended as a rhetorical question but I fear there is no precise reply. The fish locality and perhaps even the zeolite occurrence may have needed some form of protection. The area of the coral locality would not have deteriorated seriously short of blasting or mining.

The examples serve to illustrate the fragility of the material base of our science and although much work has been undertaken by the Nature Reserves Committee in our defence, they deserve a much wider body of support and professional co-operation than they have yet received. But there is also a need for the widening of site recording beyond their brief to build up an extensive file of localities to give geological excursion parties the widest selection of sites from which to choose. In this way damage to the "classic" Ulster sites can be prevented and if the file of alternatives is large enough, it is unlikely that any one will be placed at serious risk through overuse. Mrs. P.M. Thomlinson's guide to field study sites (1975) was a welcome, though controversial, lead in real use, but it covers all field science and mentions only 102 geological localities. Designed basically as a guide for teachers, it suffers from descriptions too brief to be of use in planning experienced excursions intended to illustrate curriculum points, and its coverage of some areas reflects a lack of consultation with professional and post-graduate research geologists. For example 3 listed geological localities known to me are within a quarter of a mile of bigger and better unmentioned sites of the same sort which could be exploited without limitations on hammering and collecting. There is no equivalent guide for higher educational use, and no geological archive which can be easily and quickly searched by anyone needing professional or commercial information.

The threats to our localities are legion, and not just the result of over-hammering or collecting by groups or individuals. Dumping, quarry-filling, flooding, vegetation and scree cover and general land improvement and development all take their toll. Some policy is needed to ensure that the key localities for research, educational and general amenity use are recognised, preserved and managed. Because future interests can never be accurately foretold there is also a need for recording the localities which will succumb for whatever reason. None of this can be achieved without a more serious effort to compile and maintain records than has ever been attempted so far, but any scheme should be standardized, and nation-wide to give full benefits.

The National Scheme for Geological Site Documentation.

In fact, such a scheme exists. In 1975 the Nature Conservancy Council proposed a conference entitled "Field Facilities for Geological Education" which was to be held on May 8th in London. Quite independently in the previous year, the Geological Curators' Group (G.C.G.), a specialist group of the Geological Society of London, had accepted a constitutional responsibility for "advancement of the documentation and conservation of geological sites" and had proposed its own meeting in the Spring of 1975. When the duplication was appreciated interests were pooled.

The London conference dramatically demonstrated the problems of overuse of sites, with only 2%, most already designated and scheduled as sites of scientific significance, bearing the brunt of educational use. The urgent need for documenting further sites was obvious, and it emerged that some kind of infrastructure would be necessary to ensure that records were readily available for consultation, with advice on specific localities and problems. It was concluded that museums were the most appropriate centres for such records and that possible developments should be the subject of a G.C.G. meeting in the following September.

In the meantime a working party was established with representation from N.C.C., universities, county councils, museums, naturalists trusts and academic societies to prepare ground for the G.C.G. meeting in Sheffield in September.

Another independent development had an important bearing on the scheme. The Information Retrieval Group of the Museums Association (IRGMA) which had been developing a documentation system for all museum subjects since 1967 called a meeting on May 2nd, 1975, involving geologists, biologists and archaeologists to discuss site documentation. The conclusion of the meeting was a parochial viewpoint from each subject area, opposing the development of a single unified recording format. This probably sprang from the difficulty, even in the mid 70's, of grasping the principles underlying the structuring of records for computerization. Despite this outcome I.R.G.M.A. staff were convinced of the basic soundness of their system and "decided to aim for a single system for recording all localities irrespective of subject interest", a view subsequently vindicated.

The G.C.G. meeting in Sheffield in September, 1975 sought to identify the information requirements of site users, to investigate the possibility, working in collaboration with the Nature Conservancy Council, of establishing regional museum centres for the acquisition, storage and dissemination of information relating to sites, and in co-operation with IRGMA to design and test a suitable record format for manual and computer use. There was significant progress in all these fields and with a clear programme established, responsibility for developing the scheme was placed with G.C.G.

Subsequently the information requirements were precisely defined, a draft record card for use by curators and geologists was designed by IRGMA and circulated for testing, and by 1977 in revised form the Locality Field Card (1977 - 78) was published by the Museums Documentation Association (IRGMA's successor) under a G.C.G/Museums Association joint copyright. Eventually a list of U.K. regional museum record centres was agreed and the only Northern Ireland centre is the Ulster Museum, the sole Irish museum with geological staff.

Operating the Scheme in Northern Ireland.

The role of a Record Centre is not that of undertaking a scheme to ensure a comprehensive site record of its area from its own resources. In Northern Ireland with only one centre that would be impossible. The centre exists to provide information on recording, recording media, and instructions on their use; to act as a centre for the collation of completed records; and to provide information for site users of all kinds based on the records.

The first of these, providing recording media and instructions, was originally to be financed through N.C.C. grants and the initial batch of record cards was produced in this way for distribution to centres. Spending cuts began to bite in this area almost before they were heard of elsewhere. Although N.C.C. retain a central interest in the Scheme, the support from them is now purely moral. In these circumstances there are bound to be financial uncertainties but the Ulster Museum is prepared to supply record cards now to anyone interested in the project and instructions for their completion with specimen records when they become available in January of 1980. If the demand exceeds the resources of the Geology Department of the Museum, which has itself suffered very heavy financial cuts, some alternative way of financing will have to be found, perhaps requiring a modest investment from recorders, but it is hoped that costs can be contained centrally.

The Museum is well placed to accept completed records and the preparation and organization of files should present few problems except in the unlikely event of a deluge of information arriving at a time of peak activity in the Museum on another project.

One aspect of submitting records to such a scheme deserves very careful consideration. Although the vast majority of records are likely to be of the kind where restrictions will affect the use of the site and not the people given access, there are bound to be some, of such over-riding scientific importance, and subject to such threats, that it would be unwise to make their existence widely known. Such sites as small outcrops with unique and desirable faunal elements, for example, fish remains, trilobites and well preserved crinoid calyces would be at immediate risk if information on their whereabouts was generally available, as would mineral localities of similar kind. There is a strong case for such sites to be placed on a restricted or confidential register and access permitted only on terms agreed with the recorder or expert opinion in the particular groups concerned. All experience of unrestricted access to scientifically important sites teaches us that the days of trust and respect in these matters have melted before the acquisitive or commercial obsessions of a few individuals.

The distribution of information is another field where a museum is well placed to serve. As a public institution open to the public seven days a week and manned by professional staff for five of those, access is as good as one is likely to get anywhere, and telephone and written enquiries are an established part of the daily routine. Initially files would be compiled as card indexes, but when records exceed a few hundred in number, or when searching for particular needs emerged as a time consuming problem, the records will be computerized and the searches conducted automatically. It is hoped in this way to be able to exploit all information no matter how obscure and to disseminate it widely and quickly.

Most users of geological site records are educationalists, school children, students, teachers, lecturers and professional geologists, and the Scheme was specifically designed to alleviate their problems,invariably different but on analysis rarely conflicting. However, as the records build into a useful statement on Ulster geology it can also become a useful planning tool and an early warning system in the field of land development. In Britain, there are now a few county areas where the planning authorities consult a variety of recording bodies, botanical and zoological as well as geological, in the earliest planning stages of projects before firm proposals for development emerge. It then allows professional opinion to gauge threats to sites and to examine alternatives in the case where particular uncommon features appear to be involved. Rarely have major problems arisen, but the process has led to successful opposition to some proposals, and in other cases has given sufficient warning of the destruction of specialised localities for heavy collecting of materials for deposition in public collections to be allowed before the excavators moved in.

Organised Recording Groups.

It is hoped that the Scheme will offer the same challenge to both amateur and professional geologists that the Botanical Society of the British Isles botanical mapping scheme offered to botanists in the 1960's where individuals and groups accepted responsibility for given areas and 10km squares on the grid, and work proceeded with enthusiasm and tangible results.

The only organised Recording Group at the present time is a small one based on the Ulster Museum Geology Department, a development from a Queen's University Extra-Mural class almost all of whose members started four years before without any geological knowledge. The Group has limited membership due to the space restrictions and the consequent restricted facilities in the Museum's Geology Department, but there are still around eight to ten vacancies for amateurs who have a useful working knowledge of basic geology and good field experience.

It is hoped that similar groups might develop elsewhere, but there is a great need for individual geologists to contribute to this pool of information on a long-term basis. Only by widespread interest, but particularly professional involvement to present information and assess sites, can the Scheme reach the level of usefulness achieved in some parts of the U.K.

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Anyone interested in joining the Ulster Museum Geological Recording Group should contact John Wilson in the Geology Department (Belfast 668351/5, Ext. 46) who will provide details and a programme.

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THE OPEN UNIVERSITY GEOLOGICAL SOCIETY

Founded in 1972 as the outcome of discussions at the first O.U. Geology Summer School at Leeds, the OUGS is the oldest of the student societies in the Open University. Present membership is around 500, with thirteen branches throughout the United Kingdom, though regretably lack of student numbers has up till now prevented a viable branch being established in Northern Ireland.

However, the continued increase in the total number of students and former students in the region has changed the position, and a local branch is in the process of being formed. It should be pointed out at this stage that although the Society was formed in the first place for O.U. students and with the primary objective of ensuring the provision of on-going and self-perpetuating study and self-help groups at local level, membership is open, on an associate basis, to members of the general public - and indeed members of extra-mural geology classes and other keen amateurs will be particularly welcome.

It is intended that branch activities will follow the usual line; a film and lecture programme in the winter followed by a series of field trips in the summer months. In addition, members will of course be welcome to take part in the activities organized by other branches where this is practicable, to take part in the activities organized at national level - such as the annual conference and various extended field trips, and will receive the Society's Journal and Newsletter.

Extended field trips have in recent years been organized to visit such places as Skye, Arran (regularly!), S. Ireland, S.E. Iceland, Brittany and Elba, and during the coming year it is hoped to have visits to Cornwell, Grenoble ..... and Arran.

The annual subscription is at present £2.00, and further details may be obtained either by writing to the Hon. National Secretary, Mrs. V. Glass, 17, Kenwyn, Carrick Way, Wollaton, Nottingham, NG8 2HZ (enclose S.A.E., please), or by ringing the Regional Organizer, Mrs. Elaine Murphy, at Antrim 2114, Ext. 339 (day).

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BOOK NEWS

Invertebrate Palaeontology and Evolution by E.N.K. Clarkson, George Allen and Unwin. £7.95. (Soft).

This is an advanced book but is none the less very much recommended as it covers each fossil group from scratch and includes its biology, ecology and evolution as well as the usual morphology and classification. Each section usually ends with some interesting 'case histories' and the diagrams are particularly good.

A Dynamic Stratigraphy of the British Isles by R. Anderton et. al. George Allen and Unwin £7.95 (Soft).

This is another advanced book tackling stratigraphy from a crustal evolution point of view. It is concise, up to date and packed with diagrams and should be a very useful reference book. Some of the examples given may possibly have been included a little uncritically. However, I find it easier to read and understand than some of its predecessors.

Correspondence and Subscriptions to Geology in Northern Ireland.

All correspondence and subscriptions should be sent to:

Ian S. Johnston,
Department of Geology,
Queen's University,
Belfast.

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