BULLETIN No. 6.

FIELDTRIP TO CORNWALL AND SOUTH DEVON, SEPTEMBER 1968.

The primary object of the fieldtrip to Cornwall and South Devon on 14-19 September1968 was to visit the St. Erth Beds (near Hayle, Cornwall), the fauna of which is probably of Crag age (s.l.). Two members had visited the site on a previous occasion.

Informal discussions were held and it was decided to travel by van and to camp at our destination. Two vans (a 15-cwt. and a 5-cwt.) were available and tents and cooking equipment were hired from the Ipswich Education Office (Mr. Britten of their staff was most helpful), supplemented by members equipment. A meeting was held a few days before departure, and members were given the itinerary and a list of personal and domestic items thought desirable. Each person was also required to bring a certain amount of food, e,g. jam, baked beans, butter, sugar, tinned meat - this was given with enough generosity that our estimated food bills were to be cut considerably. A tent-pitching practise was held the day before leaving. Nine people (Messrs. C. Garrod, P. Grainger, T. Jones, S. MacFarlane and R. Markham, and the Misses P. Cresswell M. Daniels, S. Giles, and L. Hyde) formed the final party. Their equipment was collected some hours before departure, and participants met in the town centre, that the vans could leave Ipswich at 11p.m. on Saturday 14 September.

After driving through the night, Sunday breakfast was obtained in Salisbury, before pressing on to Okehampton and our first geological stop.

At Okehampton, the Knowle Quarry was visited, where the grey shales of the Upper Culm Measures were worked along the strike of a syncline; part of an anticline was also seen and pieces of what appeared plant material found. In the adjoining Brickworks, the folds (upright in the Quarry) were seen (from a distance) to be overturned. Culm Measures is the name given to the local Carboniferous rocks, on account of the occasional occurrence in them of soft sooty coal ("Culm"); the Upper Culm Measures are mainly shales and sandstone.

Late lunch was obtained at Bodmin, and then on to St. Erth, where cordial relations were established with the pit owner and the owner of the camping site.

Monday morning was spent collecting fossils from the blue and brown clays of the St. Erth Beds, in a pit near the old Vicarage. The gastropods Bittium reticulatum, Nassa and Turritella, and lamellibranch fragments, were common. The age of the St. Erth Beds (?Pleistocene) has long been a matter of debate.

Later in the day, the scenic Kynance Cove, and Land's End were visited, with a stop to view (from a distance) St. Michael's Mount. Serpentine, belonging to the Lizard Series (metamorphic rocks of ?Pre-Cambrian age) was studied at Kynance Cove; the Lizard Peninsula has the appearance of a platform, with an average height of nearly 300ft. above sea-level. At Land's End, flow lines of feldspar crystals were well seen in the Land’s End Granite, and the weathering of the rock was seen in the castellated cliffs.

St. Erth was left on Tuesday morning, in order to travel eastwards across Dartmoor.

On the journey, evidence was seen of intensive working for minerals, which are related to the granite masses intruded in Permo-Carboniferous times. Seen in the distance at several localities were the huge refuse mounds of white quartz, by-products of the china-clay industry.

The disused Mulberry Openworks at Lanivet was looked at but not entered; this huge excavation was mainly for tin-ore, the ‘fstockwork’ (sediment with numerous mineralised fissures) having to be mined opencast.

On western Dartmoor, the dumps of Wheal Betsy mine (north of Marytavy) were inspected for minerals. The lode (infilled fissure) was worked for silver-lead ore, and siderite, galena and sphalerite may be found here. The characteristic tors of Dartmoor were noted (again, from a distance). Buckfastleigh was reached for the night, a camping site found after several tries, and in the evening a brief visit made to the site of a cave belonging to the William Pengelly Cave Research Centre.

Buckfastleigh was left on Wednesday morning, our first stop being Torquay, where Dyer's Quarry, east of the harbour, was visited; one member had visited the site on a previous occasion. The grey Middle Devonian limestone was very fossiliferous, with a marine fauna mainly of compound corals, and a few brachiopods. Folding of the beds was well seen, also the natural arch at Rockend, known as 'London Bridge'. A works at Kingsteignton was next visited; here the clays (and lignite) of the Bovey Tracey Beds (lake deposits of Oligocene age) are dug from pits and mines, to make earthenware, tiles, etc. The pit was viewed but not entered, the rocks being inspected in the storage sheds, after which we were most kindly given a quick tour of the works, the pottery test-discs being a source of fascination to most members.

The all-night drive home was punctuated by a few stops, including Stonehenge (unfortunately the gates were closed) and West London (for a brake repair).

It was not possible to study as much geology as had been hoped because of the time taken travelling, and in looking after tents, feeding, etc., but an interesting variety of scenery and rock types were seen.

The fine weather when we were camping (the same time as the East Anglian floods!) helped enormously. Another success of the meeting was food; hot meals were cooked on butane stoves, and to make for variety, we had curry on the second night at St. Erth and Christmas Pudding for breakfast at Buckfastleigh.#

Members were organised under several headings -administrative, geological, drivers, mechanics, tent-organisers, treasurer, cook(s), navigators, etc., which gave a very workable sharing of responsibility. The cost of petrol, food, and hire of camping gear came to an extremely reasonable £4 per person.

References.

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Dearman, W. R. 1962. "Directory of British Fosiliferous Localities".

R. Markham.

NOTES ON MUSEUMS AND SOCIETIES IN NORFOLK, SUFFOLK AND ESSEX.

IPSWICH MUSEUM

EARLY

The Rev. William Kirby of Barham (near Ipswich) proposed the establishment of a museum at Ipswich in the 1790s.

Prior to 1847 a room of the old Town Hall was used for museum purposes; teeth of the giant shark (Carcharodon megalodon) in the Ipswich Museum were noticed by Edward Charlesworth in the Magazine of Natural History, 1837.

Simpson Seaman (an Ipswich natural history dealer) apparently had his own museum in the 1820s and 1930s., but it is not known where.

MUSEUM STREET

The first Museum building was opened in Museum Street in 1847, by private subscription; after a period of financial difficulties it became the Corporation Museum in 1852. The first president (of the Corporation museum) was the Reverend Professor John Stevens Henslow, who brought the fertiliser value of the Red Crag 'coprolite nodules' to notice. The diggings for these nodules provided many fossils, and Edward Packard (of Messrs. Packard and Son) when Mayor of Ipswich (1868-1869) presented the cream of his collection to the museum.

HIGH STREET

Ipswich Museum moved to its present buildings in 1881.

Dr. John Ellor Taylor was Curator from 1872 to 1893; previously employed as a sub-editor in Norwich, where he was a founder of the Norwich Geological Society and the Norwich Science Gossip Club. He was a popular lecturer (a course of 20 free public lectures on geology delivered by the curator at Ipswich in the winter of 1879 was attended by an average of 500 people) and writer (e.g. book, "Our Common British Fossils", 1885).

In the 1930s a Local Geology Gallery (in addition to the Main Geology Gallery) was made in a room vacated by the Ipswich Library (when they moved to Northgate Street in 1924).

NORFOLK AND NORWICH MUSEUM

Established by a Society in 1824. An early donation still in the (Norwich Castle) Museum collections is the lower jaw of a fossil ‘elk’ found in a Bog near Tipperary in 1826 and presented by Captain Alexander.

In 1837 and 1838, the Rev. Professor Adam Sedgwick, Professor of Geology in the University of Cambridge, was President of the museum. He first came to Norwich as a canon of the Cathedral, and gave a course of lectures on Geology at the museum in 1836 and 1838.

Several important collections were donated in the nineteenth century, including the Forest Bed mammalian fossils of the Rev. John Gunn of Irstead, in 1868.

Before its removal to the Castle, the museum was in St, Andrews St. (although this was not its original home).

NORWICH CASTLE MUSEUM

The Gaol in Norwich Castle was converted into a museum, and opened in 1894. The collections formed by the Norwich Museum Society were made over to the Corporation of the City of Norwich. James Reeve (the first curator) made an important collection from the Norwich Crag of Bramerton, and in 1902 Frank Leney (later to be curator) published his "Type-specimens in the Norwich Museum" in the Geological Magazine.

IPSWICH AND DISTRICT NATURAL HISTORY SOCIET

-formed 1924by merging of the Ipswich Scientific Society and the Ipswich and District Field Club. Journal published until 1935 (see Geol. Group Bulletin No. 3 for list of geological articles).

IPSWICH SCIENTIFIC SOCIE

-founded 1869 as the

IPSWICH SCIENCE GOSSIP SOCIETY SOCIETY (name changed to Ipswich Scientific Society in 1875.)

The first meeting included a description (by Mr. Charlesworth) of the collection of Red Crag fossils given to the museum by Mr. Packard.

IPSWICH AND DISTRICT FIELD CLUB

-formed 1903. Journal published (see Geol. Group Bulletin No. 3 for list of geological articles); vol.V includes "A List of Type and Figured Specimens in Ipswich Museum" by A. Bell.

SUFFOLK NATURALISTS SOCIETY

-established 1929. Transactions published, (previous to this, occasional geological articles published by

SUFFOLK INSTITUTE OF ARCHAEOLOGY AND NATURAL HISTORY.

ESSEX FIELD CLUB

-inaugurated in 1880 as the

EPPING FOREST AND COUNTY OF ESSEX NATURALISTS’ FIELD CLUB (name changed to Essex Field Club in 1882).

'Essex Naturalist’ published ('Transactions' and 'Proceedings' before 1887). Passmore Edwards Museum, Newham, opened 1900.

NORWICH GEOLOGICAL SOCIETY

-founded 1864, with John Gunn as President and J. E. Taylor as Secretary. Amalgamated with Norfolk and Norwich Naturalists Society in 1888. Proceedings published for a few years before amalgamation.

NORFOLK AND NORWICH NATURALISTS SOCIETY

-founded 1869, the year following the first Norwich meeting of the British Association for the Advancement of Science. Transactions published (see Geol. Group Bulletin No. 2 for list of geological articles); 1961 Transactions ("Geology of Norfolk") marked the 10th. anniversary of the PARAMOUDRA CLUB (GEOLOGICAL SOCIETY OP NORFOLK).

NORWICH SCIENCE GOSSIP CLUB

-founded 1870 by J. E. Taylor; known to be still in existence in the 1930s. Annual Reports published.

PREHISTORIC SOCIETY OF EAST ANGLIA

-founded 1908 by W. G. Clarke and others in Norwich. Proceedings published from 1911 (see Geol. Group Bulletin No. 1 for list of geological articles). Name changed to 'Prehistoric Society’ in 1935 (see Geol. Group Bulletin No. 2 for list of geological articles).

(The above notes formed the basis of a talk given to the Geological Society of Norfolk by the writer).

R. Markham.

COMMENT AND NOTES 1967-1968

The following publications appeared;-

Newsletters nos. 7 (3 August I967), 8 (2 December I967), 9 (15 February 1968), 10 (29 June 1968), 11 (15 August 1968); (all newsletters of one page; no. 10 occupied part of page 19 of Bulletin no. 4. Newsletter no. 6 was published (14 June 1967) in year 1966-1967, but is included under 'finance of publications' for 1967-1968).

Bulletins nos. 3 (August 1967, 27 pages) and
4 (June 1968, for Feb. 1968, 19 pages).

Finance of publications (June 1967 - August 1968;-

Expenditure	£	s	d
Postage, Newsletters 6-11	4	14	4
Postage, Bulletins 3 & 4	1	16	2
Envelopes, Newsletters 6-11	1	0	7
Envelopes, Bulletins 3 & 4	1	1	10
Stencils, Newsletters 6-11	-	6	0
Stencils, Bulletins 3 & 4	2	5	0
Duplicating Ink	-	16	6
Duplicating Paper	3	8	6
Staples (for Bulletin)	-	7	7
Receipt Book	-	2	0
	£15	18s	6d

(Typing, duplicating, time, labour - not charged above)

Income	£	s	d
Subscriptions (1966-1967 received late)	-	10	0
Subscriptions (1967-1968)	13	15	0
Bulletins purchased	-	15	0
Postage stamps received	-	1	4
Competition at meeting	-	10	9
Donation	-	6	5
	£15	18s	6d

Finance of the coach run by the Ipswich Geology Group to Corton and Waveney Valley sites on 10 September 1967 was disappointing; a number of people did not turn up, and the £5 10s loss was made up by private donation.

Meetings were;-

(Christmas 'dig' cancelled because of the foot-and-mouth epidemic).
Fri. 5 Jan. 1968 -Informal Evening Meeting (slides, exhibits), Ipswich Museum.
Sun. 21 & Mon. 22 April !1968 -Beggars Hollow (Clapgate Lane), Ipswich.
Thurs. 18 July 1968 -Church Lane pit, Claydon (evening).

Fieldtrips on which group members were invited;-

Sun. 10 Sept. 1967 - Corton, Broome, Homersfield, Hoxne (Paramoudra Club).
Sat. 17 August 1968 - Barham and Great Blakenham (Ipswich & District Natural History Society).

The special subscription rate for students and retired members was discontinued at the end of 1966-1967, as being uneconomical to the Group, and because the majority of those eligible supported the Group by paying the full subscription. 10s-0d was the only rate available in 1967-1968.

Any future fieldtrips by coach will obviously have to have greater and guaranteed support.

Publication economies can be achieved by restricting the number of complimentary copies, especially of newsletters.

At the Beggars Hollow and Claydon meetings, of attendances averaging 24, over 50% were non-members. A minor amount of vandalism has taken place at these sites (not necessarily by members, nor necessarily at our meetings), but in the future, certain meetings may have to be restricted as to the number of non-members attending.

Activities for the year 1968-1969 will be similar to other years, with minor changes;-

- the Newsletter may be slightly enlarged, and the Bulletin reduced,
- a greater variety of meetings will be organised
- subscription will remain at 10s-0d but an associate membership (5s-0d, for which one may attend meetings and receive newsletters*, but not receive bulletins) will also be available.

Articles appearing in Bulletins 3 and 4 were;-

No. 3 (August 1967) pp.

R. Markham	“Battisford Red Crag 'dig’"	1-4.
R. Markham	"Interglacial Beds at Beetley, Norfolk”	4-5.
P. Grainger	"Celestine (Strontium Sulphate)"	6.
R. Markham	"Note on William’s Pit, Claydon"	6.
R. Markham	"Some Examples of Recent Induration from the Norfolk Coast"	6.
R. Markham	"A Forest Bed horse jaw from Paston, Norfolk"	7.
(EX)	"Bibliography -The Advancement of Science, Vols. VII-XXI (1950-1965)”	7-8.
(EX)	"Bibliography -Antiquity, 1927-1965"	8.
(EX)	"Bibliography -The Journal of the Ipswich and District Field Club"	8-9.
(EX)	"Bibliography -The Journal of the Ipswich and District Natural History Society"	9.
(EX)	"Bibliography -Norfolk Research Committee Bulletin"	9-10.
(EX)	"Bibliography -Transactions of the Suffolk Naturalist’ Society, Vol. 7 - Vol. 13, part 5"	10-13.
S. J. MacFarlane	"The Bourne Park Trench Exposures"	13-14.
R. Markham	"Note on a deformed elephant-tooth from the Forest-Bed"	15-16.
R. Markham	"Observations at the site of St. Albans Secondary School, Ipswich"	16-18.
S. J. MacFarlane	"Sudbourne Park Coralline Crag Dig, 14 May 1967"	18.
R. Markham	"Some Meat Equivalents of bones from a Roman rubbish pit”	18.
R. Markham	"The Foxhall Mandible"	18-21.
S. J. MacFarlane	"An Auger Traverse near Blacksmiths Corner, Belstead"	22-23.
R. M.	"Notes for - Beginners"	22, 24.
R. M.	"Comment, and Notes on 1966-1967	26-27.

(EX) = extracted by editor.

No. 4 (June 1966 } for February 1968)

J. S. H. Collins	"A Report on the Cirripedes found in an exposure of the Red Crag at Beggars Hollow, Ipswich"	1-2.
J. S. H. Collins	"Portunus depurator (Linne.) from the Coralline Crag of Suffolk"	2.
R. Markham	"Preliminary Note on Coralline Crag from Boreholes between Orford and Aldeburgh"	3-6.
P. Cambridge	"A Derived Brachiopod from the Red Crag"	6.
P. Cambridge	"Reviews"	7-8.
P. Grainger	"A Temporary Exposure at Tattingstone"	8-10.
R. Markham	"An Introduction to the Geological Collections of Ipswich Museum"	10-14.
P. Christie	"Belemnites at Lackford"	15.
R. Markham	"Some References"	15-16.
J. S. H. Collins	"Cirripedes of the Chalk (U. Cretaceous) of Norfolk"	13-17.
R. Markham	"A Scalaria from St. Erth"	17-18.
P. Grainger	"A Section through the Basement-Bed of the London Clay at Grovelands Pit, Reading"	18.

R. M.

THE BLACKHEATH BEDS FAUNA OF ABBEY WOOD.

The now mainly degraded section in the bluebelled Lessness Abbey Wood of the Greater London Council is one of the best-known sites for the Blackheath Beds, and has yielded a rich fauna.

The most complete section is given by Epps and Priest (about 8½ feet was to be seen);-

Re-sorted hillwash and soil 3 ft.
Sand, somewhat iron-stained, resting with irregular surface on
Shell-bed, lenticular, about 3ft. in thickest part
resting irregularly on
Well-graded, false-bedded, fine white sand about 1ft. seen
-auger holes showed this bed to be 12ft. thick, and to be underlain by over two feet of pebble-bed.

The shell-bed is limited in extent, and its present lenticular form may in part be due to its 'drifted shell bank' nature and in part to later decalcification; it consists of fossils, fine sand, and some of the well-rounded black flint pebbles which are so characteristic of the Blackheath Beds outcrop in this area

The fauna, of warm-water aspect, is rich in individuals and species. Molluscs are abundant, Corbicula tellinoides being characteristic and seemingly the most common. The site is famous for its vertebrate remains, the teeth of odontaspid sharks being abundant.

The following faunal list is not meant to be exhaustive, but shows the common and characteristic fossils of this locality and horizon.

		source
Gastropod Molluscs		
	Nerita semilugubria Deshayes	1,4,5?.
	Theodoxus globulus (Ferussac)	1,5.
	Theodoxus subornatus (d'Orbigny)	1,3,5.
	Euspira glaucinoides (J. Sowerby)	1,3,5?.
	Euspira bassae Wrigley	3.
	Sigatia abducta (Deshayes)	1,5?.
	Tympanotonos funatus (J. Sowerby)	1,3,5.
	Brotia melanioides (J. Sowerby)	1,3,5.
	Melanopsis antediluviana (Poiret)	1,2,3,5.
	Bayania triticea (Deshayes)	1,5.
	Murex abbatiae Wrigley	1,3.
	Aporrhais triangulata Gardner	1.
	Siphonalia subnodosa (Morris)	1,*,3,5.
	Pollia lata (J. Sowerby)	1,3,5?.
	Pollia costata Wrigley	3.
	Parvisipho cf. infraeocenica Cossman	1,5?.
	Hemipleurotoma sp.	4
	Pseudoliva fissurata (Deshayes)	1,2,3,5.
	Hastula plicatula (Lamarck)	1,2,3,5.
	Calyptraea aperta (Solander)?	5.
	* as S. mariae (Melleville), ?syn. of S. subnodosa	
Bivalve Molluscs		
	Glycimeris plumstediensis (J. Sowerby)	1,2,3,5.
	Corbula morrisi Edwards MS	1,3,5.
	Corbicula tellinoides (Ferussac)	1.2,3,5.
	Corbicula cuneiformis (Ferussac)	1,5?.
	Corbicula forbesi (Deshayes)	1,5.
	Nemocardium plumstedianum (J. Sowerby)	1,2,3,5.
	Modiolus mitcelli Morris	3,5.
	Nucula fragilis Deshayes	1,2,5.
	Ostrea bellevacina Lamarck	1,5.
	Ostrea tenera J. Sowerby	1,5?.
	Mactra semisulcata Lamarck	1,5.
	Panopaea intermedia (J. Sowerby)	4.
	Teredo sp.)	1,4,5.
	Dosiniopsis bellovacina (Deshayes	4,5.
	Barnea levesquei Wat.?	5.
Sponge		
	Cliona erodens Dollfus?	5.
Fish		
	Odontaspis maerota (Agassiz) striata (Winkler)	1,2,3,?5.
	Odontaspis cuspidata (Agassiz) teretidens White	1,2,3,?5.
	Odontaspis robusta Leriche	1.
	Odontaspis rutoti (Winkler)	1,2,5.
	Squatina prima Winkler	1,2,5.
	Hypolophus sylvestris White	1,2,5.
	Acipenser cf. toliapicus A. S. Woodward	1,?5.
	Phyllodus toliapicus Agassiz	2.
	Albula eppsi White and Frost	2,4.
	Lepisosteus suessionensis Gervais	2,5.
	Diaphyodus sauvagei Leriche	4.
	Microgadus eocenicus Frost	4.
	Mupus tenuidens Stinton	4.
	Palaeogadus pinguis Stinton	4.

Reptiles		
	Crocodile	6.
	Turtle	6.
Birds		
Mammals		
	Hyracotherium cuniculus Owen (primitive horse)	1,6.
	Protoadapsis eppsi Forster-Cooper (primitive lemur)	1,6.
	Coryphodon (ungulate)	4,6.
	Rodent	6.
	Insectivore	6.
	Creodont	6.

source;-

1. British Museum (Natural History) display (now removed).
2. "British Caenozoic Fossils".
3. Geological Museum display.
4. "Field Meeting at Abbey Wood....." (Durkin and Baldwin).
5. Author's collection (made and identified c.1960).
6. "Field Meeting at Abbey Wood" (Epps and Priest).

Notes;

Gastropods;- Theodoxus subornatus retains its original ornamentation and Hastula plicatula its colour banding.

Bivalves;- Dosiniopsis, Nucula, and Corbicula (forbesi?) have been found (by the author) with valves joined.

Fish;- Teeth and dermal tubercles of Hypolophus sylvestris are present. Fish vertebrae also occur.

References.

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Epps, F. J. & Priest, S. 1933. "Field Meeting at Abbey Wood, Kent". Proc. Geol. Assoc., Vol.44, pp.417-421.

Pitcher, W. S. 1967. "Abbey Wood", in Geol. Assoc. Guide No. 30B: The London Region (South of the Thames).

R. Markham.

GEOLOGY OF PARTS OF NORTH-WEST SCOTLAND

An account of the Assynt district, with reference to Durness, Helmsdale and Brora, based on a fieldtrip of the Queen Mary College (University of London) Exploration Society, Summer 1959.

The clear evidence for major thrust movements and for major unconformities makes the Assynt district of the N.W. Highlands a classic region for geological study. The area has attracted many workers, and a memorial to Drs. Peach and Home stands on a small knoll at the S.E. end of Loch Assynt. This account of the geology may be divided into four parts:

i) The Unmoved Region ("Foreland") in the west of the area, with Lewisian, Torridonian and Lower Cambrian rocks

ii) The Post-Cambrian Intrusive Rocks; sills and dykes, and two laccoliths.

iii) The Post-Cambrian Thrust Movements, giving in the east of the area, a complicated disturbed region with a number of thrust-masses (nappes) and the western edge of the Moine Schists.

iv) Pleistocene, etc.; work done in other districts

i) The Unmoved Region ("Foreland")

a) Lewisian Gneiss. This Pre-Cambrian group is the oldest in Britain, and in this area is a coarse, banded orthogneiss (formed by the metamorphism of plutonic igneous rocks), with quartz, feldspar and pyroxene as the essential minerals; more basic lenticles are common. Pre-Torridonian dykes are also common, and are basic. Pre-Torridonian shearing is seen in places. The side of Loch Assynt W. of Skiag Bridge provides good examples of banded orthogneiss (with hornblende and biotite), ultra-basic components (amphibolites), and basic (epidiorite) and ultrabasic (feldspathic picrate) dykes.

The Torridonian sediments were laid down in an irregular floor of gneiss, showing extensive denudation had taken place before Torridon times. The undulating character of the gneiss surface and its highly weathered form are clearly seen on the N. side of Loch Assynt, as is the junction of the Lewisian and Torridonian (in a small quarry).

b) Torridonian. Purplish-red, feldspathic sandstones and grits; current-bedding is conspicuous. The thickness varies from 0-2,000ft., and to the north of Loch Assynt the "basal" beds show alternating harder and softer pebbly sandstones, in which wind-facetted pebbles are not uncommon. These wind-facetted pebbles (dreikanter), and the freshness of the feldspar, suggest semi-arid conditions. The Torridonian sediments are nearly horizontal, but as the overlying and unconformable Cambrian beds dip at least 10° steeper, this horizontal position is not the original one. These sediments build up many of the fine mountains - Quinag, Beinn Garbh, Canisp, Suilven and Cul Mor.

Prolonged and extensive pre-Cambrian erosion of the Torridon sediments (the underlying gneiss often laid bare) produced an almost level platform over which the Cambrian sea advanced. The transgression of the Cambrian quartzite over various beds of the Torridonian until it rests directly on the Lewisian gneiss provides a striking "double unconformity", clearly displayed on the N. E. side of Beinn Garbh, and well seen from the N. E. side of the Loch.

c) Cambrian. The earliest Cambrian sediments are now seen as quartzites (Arenaceous Series), these are followed by shales and grits (Middle or Passage Series), and finally by the Durness Limestone (Calcareous Series).

i) Arenaceous Series (450ft.) forms the long, shiny dip-slopes of Quinag and Beinn Garbh. The Basal Quartzite is white, false-bedded, and often: gritty. The succeeding Pipe-Rock is also a quartzite, and is characterised by vertical cylinders ("pipes" -casts of worm-burrows (Skolithus); ripples-marked surfaces are common. Pipes are common around Skiag Bridge.

ii) Middle Series (75ft.). The Fucoid Beds are mostly bluish shales, with numerous flattened worm-casts ("fucoids"). Near Skiag Bridge, and at Knockan Village, fossils of the Lower Cambrian Olenellus zone have been recorded^fragments were found by the author at Skiag^ pipes also occur at this locality. The overlying Serpulite Grit also contains a few pipes, and (as near Skiag Bridge), rich bands of Salterella, - small conical tube-like fossils

iii) Calcareous Series (100ft) -Only the Ghrudaidh Group (chiefly dark-coloured dolomites) are found in the Unmoved Region; the Eilean Dubh Group (light-coloured limestones and dolomites) occur in thrust ground - the Base Camp was on this latter group. The limestone gives rise to a good soil, and limestone district stands out by its greenness; caves, stalactites, swallow-holes, springs, and subterranean streams add to the interest of this formation.

Both the Torridonian and the Cambrian strata dip E.S.E., - the former between 4° and 8°, and the latter between 10° and 20°.

ii) Post-Cambrian Intrusive Rocks

a) Minor Intrusions. These are chiefly sills, and are often highly sheared. Felsites are seen at Knockan Crag and the pass between Conival and Breabag Tarsuinn; hornblende-feldspar-porphyrite also occurs in the quartzite at this pass. Hornblende-lamprophyres outcrop at the roadside between Inchnadamph and Ardvreck Castle, and at Knockan, where they are well sheared. Canisp Porphry, with conspicuous feldspar and biotite, occurs in the Torridonian and Basal Quartzite of Leathad Lianach, west of the thrust zone.

The Assynt laccoliths -the Loch Borrolan or Cnoc na Sroine mass, and the Loch Ailsh mass -are both complex alkaline-type masses, and show variation from melanocratic to leucocratic facies. The Loch Ailsh mass was not visited by the author.

b) The Loch Borrolan Mass. This is the larger mass (about 10 square miles around Aultnacallagach) and is intrusive in Cambrian strata within the lowermost nappe in Assynt. The apparently layered arrangement of the mass is probably due to successive intrusions. Quartz-syenite (near nordmarkite) and leucocratic nepheline-syenites (e.g. "assyntite") occur at higher levels. Mesocratic nepheline-syenites (e.g. "ledmorite") outcrop at lower levels in the Ledmore and Ledbeg Rivers; the mesocratic melanite-nepheline-syenite known as "borolanite" is best seen in a small quarry 1½ miles E. of Aultna callagach, -it is a greyish rock with conspicuous white spots of orthoclase.

Maelanite (titaniferous iron-garnet) is the characteristic dark mineral, and well-shaped crystals are found near Ledmore. The melanocratic (dark) members of the complex are seen S.W. of Ledmore, the pyroxenite "cromaltite" being the extreme ultrabasic member.

Contact metamorphism of the dolomite has given brucite-marble, -a yellowish-white rock exposed near the river at Ledbeg.

c) Loch Ailsh Mass no silica differentiatlon is found here. Xenoliths of Cambrian strata are an interesting feature.

iii) Post-Cambrian Thrust Movements

These have affected the Moine Rocks, and Cambrian and older. The zone of thrusts expands to seven miles in Assynt, as the outcrop of the highest (Moine) thrust here makes a wide semicircular sweep to the east. Along these horizontally directed dislocations, immense lenses (nappes) of country rock have been displaced, often for great distances, north-westward.

The lowest plane of movement is known as the "Sole", and in this district occurs in Lower Cambrian strata. The Zone of Imbrication above the Sole shows steeply dipping Fucoid Beds, Serpulite Grit and dark dolomite repeated many times by steep minor thrusts (imbricate structure). A larger thrust brings forward the Ghrudaidh and Eilean Dubh dolomites and their lamprophyric sills, also showing imbricate structure, and gentle folding in places; this group is well exposed by the roadside N. of Inchnadamph, and in the Stronechrubie cliff - the greatest limestone escarpment in Scotland.

Three major thrust-planes traverse the Assynt District; they are generally inclined at low angles, and are, from west to east, the Glencoul Thrust, the Ben More Thrust, and the Moine Thrust.

The lowest of the great displacements brings forward Lewisian Gneiss (1,500 ft. in places) and Cambrian strata, but no Torridonian.

The Ben More Thrust carries Lewisian, and Torridonian and Cambrian. The outcrop of this thrust-plane may be seen dipping steeply downhill on the S. face of Conival. A conspicuous scree at this locality is made of pale reddish, highly sheared, Lewisian Gneiss, and the reddened sheared Cambrian quartzite from below the plane; this quartzite rests on the Glencoul (lowest) thrust plane. Folding and inversion of strata is well seen, e.g. the gneiss-sandstone junction is inverted on the S.W. face of Conival. There are many klippen (outliers of materials resting on the Ben More thrust plane) to the south of Inchnadamph, e.g. on Beinn an Fharain south of Allt nan Uamh, and near Ledmore.

The Assynt District clearly displays overlapping of thrusts. The Ben More Thnust overlaps the Glencoul Thrust at the pass between Conival and Breabag, and at the famous Knockan Crag section, the Moine Thrust may be seen to have overlapped all the underlying thrusts and displaced masses, and the Moinian rocks here lie only a few feet from undisturbed Cambrian sediments.

The Moine Thrust is the most easterly and most powerful line of disruption, and brings forward a series of crystalline schists - the Moine Schists, rocks of entirely different character from any that occur either in the undisturbed region or in the thrust masses. This plane generally dips at low angles to the E.S.E.. The Moine Series are metamorphosed sediments, and may be examined at Knockan Crag, where siliceous schists are common. From the Knockan Crag, the conical cap of Cul Mor may be seen - this is due to the small capping of quartzite. Rodded schists may be seen west of Oykell Bridge.

Metamorphic effects of the thrust-movements are restricted to the immediate vicinity of thrusts. Mylonite, the ultimate product of mechanical reduction, has been produced along many of the thrusts, especially along the Moine Thrust-Plane at Knockan Crag, where it is a greenish, thinly banded, very fine-grained rock. Deformation of smaller structures may be seen in the Conival area -the pebbles in Torridonian conglomerates are drawn out and flattened, and pipes in quartzite may be flattened and bent over.

The thrust-movements are younger than the Assynt sills and laccoliths.

iv) This section will include (a) later history of the Assynt district, and (b) visits to other areas.

(a) Later History of the Assynt District

The fault of the greatest interest is the W.N.W. Traligill fault, which affects the thrust-belt and the Moine Schists. Various gullies mark its outcrop.

The Northern Highlands are now part of a dissected plateau, and Tertiary times probably witnessed elevation and vigorous river action. The westward-flowing consequent streams are the more active and have cut back

through the watershed and captured the headwaters of the eastern drainage; the Strath Oykell forms part of the original eastern consequent drainage.

Glacial action during the Pleistocene modified the area; U-valleys, corries, striated rock-surfaces and hummocky lateral moraine drift are common. The ice moved westwards in this area, and Ben More Assynt was a centre of glacial radiation.

The Allt nan Uamh caves have yielded remains of bear, northern lynx, reindeer, lemming and man.

Holocene peat (used as fuel) and alluvium cover large areas.

(b) Other Areas

(i) Durness. The Balnakiel Group of the Durness limestone at Balnakiel Bay shows limestones, dolomites, and chert nodules. Modern shell-sand occurs on the beach. The Croisaphuill Group, between the lochs to the south of the bay shows worm-burrow like markings. Both these groups have yielded gastropods and cephalopods.

(ii) Helmsdale and Brora, (E. Sutherland coast). Jurassic strata are found along the east coast, and the following were examined at Brora Upper Estuarine Series - a dark shale overlain by the Brora coal (3ft. seam). These strata were seen in the local coal mine

Lower Oxfordian - the Brora Roof-bed (- Kellaways Bed) with lamellibranchs, is also seen in the mine. A thick series off shales follow (Brora Shales), and may be seen at the Brickworks pit; belemnites, ammonites and lamellibranchs are common, also lignite.

Upper Oxfordian - Lower Corallian, - the Brora Arenaceous Series may be seen in the banks of the River Brora, in the disused Clynelish Quarry (the silicified Clynelish Sandstone) and on the shore north of the Brora estuary (Ardassie Limestones). Molluscs are common.

Kimmeridgian (at Helmsdale, on shore) - shales, sandstones, and boulder-beds. The latter is a gritty shelly limestone with many blocks of Old Red Sandstone. The matrix yields shells, lignite, and the coral, Isastraea oblonga.

Raised terraces and various moraines are seen in the Brora area.

R. Markham.

(This article previously appeared in Queen Mary College (University of London) Exploration Society Official Report of the 1959 North West Scotland Expedition)

NOTES ON TWO BOREHOLES NEAR FELIXSTOWE.

Walton (TM 288361) 80 feet deep (starting at c. 60 feet 0. D.).

		Thickness	Depth
Soil		0.5	0.5
Stiff brown clay		4	4.5
Gravel		22	26.5
Brown clay		1	27.5
Blue clay	London Clay	27.5	55
Mudstone		3	58
Blue Clay		22+	80+

Trimley (TM 277381) 40 feet deep (starting at c. 80 feet O.D.).

Soil	1	1
Shelly sand - Red Crag	24	25
Blue clay - London Clay	15+	40+

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Geological Group, Ipswich. Bulletin No. 6 (July 1969, for Spring 1969).

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The editor wishes to thank P. Grainger for practical help with bulletin production, and Ipswich Museum for facilities granted; stencils typed by editor.

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