WEEK-END EXCURSION TO THE CARTMEL PENINSULA, CUMBRIA

Leader: Murray Mitchell

September 11–13th 1987

For the twelve members arriving at Castle Head Field Centre, the rain was quickly forgotten in the warmth of their reception; a welcoming cup of tea and the blazing log fire in the library gave the impression of a country house week-end rather than a geological field excursion, an impression that was further enhanced by the excellence of the accommodation and the abundance of the dining table.

The leader, however, was anxious to remind us of the purpose of our visit, and, after allowing time for the four non-resident members of the party to join us, he proceeded to introduce the group to the geology of the area. He began with a review of Lake District geology and continued with a more detailed examination of the Carboniferous Limestone succession in the Cartmel Peninsula (Table 1) and its structural relationships with the underlying Bannisdale Slates, of Silurian age. In this area of the Southern Lake District the Lower Carboniferous limestones rest unconformably on the folded and eroded Bannisdale Slates and dip gently eastwards; north-south faults, associated with the early stages of the opening of the North Atlantic, in Tertiary times, downthrow to the west, and the limestone fells have steep west-facing scarp faces. (Figs. 1 & 2).

This introduction, well illustrated with slides, was enlivened by the speaker's obvious wider interests in the relationships between the geology and the landscape, natural history, and the history of man in the area. A comprehensive set of hand-outs was issued and discussed, and the programme for the week-end was outlined.

On Saturday morning, the party assembled on the east lawn of Castle Head, where the leader, supported by Frank Dawson, one of the Directors of the Centre, explained the view in front of us and its associations with Castle Head. An expanse of very flat grazing marsh, about 1 km wide at this point, is backed by the wooded ridge of Meathop Fell, rising abruptly from the marsh, with Meathop Quarry at its southern tip. The marsh, which is underlain by at least 30 m of post-glacial marine deposits, was the former Lindale Pool, a tidal marsh extending for over 2 km inland until the late 18th century, when John Wilkinson, a noted English ironmaster, built an east-west bank to protect the inland area to the north, an act of benevolence that enabled him to purchase the land and build Castle Head, on its island of higher ground, in 1780. Wilkinson had learnt his trade in his father's foundry at Blackbarrow, and by the age of 20 he was establishing ironworks in Shropshire and Staffordshire. In 1774 he invented a machine which made possible the accurate boring of cylinders, an advance that contributed much to the success of Watt's steam engine. He died in 1808 and was buried, in an iron coffin, in the grounds of Castle Head, with his grave marked by an iron monument.

The remnants of Wilkinson's bank can still be seen, but it became obsolete with the construction of the Ulverston and Lancaster Railway in 1857, when the new railway embankment made an effective barrier against the tides for the whole area of the Pool.

A short walk to the south of the Centre led to an exposure of the Lindale Fault, where a cliff marks the faulted junction of the Bannisdale Slates with the Park Limestones, of Dinantian age; it was pointed out that the undercutting here does not indicate a relative softness of the Slates, but results from the brecciation caused by the movement of the fault. From the dip of the limestones, and their reappearance on Hampsfell to the west, it was demonstrated that there must be at least one other fault between this outcrop of Park Limestone and the Urswick Limestone on Hampsfell. (Fig. 2).

By this time the leader's discussion was being disrupted by the rustling of waterproofs, and the group retreated to the shelter of the Castle Head verandah, where the hospitality of the Centre was further demonstrated with coffee being brought out to us. With the rain becoming a downpour, a change of plan was indicated and the group headed for Cartmel Priory.

In the shelter of the south porch of the Priory, with its beautiful Late Norman doorway, the leader discussed the history of the building and its geological relationships; three different sandstones were used in the early building, all from the Gleaston Formation (Table 1) quarried from the grounds of Holker Hall some 3 km to the south-west; the practical skills shown by the stonemasons in choosing each sandstone for its own particular use in

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plates 1 & 2 (1p.)

the building was demonstrated. The poorer quality of the stonework of the 15th century additions was speculated on, as were the possible reasons for moving the cloisters from the south side to the north, and the diagonal setting of the upper stage of the tower. The Priory is sited on a glacial 'crag and tail' structure, and was originally surrounded on three sides by a post-glacial lake; glacial till is draped around the crag of Bannisdale Slate, particularly on the south side, and this may have led to the differential settlement indicated by the curve in the drip course at the east end of the structure.

With the clouds lifting, the excursion continued to Humphrey Head (SD 391739) where, after walking a short distance over the Urswick Limestone, we were able to enjoy our lunch in bright sunshine, comfortably seated on the limestone pavement. Visibility had improved considerably by this time, and, from the triangulation point on the summit of the headland, the geological features of the landscape were described; a group of drumlins to the north was pointed out, and in the distance the Lancashire Fells, the Howgills, and Ingleborough showed up clearly.

At Humphrey Head Point it was possible to examine the Urswick Limestone in more detail; the pseudobrecciation (Table 1) is clearly displayed, and this was attributed to burrowing by worm-like animals, a view supported by the fossil forms of these burrows demonstrated in the limestone. The cyclic depositional sequences were also demonstrated here; each shallow-water master bedding plane and shale is succeeded by thinly bedded limestones passing upwards into massive-bedded limestones to the next master bedding plane (Table 1). The shales frequently include volcanic dust deposits. Along the eastern shoreline of the Head, the thin-bedded dark grey limestones, forming the lower part of the Gleaston Formation, were seen to contain abundant corals, and the leader was able to demonstrate his classification system for the identification of Carboniferous corals. For the botanists in the party, the walk back through Humphrey Head Wood was an added bonus.

The final exposure of the day was an outcrop of Permo-Triassic brockrams at Rougholme Point (SD 385740) (fig. 1) on the shore west of Humphrey Head. The brockrams are coarse breccia, deposited by flash floods, with mainly locally-derived limestone pebbles and thin, inter-bedded layers and lenses of red sandstone forming the matrix. A curious feature, which aroused much discussion, is that many of the pebbles show a hardened skin surrounding a hollow or rotted core. This is most apparent on the eroded surfaces, where the skin has been partly eroded away but it was demonstrated that pebbles which retained an intact outer skin may also show a hollow centre. Precise dating of this exposure is uncertain, but Arthurton *et al.* (1978, p. 198) suggested a position high in the Permian sequence. A borehole has shown the brockrams here to have a thickness of 257 m and to overlie strata of probable Namurian age; together with the estimated thickness of 250 m of Lower Carboniferous Urswick Limestone and Gleaston Formation rocks on Humphrey Head, this implies a minimum westerly downthrow well in excess of 500 m on the fault separating Humphrey Head and Rougholme Point.

Sunday morning dawned bright and clear, and the indications of a fine day were confirmed by the local weather forecast. At breakfast, Mrs. Fev Dawson and her colleagues were thanked for the excellent domestic arrangements of the week-end.

The group headed first for Meathop Quarry (SD 432792) where the lowest formation of the Lower Carboniferous present in the area, the Martin Limestone, is exposed. The fine-grained, even-bedded limestone makes an excellent building stone and the quarry was exploited by the builders of the Ulverston and Lancaster Railway, although it probably has a much longer history. It was pointed out that prior to the building of the railway it was possible for stone to be loaded directly into boats moored at the foot of the face.

Evidence for shallow-water deposition for part of the Martin Limestone was demonstrated, including 'birds-eye' structures (fenestral fabric), algal mats and a pavement of dessication polygons, the latter being unfortunately in danger of destruction by over-zealous hammering and collecting.

In the view westwards to Hampsfell, the line of the fault separating the Urswick Limestone, on the south side, from the Bannisdale Slates exposed in the road cuttings and on the Fell to the north (Fig. 1) was clearly shown by the topography and by the differences in vegetation.

The rest of the day was to be spent on a traverse of part of Whitbarrow, starting from Witherslack Hall (SD 437859) some of the cars being parked at North Lodge to avoid a weary trek back along the road at the end of the day. The Hall is sited on a narrow outcrop of Martin Limestone, resting unconformably on Bannisdale Slates; a short distance to the west, a north-south trending fault separates the Martin Limestone and Bannisdale Slates of Whitbarrow from the Dalton Beds of Yewbarrow (Fig. 2).

Walking eastwards from the Hall, an area of flat low-lying meadow, referred to as Witherslack Tarn, was noted to the south and described by the leader as a former glacial lake, now infilled with some 15 m of post-glacial deposits. A small outcrop of Red Hill Oolite to the north of the path was examined; despite its name, this

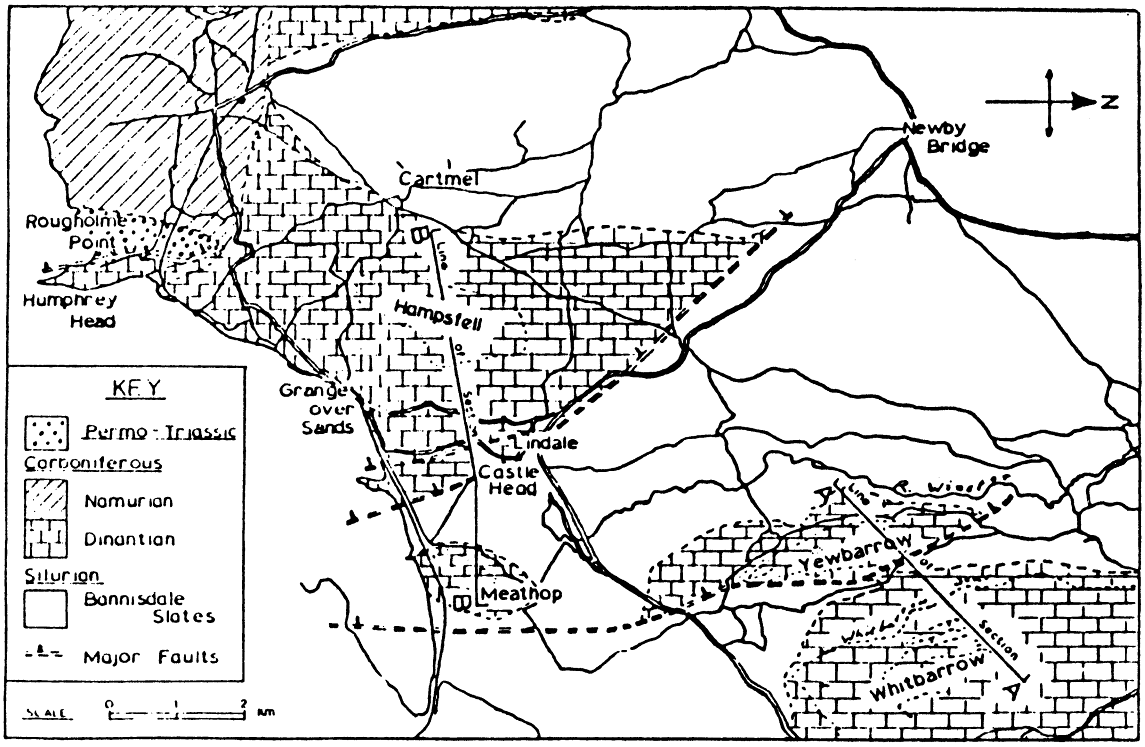


Fig. 1. Location Plan, with geological boundaries (after M. Mitchell).

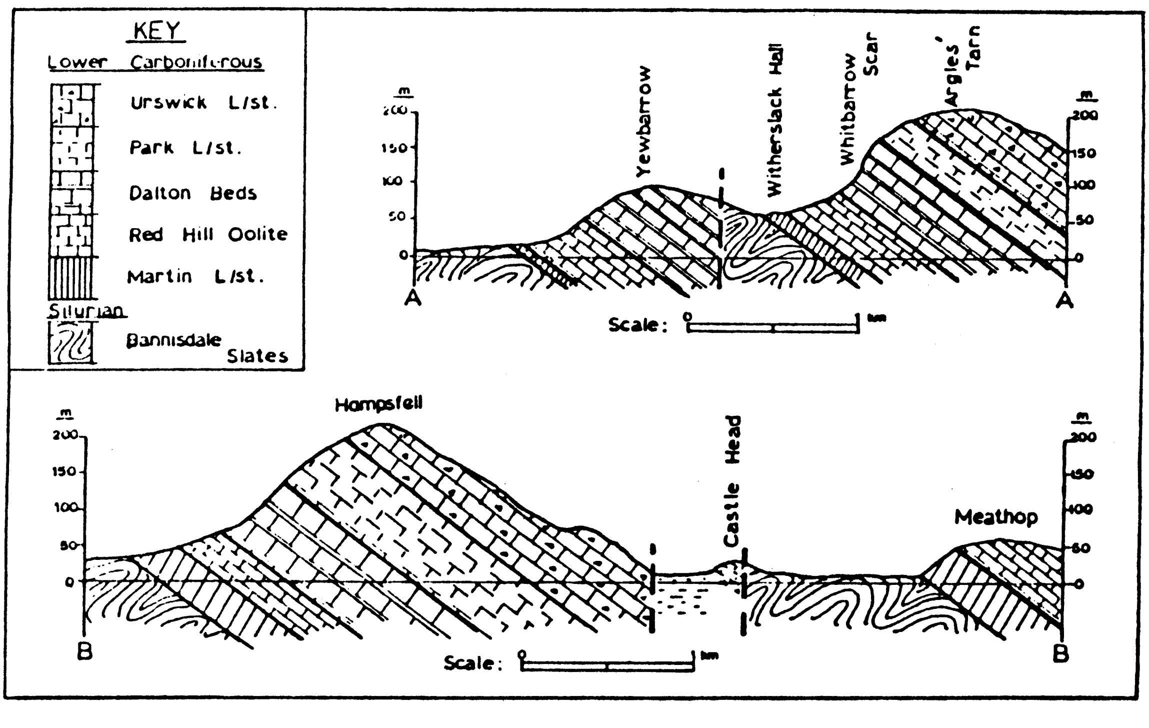


Fig. 2. Geological cross-sections (after M. Mitchell).
AA - Yewbarrow and Whitbarrow
BB - Hampsfell and Meathop

limestone is not an oolite but contains small rounded pellets of carbonate sand. In contrast to the Martin Limestone the rock is poorly bedded and the absence of shale partings made it an excellent stone for lime-burning.

The three divisions of the Dalton Beds were crossed, with the thicker shale partings of the middle division emphasised by springs and wet ground on the lower slopes of Whitbarrow, and the massive-bedded upper division forming the prominent Whitbarrow Scar. The path up the Scar was less steep than it had appeared from below and was further relieved by the need for occasional halts for the leader to point out the geological features of the landscape as they came into view. The progression to the succeeding formation, the Park Limestones, was evident from the well-displayed 'ridge-and-furrow' topography, a succession of outcrop ridges separated by loess-filled hollows covered by grass and heather. A band with the cerioid corals, *Lithostrotion* sp., was seen some 20 m above the base of the Park Limestones, providing another opportunity for the leader to demonstrate the value of his identification key. At the top of the formation shallow-water deposition was indicated by the presenceof 'birds-eye' structures (fenestral fabric) as seen earlier in the day in the Martin Limestone.

The limestone pavements of the Urswick Limestone, forming the top of Whitbarrow, are developed to a much greater extent than at Humphrey Head, and help to accentuate the depositional cycles of this formation; the pavements, formed on the master bedding planes of each cycle, dip eastwards at about 10°, passing up into a low cliff formed by the shales and thinner-bedded units of the next cycle and capped by the massive-bedded limestone on which the next pavement with well-formed clints, grikes, and runnels is developed. Nine or ten of these cycles are present in the Urswick Limestone, forming a distinctive stepped topography, with each cycle representing a period of some 0.5 my, deposition taking place, however, for probably only a third of that time.

The massive-bedded limestone units can be cut out in large blocks, and made excellent gate-posts; a more unusual application, in the past, was for grinding wheels for use in the Sedgwick gun-powder works, where the sparks common to more traditional grinding media would have been a decided disadvantage; another gun-powder works was near Chapel Stile (R.J. Firman, personal comm.).

Much interest was aroused by Argles' Tarn (SD 443871) as much by its distinctive fauna as by its actual existence, apparently sitting on a limestone pavement. Named after the Argles family, former owners of the area, it is fed by a spring and maintains an almost constant level throughout the year. The leader suggested, in explanation, that the shale unit at the base of this particular cycle was thicker than in other cycles, and pointed to the adjacent cliff which also seemed to indicate a thicker sequence in this cycle. As we turned to continue our traverse northward, he pointed out a slight depression crossing the hill-top and trending towards the Tarn, which might possibly indicate a small fault and have some bearing on the origin of the Tarn.

A large erratic block, perched on top of the limestone, provided evidence that, at some stage in the Pleistocene glacial period, ice had covered Whitbarrow; of equal interest was the block itself, an agglomerate from the Borrowdale Volcanics, north of Kentmere.

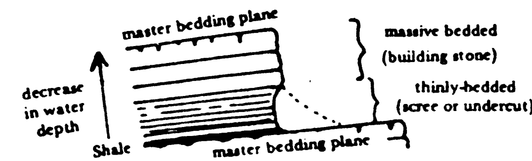
Descending the slope northwestwards from the summit, some small parallel-sided excavations were noted, marking the line of an unproductive mineral vein; a short distance downslope a small adit again showed little sign of productive mineral extraction, specimens in the spoil heaps showing calcite and barytes but only thin stringers of haematite.

The track to North Lodge continued through woodland, crossing the Dalton Beds and the Red Hill Oolite, but with few exposures. At the foot of the slope, a short detour was made to Fairies' Cave, a narrow entrance in the lowest beds of the Martin Limestone. Previous exploration had shown that it leads to a water-filled siphon and on into a large chamber. Flood-flow debris downslope from the cave entrance indicated that the heavy rain of the previous day had caused the siphon to overflow. Along the slope, the cave system had been exploited for a local water supply, still in use, by means of pipes driven into the hill-side, and there was some speculation as to how the locals had determined the right places to insert their pipes.

The junction with the Bannisdale Slates is not exposed, but the presence of slates in the nearby stream was pointed out, thus fixing the position of the junction to within a few metres. The leader stressed that the upper surface of the Bannisdale Slates is very irregular, and this feature is well displayed by the switchback nature of the road from North Lodge to Witherslack Hall.

This completed a very enjoyable excursion, and the members unanimously expressed their thanks and appreciation to Murray Mitchell for a most interesting and informative week-end; also to Frank Dawson, whose contributions and experience in his own fields had added a great deal of extra interest.

Table 1. (prepared by M. Mitchell).

STAGES	LITHOLOGICAL FORMATION	CARBONIFEROUS LIMESTONE OF SOUTHERN LAKE DISTRICT		
			LITHOLOGICAL CHARACTERISTICS	FEATURES OF INTEREST IN GRANGE AREA
BRIGANT-IAN	GLEASTON FORMATION (c.200m)		Limestones, shales and sandstones: limestones, dark grey, medium grained, crinoidal, thinly-bedded; prominent algal band (Girvanella Nodular Bed) c8 above base.	Exposures in grounds of Holker Hall. Basal 15 m of limestone well exposed on eastern flank of Humphrey Head.
ASBIAN	URSWICK LIMESTONE (150m)		Limestone, pale grey, medium grained, abundant shell debris, well-bedded, part massive-bedded, part thinly-bedded, regularly jointed. Much pseudobrecciation with irregular dark patches in a paler grey matrix, probably resulting from burrowing of worm like animals. Strongly cyclic (8-9 units).	Major source of Grange building stone (Eden Mount Quarries). Fine stepped dip and scarp topography on Hampsfell and Whitbarrow with clints and grikes on limestone pavements. Cycles  Pseudobreccias well seen at Blawith Point and on Chapel Island.
HOLKERIAN	PARK LIMESTONE (120m)		Limestones, pale grey, medium grained, some pellety fragments, dark crinoidal debris, massive, poorly-bedded or unbedded, occasional partings, closely jointed, blocky and platy weathering.	Stratotype (type section) for Holkerian Stage is taken at the base of the Park Limestone at Barker Scar on the eastern shore of the Levens Estuary. Poorly exposed on Hampsfell – grassy slope below summit. Exposed on Whitbarrow between Lord's Seat and cliff top – cyclic; stony/scree covered ridges and grassy hollows.
ARUNDIAN	DALTON BEDS (120m)		Limestone, medium to dark grey, medium grained, crinoidal, well-bedded with partings of calcareous shale. In 3 parts upper: massive-bedded, sandy, dolomitic middle: shaly partings thicker lower: thick bedded, medium grey.	Upper massive part: forms cliffs of Yewbarrow and Whitbarrow blocks and limestone pavement on summit of Yewbarrow. Middle part: small quarry opposite Witherslack Church. Lower part: seen in crags east of Reake Foot Quarry; base taken at first darker limestone, also more bedded than R.H.O.
	RED HILL OOLITE (60m)		Limestone, pale grey, medium grained, carbonate sand, well sorted, pellety, massive, poorly-bedded.	Caps Meathop hillside and forms broad shelf on west side of Yewbarrow Block to south of Witherslack Church. Used for lime burning (no shale partings) see Catcrag Quarry.
CHADIAN	MARTIN LIMESTONE (50m)		Limestone, medium grey or grey brown, fine grained, laminated algal layers, well-bedded, hard and compact with thin calcareous shale partings.	Well exposed in Meathop Quarry, much used as building stone especially by Furness Railway. See Grange railway station – larger blocks are mostly Urswick Limestone, smaller blocks are Martin Limestone.
TOURN-AISIAN	BASEMENT BEDS (0-100m)		Conglomerates, sandstones and shales reddish brown in colour.	not present in Grange area.

Acknowledgements

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References

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Photo by Phillip Small.

Plate 1. View of Humphrey Head from Rougholme Point, with brockrams on shore in foreground.

Photo by Phillip Small.

Plate 2. Urswick Limestone surface on Whitbarrow. Standing figure indicates dip of pavement.