

## EXCURSION REPORT: INGLETON AND INGLEBOROUGH

Leader : A. C. Waltham

Weekend 2-4 May 1975

The purpose of the excursion was two-fold; firstly to examine the many aspects of the solid geology revealed along the line of the Craven Fault Zone, and secondly to see some of the spectacular glacial and karstic features which are so well-developed in these western regions of the Yorkshire Dales. Reference should be made to text-figs. 1, 2 and 3.

The main feature of the solid geology of the region is the Askrigg Block, lying immediately northeast of Ingleton. Resting on the block is the 600 feet thick, almost horizontal, Great Scar Limestone of Lower Carboniferous age, which form the karst plateaus around Ingleborough. Above the Great Scar, there are over 900 feet of shales, limestones and sandstones, the Yoredale Series, which now occur as plinths on the limestone plateaus rising to the summits of the Three Peaks; Ingleborough, Penyghent and Whernside. Just above Ingleton the floors of the main dales cut down through the limestone to reveal the tightly folded sediments of the Lower Palaeozoic rocks which form the Block itself. These inliers are terminated to the southwest by the Craven Faults, with their large downthrows on the southern side. Exposures south of the faults, in the Craven Lowlands, are not so abundant, but around Ingleton the presence of the Productive Coal Measures and some overlying red beds indicate the stratigraphic level reached. The Craven Fault Zone has an extremely long tectonic history. It was already established in Lower Carboniferous times as it marks the facies boundary between the clean shelf limestones to the north and the dirty basin limestones to the south, and it continued to move during the entire Carboniferous. Large vertical movements, still clearly evident, took place in the Hercynian orogeny and the freshness of some of the topographical features on the faults, noticeably at Giggleswick and Malham to the east, suggest further Tertiary movement. Small earthquakes at Skipton and Settle, in the last few decades, may also have originated on the Craven Faults.

During the Pleistocene, ice moving from the north overran the entire region except possibly the summits of Ingleborough and the other Peaks. The Dales are all fine glacial valleys, and though the early glacial history of the region is not yet understood, it is clear that the area was actively glaciated during the Devensian. From this glaciation at least the landscape now exhibits an abundance of fine glacial morphological features. Furthermore the relatively short time since that latest glaciation means that the karst features are fresh and clean and the area is a classic one of glacial karst, with excellent limestone pavements and numerous cave systems.

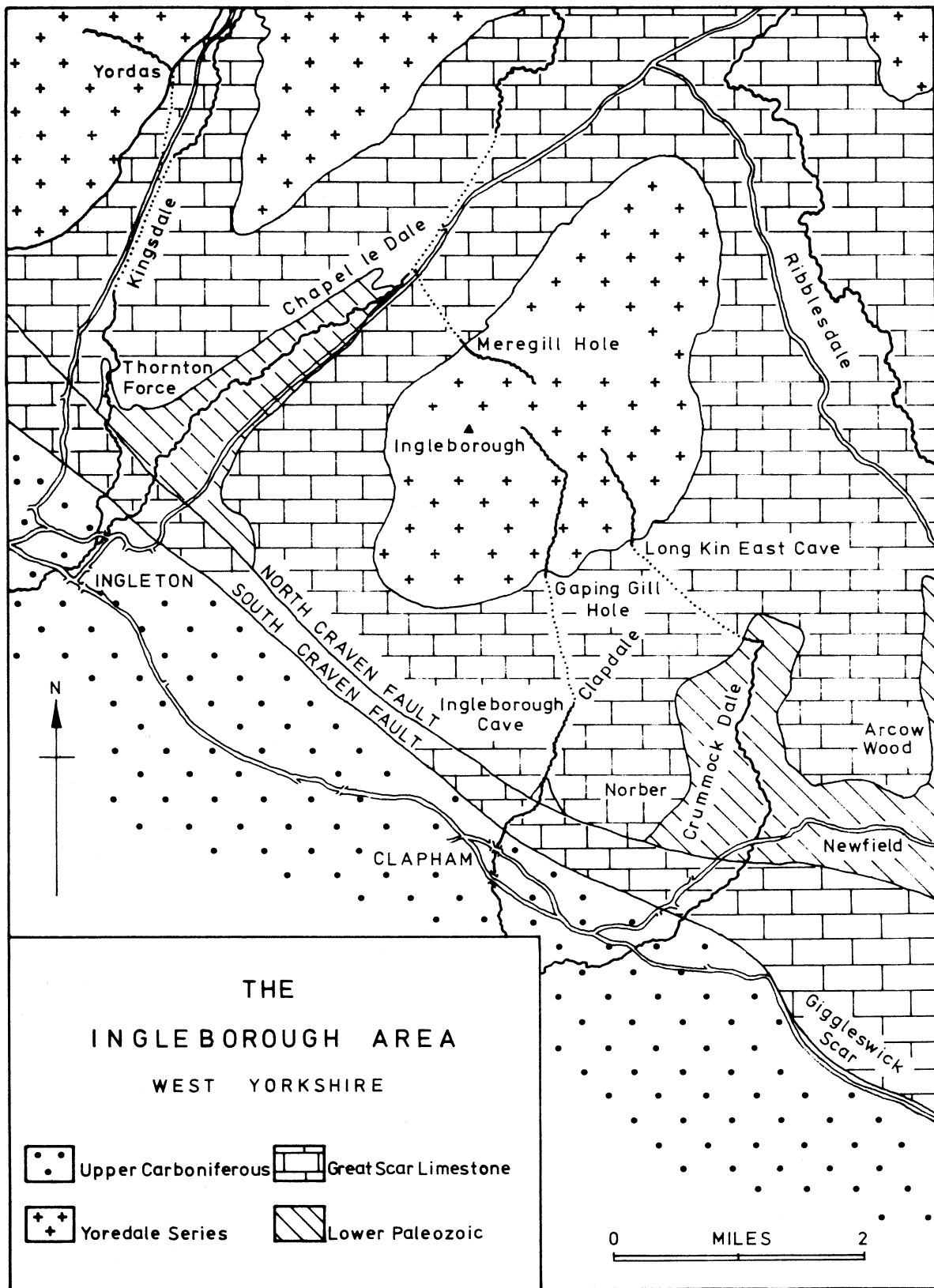
### Friday 2nd May

During the evening some 35 members and friends gathered in the Oakroyd Guest House in Ingleton and Dr. Waltham introduced the geology and geomorphology of the region with a short talk and slide show. Note was also made of the two key references for the region: Dunham *et al.* (1953) on the solid geology, and Waltham (1974) on the geology and geomorphology of the limestones.

### Saturday 3rd May

First thing in the morning members left Ingleton by cars and drove northwards to Kingsdale. By dint of redistribution of bodies some cars were left in Ingleton, as the day's walk was planned to end back in the village, the objective for the day being the traverse of the Craven Fault Zone from Kingsdale to Ingleton. (Text-figs. 1, 2 and 3).

The first stop was made at Yordas Wood (707791). There a small ravine cuts down through the limestone scars on the west flank of Kingsdale, and in its side lies the open



Text-fig.1. Geology of the Ingleborough area.

entrance to Yordas Cave just over a hundred yards from the road. This cave is perfectly safe for a "walk in" visit, and with a varied selection of torches headed by a car battery and car headlamp, the members traversed the few yards of passage into the main chamber of the Cave. The chamber is nearly 200 feet long and 50 feet high and wide, and is floored by a mass of stream laid mud, sand and cobbles. Attention was drawn to the masses of old flowstone and remnants of pebble beds high in the cave walls which were taken to indicate the very considerable age of the cave. A pre-glacial origin permits these relict sediments to be ascribed to another interglacial or late glacial melt stage conditions, as they are clearly out of phase with the present cave stream. The leader commented on the uranium decay method of dating stalagmites, recently developed in America which it was intended, in the near future, should permit a reasonable dating of the Yordas Caves' Pleistocene development and, by correlation, therefore a dating of the glacial history of the Yorkshire Dales themselves. The members followed the stream to the top end of the chamber where the waterfall was seen descending from a clean washed passage. Back in daylight, a periglacial origin was considered for the small Yordas gorge and dry valley, and the feature was then followed up to the various sink-holes which engulfed the stream before it entered the cave below.

Just beyond the sinkholes and out of the woods (705792) the stream was seen flowing off the thinly bedded limestones and shales of the Yoredale Series. The *Girvanella* Band was located in the stream bed where it is easily recognised by the distinctive almond shaped nodules of the algae, which crowd together in the foot-thick bed. Locally this band is taken as the boundary between the D1 zone comprising the Great Scar Limestone and the D2 zone consisting of the Yoredale Series.

The party then returned down Kingsdale, observing the many fine glacial features. The terminal moraine at Ravenray is especially conspicuous, as is the left bank lateral moraine on which is built the farm of Braida Garth. The right bank lateral moraine is barely visible though the road is built on it. In between, the valley is floored by lacustrine sediments dating from a temporary lake held back by the terminal moraine. On this floor numerous old meander scars could be seen, but the flood channel of the river has now been canalised and in ordinary weather the entire flow is underground as far as the spring at Keld Head, where the Yordas Cave water re-emerges. The cars were left at the junction with Twistledon Lane (693760) and the party walked down the lane to join the "Waterfall's Path" down to Ingleton. Just south of Ravenray Footbridge (695756) the river was seen to lie in a post-glacial gorge cut around, and partly through, the terminal moraine, and incised into the underlying limestone. A buried valley filled with boulder clay was pointed out on the left bank, and from the levels of the limestone-drift interface on each side of the modern gorge, this could be seen to be a left-bank tributary to the pre-glacial valley which now lies beneath the moraine. The limestone in the river bed was noted to be thin bedded and dark in comparison to the massive white lithologies seen at Yordas Woods.

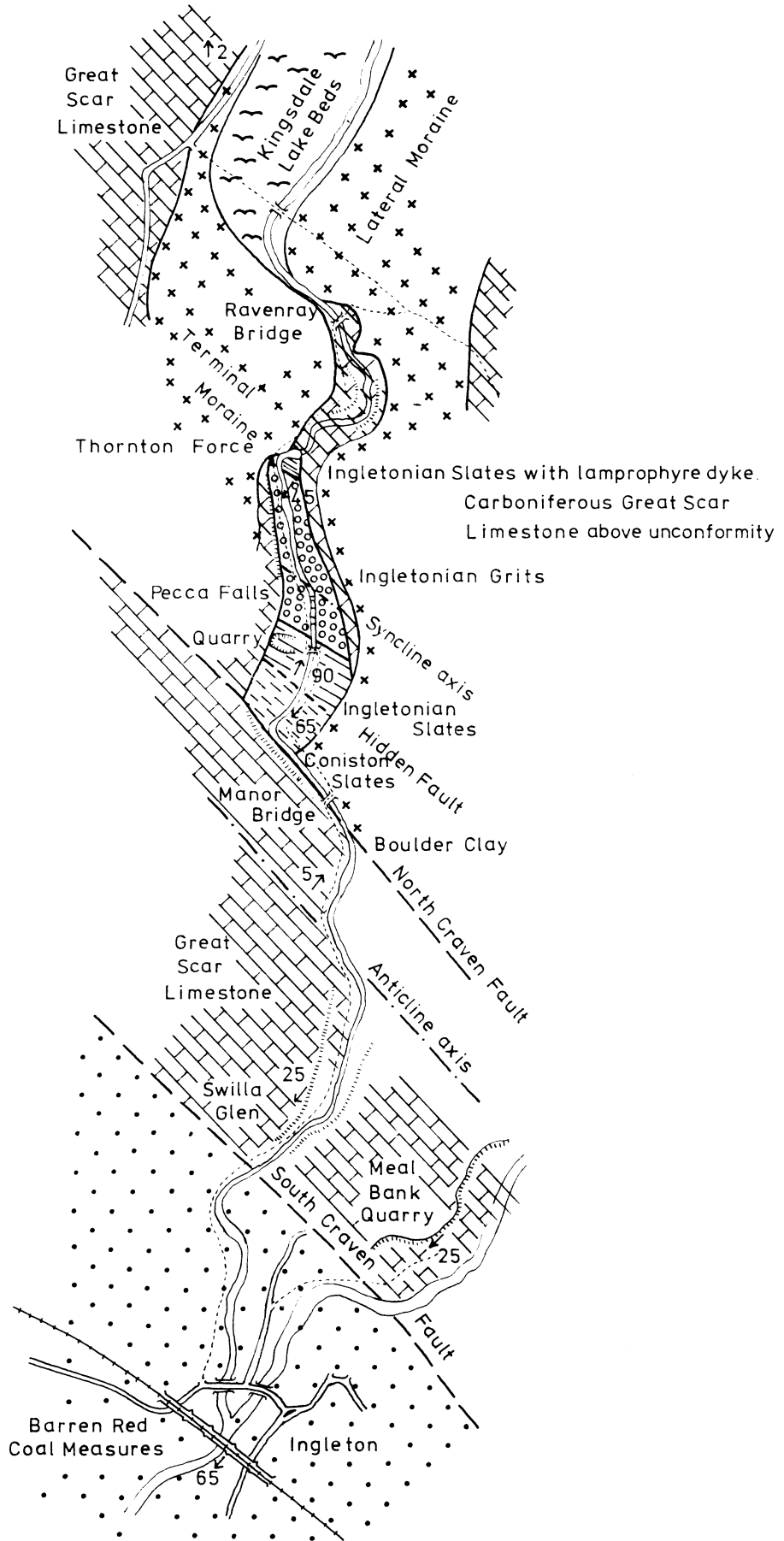
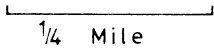
At the well-known locality of Thornton Force (694754) the basal unconformity of the Lower Carboniferous was clearly seen half way up the waterfall, though the beds immediately above it are only of the S1 zone, indicating the relatively late submergence of the Askrigg Block. Beneath the unconformity lie steeply dipping slates and greywackes of the Ingletonian Series, once thought to be Pre-Cambrian but now dated both radiometrically and palaeontologically in the Lower Ordovician. Members examined the unconformity and noted both its slightly irregular surface and also the large number of well rounded boulders of Ingletonian in the lowest few feet of limestone. To protect this site of special scientific value, no hammering was permitted and no specimens collected. A thin lamprophyre dyke was observed in the slates on the edge of the plunge pool. Only a couple of feet thick it is rather weathered but easily recognised as it steps across the bedding by about 4 inches at one point. Lack of visible signs of contact baking led to the suggestion that it may have been pre-metamorphic. A discussion then followed on the bedding-cleavage relationships in the Ingletonian at that point. The structures are difficult to see but some members convinced themselves that the direction of younging was towards the south.

One hundred yards from Thornton Force the Ingletonian in the riverbed was seen to

THE  
INGLETON  
WATERFALL



GEOLOGICAL  
SKETCH MAP



Text-fig. 2.

consist of thick greywackes dipping south at a little more than 45°, and therefore overlying the slates. Looking back from this point the party had a wider view of the waterfall and could clearly see the buried valley just to the west-side where grass covered slopes of boulder clay broke the line of limestone scars round the valley. It was clear that the Force had formed where the water had dropped back into the pre-glacial valley, and waterfall retreat had been only slight. Water pouring from a bedding plane cave only a few yards west of the waterfall was pointed out by the leader as originating in the riverbed some 50 yards upstream of the falls. As this subterranean cut-off continues to develop, the time will come when it will capture the entire flow in periods of low flow, and leave Thornton Force dry.

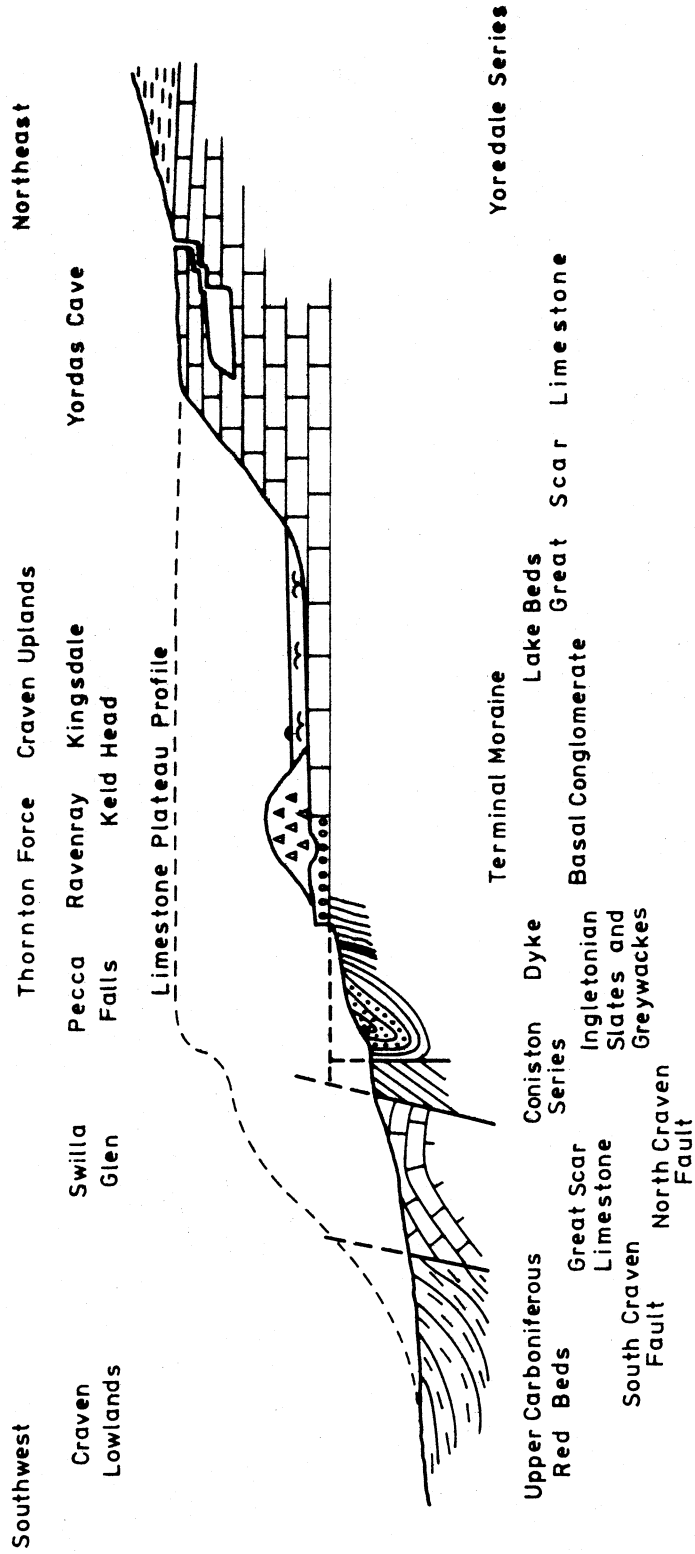
Close to the "lemonade hut" on the path, the leader pointed out the synclinal axis in the riverbed where the dip of the Ingletonian changes from 45° S.W. to 90° N.E.

Lunch was taken in the vicinity of the hut after which the party walked down the Pecca Falls, where the river cascades over the vertical greywackes bands to the old slate quarry (695749). There the vertical slates were more accessible and members examined various small scale sedimentary structures which proved a younging of the beds to the north. The synclinal structure of the Ingletonian, with these slates re-appearing at Thornton Force, was then discussed and it was conceded that other subsidiary folds could lie in the zone traversed but be easily missed without detailed searches for sedimentary structures and way-up indicators.

The party did not follow the path downstream of the quarry but kept to the right bank where the next exposures were dark blue, soft, slaty mudstones dipping steeply to the south and containing thin beds of impure limestone. Fossil hunting was not carried out, but the leader related that fossils in these beds had correlated them with the Upper Ordovician Coniston Limestones, and though the contact with the Ingletonian was not now visible, it had once been excavated and seen to be faulted. The sharp bend in the river, where it turns to flow to the southeast, marks the position of the North Craven Fault. Immediately to the south-west the Great Scar Limestone re-appears and forms a prominent cliff. It is downfaulted to this position from the level where its base lay at Thornton Force. By climbing the tree roots into the very corner, members could examine the fault at close quarters, with a hanging wall of limestone overlying a thin zone of gouge and breccia separating the limestone from the contorted Ordovician mudstones. A thick wedge of well cemented Pleistocene scree was also noted where it fills in the valley side and underlies the modern screes. Some mild amusement was then afforded to one and all as some members of the party were encouraged to boulder hop across the river to rejoin the path.

Downstream the right bank is the fault line cliff of Great Scar Limestone and the left bank is boulder clay masking the Ordovician mudstones. At one point a branch fault and slice of Ordovician rock was seen on the far side and discussion ensued on the detailed variations of the nature of the fault. After crossing the Manor Footbridge there are few exposures, as the river gently swings away from the fault line. A single bedding plane at one point, beside the path, indicated a northerly dip of about 5°, and then the limestones encountered in Swilla Glen were seen to dip southwards at around 25°. On emerging from Swilla Glen through the gate and out into a more open valley (694736) the leader suggested that the change in topography could indicate the line of the South Craven Fault. To find an exposure south of the fault the party walked down to the road, under the viaduct and (with permission) through the caravan site to the river bank at 693731. There members examined the southward dipping red sandstones which include a rather spectacular clay-pellet sandstone. The leader pointed out that these beds were now correlated with the upper Barren Coal Measures and speculations were then made on the total downthrow of the Craven Fault Zone. Using rather rough estimates of thicknesses of beds displaced, a total vertical displacement in the order of a mile, was calculated.

The party then recrossed the South Craven Fault and visited the Meal Bank Quarry (697746) (permission having previously been obtained from Craven District Council) cut in the south-west dipping Great Scar Limestone. Three features were pointed out here. A thin coal



Text-fig. 3. Diagrammatic section of Kingsdale, West Yorkshire. Not to Scale.

seam, of a few inches in thickness and apparently autochthonous, sits on top of a layer of shale, locally some 5 feet thick within the sequence of pure limestones. Jarosite was observed on the shale due to weathering of pyrite within it. Viewed from the far side of the quarry the base of the limestone was seen to be an unconformity, as it cuts out about 20 feet of underlying shale at the south end of the visible section. Nearer the quarry entrance a prominent nodular bed was examined and found to contain large quantities of corals and brachiopods coated in nodular calcite. All three of these features were then said by the leader to be restricted as far as is known to the limestones in the immediate vicinity of the Craven Faults, and the suggestion was then made that they all owe their origin to local periods of small scale vertical movements on the Faults causing extreme shallowing of the seas or even emergence.

Whilst some members collected from the nodular bed, the car drivers recovered their vehicles from Kingsdale, and shortly after, the entire party drove up Chapel-le-Dale, another fine glacial valley, to God's Bridge (733765). The River Greta was seen to be emerging from powerful springs very close to the base of the limestone, and the day was rounded off with a brisk walk up to the adjacent limestone benches, 500 feet above the road. Fine views across to Twistleton Scars and the Yoredale plinth of Whernside provided excuses for short rests, but the top of the limestone was soon reached just west of Meregill Hole (740757). Very fine limestone pavements have been formed here with unusually large and smooth clint blocks, and some discussion took place on the importance of glacial stripping in the development of these features. Meregill Hole was seen to be a fault guided pot-hole close to the boundary between the Great Scar Limestone and the Yoredales. The leader briefly described how the rather complex underground drainage of these benches showed a close relationship to the geological structures but a complete disregard for the surface topography. Looking north-east along the limestone bench, a few drumlins could be seen in profile, some outliers of the magnificent drumlin field which floors the top end of Ribblesdale. The party then descended to the cars for the short journey to Ingleton and dinner.

#### Sunday 4th May (Text-fig.1)

The party gathered in the car park in Clapham village to walk for most of the day over the flanks of Ingleborough. The South Craven Fault almost passes through the village, but only the topography hints of its presence. The first part of the walk was through the grounds of Ingleborough Estate where the unusual botany provided some diversion in an area of little rock exposure. The first stop was made at the stream bed from the wet weather resurgence of Cathole (750700), where folded Palaeozoic slates were observed and therefore the North Craven Fault had already been crossed. The Carboniferous unconformity was located above the path, and shortly afterwards the leader pointed out limestone outcrops at lower levels in the main valley, indicating the scale of relief on the sub-merged pre-Carboniferous topography.

Clapham Beck was seen to emerge from the resurgence of Beck Head Cave (754711), beyond which the Clapham valley is dry. The water comes from the Gaping Gill sinkhole and just above the resurgence lies Ingleborough Cave, now open to the public as a show cave, an abandoned outlet for the Gaping Gill water. All the members went round the cave and were fortunate to have a guide who described the geology of the cave and its formation, instead of romanticising on the shapes and names of stalagmites. The show cave is a single passage which mostly follows the bedding of the nearly horizontal limestone and the influence of jointing on the cave plan was also clearly visible to members. Roof solution in some parts of the cave, notably the upper reaches, indicated formation by ponded phreatic water, whilst the canyon passages nearer the entrance were inferred to have been formed by free flowing vadose water. Large amounts of clastic fill in the cave indicated its considerable age, and the nature of the stalactite formation was used to determine the level of old lakes in the passage, which were drained out in the last century to permit exploration of the cave.

The party then returned to daylight and proceeded up the Clapdale dry valley to where it is nearly blocked by a moraine barrier. From this point members followed the path up to the left through the narrow gorge of Trow Gill (756716). The leader opened a discussion on the

origin of the gorge and, though some cave development was visible in its walls, the popular idea of cavern collapse was dismissed on the grounds of size and shape of the gorge and lack of collapsed roof structures. Instead, the idea of rapid down-cutting by meltwater under periglacial conditions was developed. It was suggested that the gorge could have been cut when the underlying Ingleborough Cave was temporarily blocked by ice and/or large amounts of debris some remnants of which had been seen in the cave. Subsequent return of drainage to the underground system would have resulted in the preservation of the steep gorge walls.

The walk continued up the dry valley above Trow Gill until the main limestone bench was reached. Bar Pot (752724) was passed on the left and the leader pointed out that though it now carried a small amount of water down into the Gaping Gill Cave System below, it may originally have been developed by ponded phreatic water flowing up out of the Gaping Gill Caves and away as a surface stream down Trow Gill. The limestone bench in this area is covered by boulder clay and peat bog; there are no limestone pavements here. This may be due to stagnant ice, sheltered from the scouring Ribblesdale glacier, in the lee of Ingleborough Hill, preserving *in-situ* boulder clay deposits.

The famous sinkhole of Gaping Gill (751727) was soon reached. Fell Beck here cut through the boulder clay and on reaching the limestone surface drops down the 365 feet deep vertical shaft into the cave system below. Members enjoyed their packed lunches while sitting around the edge of Fell Beck and examining the top of Gaping Gill.

Suitably refreshed, the party moved off eastwards pausing at various points to look at disappearing streams, shakeholes and the views out towards Penyghent Hill, the third Yoredale plinth situated above the limestone plateau. A stop was made at Lona Kin East Cave (763731) where a small stream drains off the Yoredales and enters a walk-in meandering vadose canyon cave cut into the limestone. On being advised that it was safe to go in a few hundred feet to where a side passage returned to daylight, a large number of members, with a small number of torches, experienced some of the joys of caving. The party then walked a few yards up the surface stream to some limestone slabs projecting from beneath the cover of boulder clay. Removal of a small patch of till revealed glacial striae on the limestone and the leader related how striae similarly exposed a few years ago had now been removed by solution activity. Some discussion then commenced on karren formation, in that soil was needed to encourage solution, but an impermeable drift cover caused total cessation of limestone surface solution.

Walking southwards down the length of Long Scars, members observed patches of limestone pavement in various stages of development and also noted zones of shattered limestone indicating minor faults parallel to the Craven Fault. Descending to Norber (765697) the famous glacial erratics were visited. These consist of blocks of Silurian Austwick Grit carried up by ice from the floor of Crummockdale and many now rest on plinths of Carboniferous Limestone a foot or so high, indicating the amount of post-glacial surface lowering by limestone solution. A walk along Thwaite Lane led back to the cars at Clapham.

A convoy of cars then left Clapham and drove east to a point just beyond Newfield House at 800693, where some low crags just above the road are easily gained. The crags consist of steeply dipping greywacke turbidites of the Austwick Grits and members were impressed by the superbly developed flute and groove markings. They were found at many horizons but the best were preserved on the undersides of the coarser bands. The party drove on down into Ribblesdale and turned left at Helwith Bridge between buildings constructed of the local Horton Flags and up to Arcow Wood Quarry (803707). There the Austwick Grits reappear in a spectacular anticline, though the state of quarrying at the time of the visit did not reveal the fine fold as it has in the past or may in the future. The fold axis is orientated roughly north-west to south-east and it is clearly pre-Carboniferous; its marked divergence from the normal Caledonian trend may indicate the local structural influence of the Askrigg Block and Craven Fault line even at this early stage in time.

From Arcow Wood, the party dispersed mainly in directions south, down Ribblesdale. The minibus group, however, took the high road from Stainforth by heading east over the



shoulder of Fountains Fell. This led to Malham Tarn, surrounded by limestone but sitting largely on an impermeable Lower Palaeozoic inlier. South of the tarn, the line of the North Craven Fault was recognised by the reappearance of the limestone, and the drive down the hill to Malham gave excellent views left to Malham Cove. This was said to be a periglacial waterfall which had suffered post-glacial subterranean capture of its river. It has initially formed on the line of the Mid-Craven Fault, which is still a marked feature of the topography just north of Malham village, and the waterfall must therefore have retreated around 600 yards during its active phase. Reef knolls overlooking Malham village just south of the Mid-Craven Fault were pointed out which led to comment on the influence of the Craven Faults in the environment of the Carboniferous seas.

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