EXCURSION TO EMPINGHAM, KETTON AND HOLWELL

Leader: W.S. Moffat. Sunday, 2 July 1972

The main object of this excursion was to see the geology of the Empingham Reservoir site in Rutland and learn something of the engineering geology involved in the construction of the reservoir. The visit to Ketton Quarry, Northamptonshire and the Holwell Quarry, Leicestershire, provided further opportunity to see Lower and Middle Jurassic rocks on the same excursion.

Empingham Reservoir Site (SK 9407)

The EMGS party travelled to Empingham, Rutland, by coach, picking up Mr. Moffat, en route. On the journey out, Dr. F.M. Taylor outlined the geology of the route pointing out various topographical features, including the fine escarpment of the Marlstone Ironstone seen beyond Nether Broughton. At the reservoir site office, Mr. Moffat introduced the resident geologist, Mr. P. Horswill, who first of all showed the party plans of the reservoir and photographs of the site, both before construction began and during construction up to the time of the visit. The geology of the site was explained. It was stated that the valleys to be flooded were floored by Upper Lias Clays, part of the following sequence:

Lower Lincolnshire Limestone	-	lowest beds, flaggy limestones similar to the Collyweston Slates.
Lower Estuarine Series		
Northampton Sand Ironstone	-	about 5 metres thick and not exploited.
Upper Lias Clays	-	a max. thickness of 55 metres but on the site often less.
The Marlstone Rock Bed	-	$2\frac{1}{2}$ metres thick; an oolitic limestone in this area, with abundant water content with an estimated yield of 1 million gallons per day, but not to be used.

Investigation of the site with numerous bore-holes had shown that the centre of the valley (that of the R. Gwash) exhibited classic features of valley bulging, with the Marlstone Rock Bed being pushed upwards closer to the valley bottom than it ought to be. The overlying Lias Clays were thrust upwards and as a result were broken and contorted. The valley was not as impervious as originally thought and it would be necessary to floor much of the site with puddled clay to improve the impermeable characteristics of the foundation. In addition to re-working clay on the valley floor, it would be necessary to import extra clay, both for laying on the sides of the reservoir and for the main clay core of the earth dam. Mr. Horswill went on to describe the siting of the dam just to the west of Empingham church and stated that, because of the low mechanical strength of the local rocks an earth dam with a broad base and relatively low height would be used. Excavations in the Lincolnshire Limestone and the Northampton Ironstone would provide an outer facing for the earth dam to reduce erosion during storms. The method of dam construction was outlined. The timing and problems associated with the earthmoving operations were described and a display of rocks and fossils so far collected was available for Members to see. A highlight of the indoor section of the visit was a topographical scale model, constructed by pupils of Oakham School and by the ingenious use of ultra-violet illumination it was possible to see the site dry and as it would be, when flooded to the final water level. Diagrams were available to see the route of pipes from the reservoir to the pumping stations, situated to the east near Stamford, which would control the water level. Winter flood water from the Rivers Nene and Welland would be pumped into the reservoir and during the dry summer months, the flow would be reversed.

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The members on the excursion then went on to the site and to the 'Borrow Pits', situated upstream from the dam in the valley of the R. Gwash. Sections were examined in the Upper Lias Clays, both *in-situ*, and later, on the dam site, where some of the clay had already been placed in position. Specimens of ammonites, including *Hildoceras*, *Harpoceras*, and *Dactylioceras* were readily available for the collectors and the other common fossil was the bivalve *Nuculana*. Some parts of the Northamptonshire Ironstone and the base of the Lincolnshire Limestone were also examined.

At the time of the visit, the base of the dam, eventually to be 810 m. wide, was exposed and the method of dam construction to an ultimate height of 35 metres was explained. In order to de-water clays in the valley floor, vertical sand drains with drainage blankets were used. Water would be squeezed out of the clay and pass by way of the sand to drainage channels away from the site. The mechanical strength of the clay would be increased as a result of this process. The forces exerted by the impounded water would be spread over a wide surface area and would be very small compared with the total weight of the earth dam.

Water would be impounded behind the dam, producing a reservoir over 8 km long and reaching almost as far west as Oakham; the village of Upper Hambledon would remain on a peninsular between two flooded valleys. At the end of the visit to Ketton, the coach returned and followed the minor road to Upper Hambledon and Members attempted to visualise the state of affairs when the area would be almost surrounded by water.

An expression of thanks was made to Mr. P. Horswill, to the Welland and Nene River Authority and to the consulting engineers Messrs. T & C Hawksley for permission to visit this extremely interesting project.

Ketton Cement Works (SK 9706)

From Empingham, after a rather late lunch, the party continued to Ketton, to see the quarry from which the Ketton Cement Works obtains its raw materials. This is a very large quarry exposing: (Sylvester-Bradley and Ford 1968 Chapter 12)

The Upper Estuarine Series	-	mainly clays.
The Lincolnshire Limestone	-	Weldon Beds, very fossiliferous. Ketton Beds, easily distinguishable by the unweathered blue centres of the limestone blocks. A worm-bored surface occurs at the top.
		Cementstones, oolitic limestones, with broken fossil shells and irregular bedding.

The quarry exposes almost the southern most occurrence of these formations, which further to the south are replaced by the standard Cotswold sequence. Many Members of the Society immediately commenced their examination of the Lincolnshire Limestone sequence.

In the meantime, Mr. Moffat had arranged a demonstration of seismic profile shooting, using a Huntec seismic refraction instrument, and proceded to fire the explosive charges and record the resulting shock waves. The right and wrong way of preparing the charges in the shot holes was effectively demonstrated. Although described here in only a few lines, both the organisation and demonstration of the first ever display of a geophysical technique to the EMGS was carried out very smoothly, and must have necessitated prior thought and activity.

After the pyrotechnics, Members continued their examination of the Ketton Pit, examining the Upper Estuarine Series. The beds here are mainly clays with a fresh water bivalve fauna. Plant remains and rootlet beds were seen and in the lower part of the sequence *Lingula* was obtained by some Members.

Holwell Quarry (SK 743237)

On the return journey to Nottingham, a diversion was made to examine the Marlstone Ironstone Formation and the Middle Lias Shales, which are seen above, in one of the ironstone pits at Holwell. Although the pits have not been worked for some years, it is still possible to see 3 to 4 metres of the ironstone with its characteristic fossils, *Lobothyris* and *Tetrarhynchia*, and a belemnite. Very weathered ammonites were collected from the paper shales above and in the tips specimens of *Gryphaea* could have been obtained.

At the end of this visit, Mr. Moffat left the party to return to Loughborough and the President thanked him on behalf of the assembled Members for organising the visits, arranging his geophysical demonstration and adding appreciably to the engineering and general geological knowledge obtained from the excursion as a whole.

References

SYLVESTER-BRADLEY, P.C., and FORD, T.D. 1968, *The geology of the East Midlands*. Leicester, 400 pp.

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