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UBLEY CONDUIT
AN UNDERGROUND STREAMWAY IN TRIASSIC CLAY AT UBLEY, NORTH MENDIP

by

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ABSTRACT

Excavation for a water main in 1979 revealed an underground stream flowing through a pipe-like conduit in clay, 2 metres below ground. Several active sinkholes near the site are linked to the streamway. It is thought that the streamway developed as a cave in a thin calcareous bed, interbedded among mudstones, that has been locally removed by solution.

HISTORY AND DESCRIPTION

In July 1979 Bristol Waterworks Company laid a water main from east to west across a field on Ubley Farm, near Blagdon. The field slopes gently down northwards towards Blagdon Lake, the south shore of which is some 300m distant (Fig. 26). The excavations showed that the subsoil consisted of 1-2m of stony soil (Head) overlying stiff reddish-brown clay (Keuper Marl).

At one point (ST 5211.5854) the trench intersected a natural open conduit in the Keuper Marl. It was a smooth-sided tube in stiff clay, running almost horizontally from north to south, about 2.2m below ground level. The cross-section was oval, about 0.3 x 0.15m, the long axis being vertical. Water was flowing northwards along the conduit at an estimated 0.2 litres per second. The workmen laid 2 lengths of 0.1m diameter flexible pipe to carry the flow across the trench, the main was laid over these, the trench was backfilled, and the matter would probably have been forgotten had there not been unexpected developments.

In January 1980 the farmer, Mr. Bath, noticed that a vertical-sided pit had developed over the intersection point. At the bottom, water was flowing over the exposed main. Mr. Bath also found that craters had formed by ground subsidence in two places higher up the field. Water had burst out of the lower crater and run down the hill. Mr. Bath pointed out an older crater, partly filled with tipped rubble, at the top of the field. Fig. 26(b) shows the locations of the craters, the intersection point, and the resurgence of the underground stream.

The resurgence is in a dry ditch only 15m from the intersection point, but on the other side of a hedge. It is a pit about 1m deep, overgrown with ferns and mosses. Water wells up a steeply rising conduit with clay roof and walls, over an aggraded floor of clay pellets and gravel, from a depth of at least 2m. The water enters a large iron pipe about 1m below ground level and is conducted, presumably, to a nearby stream.

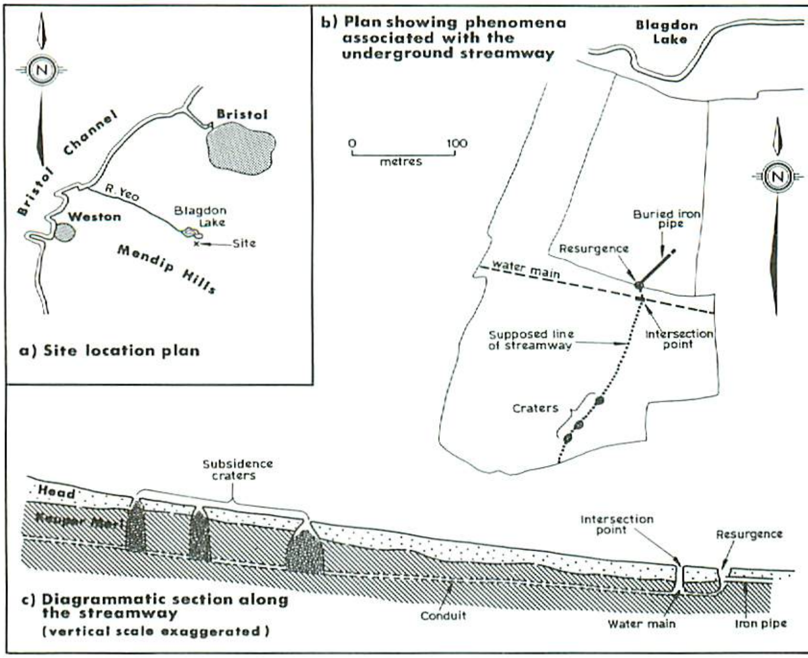

Fig. 26. (a) Area map, showing site of underground streamway at Ubley.
(b) Plan of Conduit.
(c) Section along Conduit.

Each of the 3 craters consisted of a breach in the roof of a dome-shaped collapse chamber developed in Head overlying Keuper Marl. The lowest crater was the largest, with a breach 1m in diameter above a cone of collapsed earth forming the floor of an oval chamber 3m long, 2.5m wide and 2.5m deep. The long axis pointed downslope. Collapse was still actively working upwards as flakes and slabs of roof peeled off and fell, and there was evidence that a strong flow of water had welled up between roof and cone on the upslope side. The other two craters were rather smaller. The middle one was 2m deep and still active, but the upper one was partly filled with tipped rubble which on the evidence of plant growth was at least a year old.

The craters, intersection point and resurgence were all in a line down the slope of the hill, and it seems reasonable to assume that they are linked by one underground streamway. On the available evidence, the sequence of recent developments is thought to be as follows:

1. Frequent collapse of the conduit roof in the field north of the present resurgence, owing to the conduit being at shallow depth. The resulting inconvenience to agriculture led to the installation of the iron pipe, well before the 1970's.
2. Collapse of the conduit roof higher up the slope, working up through Keuper Marl and Head to reach the surface, forming the highest crater, about 1977.
3. Intersection of the conduit by the water main trench in July 1979.

4. Blockage of the narrow flexible pipes underlying the water main by stones and lumps of clay that were washed down the conduit from collapses developing further upstream during high winter flows, December 1979.
5. Backing-up of water behind blockages in the conduit, causing accelerated development of collapses further upstream, 2 of which reach the ground surface forming the lower and middle craters. Water overflows from the lower crater, December 1979.
6. The same pressure head of water forcibly opens a route bypassing the flexible pipes through the unconsolidated backfill material in the trench. Collapse above the bypass route reaches the ground surface, January 1980.

The overall picture is of an underground streamway in incompetent clay with roof collapse at several points working up towards the ground surface. Large quantities of collapsed material are washed along the streamway: the clay removed from the lowest crater alone must amount to at least 15 tonnes. If such material blocks the conduit at a bend or a constriction, water backs up and the pressure head may accelerate the growth of collapse zones or even open new escape routes through the roof. If the collapses were allowed to run their course without agricultural modification, a line of depressions or sinkholes would form; eventually coalescing into a gully occupied by a surface stream.

DISCUSSION

It is not easy to explain extensive cave formation in clay. The model suggested here is based on the well-known interdigitation, around the Mendips, of beds of Dolomitic Conglomerate (limestone breccia-conglomerate) with beds of Keuper Marl. The conglomerate beds are thick and dominant where they abut against the Mendip massif, but they gradually become finer-grained and thinner, eventually petering out, as they are followed into the sedimentary basin where marls and clays predominate. They tend to slope down gently away from the Mendips. If a solutional cave system developed in a conglomerate bed sandwiched between thick beds of clay, any sections of passage that had a clay roof would be liable to collapse. Where the conglomerate bed was thin it might locally be wholly removed by solution, the clay squeezing in to replace it, but a small-bore conduit through the clay could be kept open by the scouring action of the stream. Hawkins (1979) describes a zone of low wide solution cavities in a bed of dolomitic sandstone 1.5m thick, among marls and siltstones, near Bristol, which shows that solutional activity does occur in isolated soluble beds in the Keuper Marl. Hawkins noted that in the Bristol area the range of soluble minerals includes gypsum and celestine as well as calcite, but there is no evidence that the first two minerals are present in significant quantities at Ubley.

ACKNOWLEDGEMENTS

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REFERENCE

HAWKINS, A. B. 1979 Case histories of some effects of solution/dissolution in the Keuper rocks of the Severn Estuary region. *Q. Jl. Engng. Geol.* **12**, 31-40.