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Magnetic Prospecting. I - The Water Newton Survey.

The basis of the method of magnetic dating described in another article (pages 16-20) is that clay which has been baked behaves as a weak magnet. The 'action at a distance' property of magnetism makes possible another archaeological application of this same phenomenon - the detection of buried kilns by magnetic measurements made just above ground level. The magnetism due to the buried kiln will be additional to the normal magnetism at the earth's surface; the effect is conveniently termed 'an anomaly' and the strength of the anomaly is measured in a magnetic unit called 'a gamma'* which expresses the magnetic intensification caused by the presence of the buried kiln. The larger the kiln the bigger the strength of the anomaly but also, the deeper the kiln is buried the weaker will be the anomaly.

The feasibility of the method was demonstrated in 1956 by Mr. J. C. Belshé[1] who detected the anomaly produced after the firing of a reconstructed pottery kiln of the Romano-British type. The archaeological possibilities were taken up by Mr. Graham Webster and when in 1958 he undertook the excavation of a one mile stretch of the proposed route of the new Great North Road where it borders the Roman city of Durobrivae near Water Newton (Northamptonshire) he invited the laboratory to co-operate with Mr. A. Rees of the Geophysics Department of Birmingham University in conducting a magnetic survey before the commencement of digging. The main part of the survey was carried out during ten days of bitterly cold weather in the second half of March, and the completion of an area of 10 acres during that time is a tribute to the stamina of the various members of the laboratory staff taking part.

Except for a waterpipe and some buried iron bedsteads the main area was disappointingly void of anomalies sufficiently strong to indicate the presence of a kiln (and in fact none were found by any of the excavations that followed). Subsequently attention was directed to a region where the vanguard of the road constructors had cut into a kiln and a survey was made of the adjacent area in a search for other kilns; a strong anomaly was found amounting to 100 gammas at its centre and upon digging there the upper rim of a pottery kiln was found at a depth of 3 foot 6 inches. Since it was outside the route of the new road further excavation of the kiln was not then possible, but it is hoped that this will be undertaken next spring. With this prospect in mind

* 100,000 gammas equals 1 oersted.

the anomaly was mapped out in detail; the more intense part (50 gammas or greater) was only 10 feet across, whereas regions of medium anomaly (25 to 50 gammas) spread to a distance of 30 feet.

Although the primary purpose of the survey was to discover kilns, the accompanying table of anomalies illustrates that many other buried features can be located by the magnetic method. In some cases the feature was geological or modern (e.g. an iron bedstead), but, the value of magnetic surveying in locating whatever archaeological remains are buried in an unknown region can be gauged from the experience that in one field 20 random trials holes all proved blank whereas 4 holes dug on magnetic anomalies revealed archaeological features in 2 cases, a geological feature in the third, and a horseshoe in the fourth. In all the areas covered by magnetic survey only one substantial archaeological feature - a mediaeval hearth - escaped detection and this was not surprising because its presence was obscured by the magnetic disturbance due to a buried iron waterpipe.

The interferring effect of iron is a drawback of the method and it is not practicable to survey within 20 feet of sheep netting, barbed wire, telegraph pole stays etc. Even a regular five-strand wire fence in concrete posts does not produce a uniform anomaly all along its length at a given distance from it and failure to realize this initially led to the prediction of a kiln where in fact there was none - this was the one serious false prediction made during the survey. Iron objects lying on the ground are also troublesome; although with experience it is possible to recognize the type of anomaly so produced, in practice the presence of many iron objects reduces the pace of the survey to a crawl. The use of a mine detector was tried for finding whether an anomaly was due to a hidden iron object but because of its very limited range (about 6 inches for most objects) it was not much help; it was found quicker to remove the turf where the form of the anomaly suggested iron as the cause.

In discussing limitations, it should be mentioned that the surface of the ground must not be too irregular. The digging of a trench produces a measurable anomaly, so too does a ditch. The reason is that soil itself has an appreciable magnetic susceptibility and the different magnetic properties of top soil and sub soil etc. is why it is possible to detect geological features. The surprisingly large anomaly produced by an occupation pit is presumably due to the fact that the filling material has in the main been burnt at some time (not necessarily in situ) and consequently has an enhanced magnetic susceptibility [2].

The experience gained at Water Newton confirms that the magnetic method is valuable not only for the detection of kilns but also for general archaeological surveying. Compared to the resistivity method it has the disadvantage of being subject to interference by extraneous iron but the very great advantage of being quicker; a trained team of three can cover ground at the rate of an acre every three or four hours, with only one operator progress is somewhat slower. The instrument used was a transistorized proton resonance magnetometer based on the design of Waters and Francis[3]. It is simple to operate and an intelligent operator can be trained in a few hours; there are no probes to insert and the sensing element is merely a small bottle of water carrying an electrical coil and the associated electrical "black box" that interprets the measurements weighs only about 25 lbs. A fuller description of the instrument and the surveying technique employed will be given in a succeeding article.

The helpful archaeological co-operation of Mr. Graham Webster, Mr. Brian Hartley, and Mr. John Gillam is most willingly acknowledged and grateful thanks are offered to the various archaeological volunteers who helped to operate the instrument in the later stages of the survey.

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References:-

1. Belshé J.C., Advances in Physics, 6, p.192-3 (1957).

2. Thellier E., Thèse Fac. Sc., Paris; Ann.I.P.G., Paris 1938, XVI, p.157-302.

3. Waters G.S., & Francis P.D., "A Nuclear Magnetometer" J. Sci. Inst. 35, 88 (March 1958).

Table: Magnetic Anomalies at Water Newton

Location	Strength (gammas)	Extent (feet)	Cause
(a) Main Survey			
1C5, c1	35Y	at least 10'	Isolated pockets of clean gravel and clean sand sharply differentiated were found at a depth of 3', also a few small pieces of iron stone. No sign of human habitation. Anomaly removed by excavation.
1C17, d3	15Y	15'	Not yet dug.
1C17, d,e,f5	30Y	10' by at least 30'	Not yet dug. Possibly continuation of crop-mark on aerial photograph.
1C19, f2	15Y	5'	Not yet dug.
1C21, f,g4-6	15Y	at least 40'	Not yet dug.
1C22, f4-6	15Y	at least 20'	Not yet dug.
1C23, f4,5	25Y	at least 10'	Not yet dug. Probably associated with ditch found in area 2.
2B2, a,b,c,123	100Y	40'	Iron bedsteads.
2C2, f2	15Y	5'	No cause found on digging to 2' when natural was reached. Anomaly removed by excavation.
3C11, c5	20Y	10'	Not dug.
3C13, c1	15Y	10'	Not dug.
3A15,a3 to D15,f5	150Y	20' across	Waterpipe reputed to be at 3'.
3C16, c4,5	15Y	10'	3' deep ditch cut into limestone